4.4 WATER RESOURCES AND WETLANDS

4.4.1 Groundwater

4.4.1.1 Jordan Cove LNG Terminal

The Jordan Cove LNG terminal would be located on the North Spit of Coos Bay at the southern edge of the 19.5-square-mile (12,480-acre) Dune-Sand Aquifer, an unconsolidated-deposit aquifer. Unconsolidated-deposit aquifers consist of sand and gravel, but may contain variable quantities of silt and clay (USGS 2009b). The North Spit is primarily composed of sand dunes, dune forest, and marsh areas that are easily penetrated by water. The Dune-Sand Aquifer is generally 100 feet thick, ranging from a maximum of 200 feet to zero (USGS 1992). At the LNG terminal, the sand aquifer extends to a depth of -160 feet below sea level.[41] Surficial groundwater can be found approximately 8 to 10 feet bgs at the terminal and fluctuates with the Coos Bay tides.

A review of EPA's sole or principal source aquifer (SSA) mapping revealed that the closest SSA is approximately 40 miles north of the LNG terminal site.[42] Additionally, a review of ODEQ data showed that the LNG terminal does not overlie any Groundwater Management Areas where groundwater contamination from non-point source activities warrants state intervention. The potential for contaminated soils at the LNG terminal is discussed in section 4.3.1.3 of this EIS.

Data maintained by the OWRD indicate that there are four groundwater wells permitted for industrial use and fire protection to Roseburg Forest Products located just east of the LNG terminal site. Three of the wells are within the footprint of a proposed construction laydown area that Jordan Cove would lease from Roseburg Forest Products. The fourth well is approximately 550 feet south of the proposed temporary heavy equipment truck haul road that Jordan Cove would use across the Roseburg property. Jordan Cove has stated that activities within the temporary laydown area would not restrict access by Roseburg Forest Products to the wells or the water from the wells. Additionally, Jordan Cove has stated that following construction, the leased construction laydown area would revert to its pre-construction condition and use, and that operation of the LNG terminal would not restrict access to the wells. We note, however, that Jordan Cove has not stated how the wells within the construction laydown area would be protected from construction equipment or supplies being parked on top of the wellheads or from the inadvertent release of fuel or other hazardous liquids used to fuel and/or maintain construction equipment. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file with the Secretary, for review and approval by the Director of OEP, a plan to protect the four groundwater wells located on Roseburg Forest Products property from physical damage during construction of the LNG terminal.**

[41] See Livesay, D., 2006, *Jordan Cove Energy Project, Groundwater Review*, Groundwater Solutions, Inc., Portland, attached as Appendix E.2 to Resource Report 2 filed with Jordan Cove's May 2013 application to the FERC.
[42] EPA defines an SSA area as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. EPA guidelines also stipulate that these areas can have no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend upon the aquifer from drinking water (EPA 2013a).

The CBNBWB has 18 groundwater wells located within the Oregon Dunes National Recreation Area (ODNRA) within the Siuslaw National Forest to the north of the LNG terminal. These wells, ranging in depth from 90 to 120 feet bgs, withdraw non-potable water from the Dune-Sand Aquifer. The CBNBWB's well field is capable of producing up to 4 mgd of water during normal precipitation years (CBNBWB 2012). The well field is managed though conditions outlined in the Forest Service Special Permit. Conditions in the permit are protective of aquatic and terrestrial ecosystems located in the ODNRA (CBNBWB 2009). The closest CBNBWB well is about 3,500 feet north of the terminal (see Appendix E.2 in Jordan Cove's Resource Report 2). Neither construction nor operation of the LNG terminal would have any direct impacts on the structure of the CBNBWB wells due to the distance of the wells from the Project.

As described in section 2.1.1.10, Jordan Cove would obtain both raw and potable water from the CBNBWB. The CBNBWB has one potable water line that runs along the Trans-Pacific Parkway, and two raw water lines that extend from its well fields. As shown in table 4.4.1.1-1, Jordan Cove estimates that it would need a total of approximately 1.7 billion gallons of water for construction. If calculating a five-day workweek over the 3.5-year construction period, construction of the LNG terminal site would require approximately 1.9 mgd, which is within the amount CBNBWB stated it could provide.

TABLE 4.4.1.1-1

Water Usage from CBNBWB Sources for Jordan Cove Facilities

Activity	Amount of Water
Construction	**Million Gallons—Total**
Construction activities (concrete washouts, tire washes, offices etc.)	100
Concrete Operations	100
Site Work	1,500
South Dunes Power Plant	23
Hydrostatic testing –LNG storage tanks	28
Hydrostatic testing of process lines on the South Dunes site	1
Initial fill of firewater ponds	5.3
Hydrostatic testing usage – South Dunes	8.4
TOTAL	**1,765.7**
Operation	**Million Gallons—Annual**
LNG Terminal	184 a/
Make-up to the firewater ponds due to evaporation water loss	3.1 b/
South Dunes Power Plant	295 a/
LNG Terminal/South Dunes Power Plant Workers	0.57 c/
TOTAL	**482.8**

a/ The operational water usage is the average consumption rate on an annual basis (based on a 310 MW plant output, relevant to the terminal and power plant).
b/ Western Regional Climate Center (2013).
c/ Assumes 145 workers using 15 gallons per day for 260 working days per year (CSG Network 2014).

Currently the wells in the ODNRA are not being used due to the closure of the Weyerhaeuser mill; therefore, use of water from the CBNBWB wells for project construction and operation may temporarily lower groundwater levels in the wells. However, the water need of 1.9 mgd is within the capacity of the well field (which has an average capacity of 4 mgd), while still protecting aquatic resources such as surficial lakes and wetlands (CBNBWB 2009).

During operation of the Jordan Cove Project, water from the CBNBWB potable line on the North Spit would provide the potable water requirements for the various buildings, staff needs, the supplementary filling of the fire water pond from evaporation loss, and supplemental water in the

event of an emergency. Operational water usage is estimated to be approximately 1.3 mgd. This amount is within the limit of 1.5 mgd of potable water that the CBNBWB has stated it could provide.

Construction and operation of the LNG terminal has the potential to affect groundwater resources, because of the shallow depth to surface groundwater and the permeability of the sand and gravel soils across the site. Construction impacts could result from excavation of the upland portion of the terminal marine slip, driving of piles for the LNG vessel berth and the tug boat berth, and installation of foundations for major structures. During both construction and operation of the terminal, spills or leaks of hazardous liquids, such as lubricating oil, gasoline, and diesel fuel used for equipment and facilities, may affect groundwater. In addition, there is the potential for a spill or leak of LNG during plant operations.

To create the marine slip, Jordan Cove would excavate and dredge to a depth of -45 feet NAVD88, removing about 4.3 mcy of material. Since the bottom of the marine slip would be below the surface water level, excavation and dredging may cause local groundwater elevations to drop. Water levels at the CBNBWB well that is closest to the LNG terminal (Well 46 located 3,500 feet north) may drop as much as 0.5 feet (see Appendix E.2 in Jordan Cove's Resource Report 2). After construction of the slip is completed, we expect that groundwater levels would fluctuate somewhat with the tides (GRI 2013b). As a result of the tidal influence on the local groundwater, the change of 0.5 foot in the vicinity of the terminal is not considered substantial.

There is also the potential for seawater intrusion caused by the construction of the marine slip. A study conducted for Jordan Cove[43] estimated that introduction of seawater into the slip would move the current seawater/saltwater interface northward about 1,650 feet. This should have no impacts on the CBNBWB well field on the North Spit. The water table would remain at an elevation of about +10 feet above mean sea level at the northern boundary of the terminal property.

Jordan Cove would drive approximately 210 piles into the slip during construction to support the LNG berth, loading platform, and tug berth. Depending on the location and type, piles could potentially be conduits for contaminants to impact groundwater if a spill of hazardous material occurs at the pile (Boutwell et al. 2004; IDEM 2011). Once subsurface materials have been disturbed, soils may be more permeable, and manmade preferential pathways can transmit contaminant away from the release point as pure produce, in a vapor phase, or dissolved in water, regardless of depth to groundwater (IDEM 2011). Non-displacement piles (steel "H") form conduits, but displacement-type piles (wood, steel, and probably concrete) do not form conduits for contaminate migration (Boutwell et al. 2004). If a hazardous spill occurs and seeps into the groundwater, remediation of the spill would be necessary to clean up the contaminated soil and groundwater. Spill-related impacts are discussed below. Implementation of Jordan Cove's SPCCP would minimize the risk of a spill occurring.

No blasting is anticipated during construction of the terminal. Therefore, no adverse effects on groundwater flow due to blasting in the vicinity of the proposed terminal are expected.

[43] Livesay, D., 4 December 2006, *Jordan Cove Energy Project, Groundwater Review*, Groundwater Solutions, Inc., Portland. Attached as Appendix E.2 in Resource Report 2 included with Jordan Cove's May 2013 application to the FERC.

When groundwater is encountered during excavation, dewatering would be required. Methods for dewatering may include the use of wellpoints, which consist of a closely spaced series of small-diameter shallow wells connected to a common headermain and high-efficiency vacuum dewatering pump. The contractor would determine the most appropriate method for dewatering excavations and obtain appropriate permits prior to construction. All water associated with dewatering would be pumped to a discharge structure that is appropriately sized for the discharge volume. Water associated with construction dewatering would not be directly discharged to waterbodies until either filtered or directed to a settling pond before discharge. Technical memoranda were submitted in Jordan Cove's February 13, 2015, filing that summarize evaluations of the potential for dewatering activities during construction to impact groundwater, surface water, and wetland habitats near the terminal (DEA 2015; GSI Water Solutions Inc. 2015). Dewatering proposed for excavation of the LNG facilities would be temporary, and it is expected that groundwater movement would return to currently normal conditions following construction. A monitoring program would be conducted prior to, during, and after construction to monitor potential impacts to ground and surface waters. The details of the monitoring program would be developed in consultation with the Project's assessment of biological resources and design/construction teams.

To prevent or reduce impacts on groundwater from the accidental release of hazardous materials during construction, Jordan Cove has prepared a Spill Plan[44] that describes preventive measures that would be implemented to avoid spills and leaks, as well as the measures used to minimize potential effects should a spill or leak occur. The Spill Plan designates refueling procedures; spill response procedures, spill response materials, and training; countermeasures/contingency plan; and hazardous liquids storage, and disposal.

Spill-related impacts during operation of the LNG terminal would mainly be associated with fuel storage, facilities use, equipment refueling, and equipment maintenance, which would be prevented or minimized with the implementation of Jordan Cove's SPCCP. Jordan Cove included a Preliminary SPCCP as Appendix N.2 of Resource Report 2 in its May 2013 application to the FERC and submitted a final SPCCP in its February 12, 2015, response. The SPCCP includes detailed information such as the location and type of bulk storage containers and the type of potential spills.

The terminal would have a system of curbs, drains, and basins to collect and contain any spills of LNG during operation. In the unlikely event that LNG is spilled, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water. Because LNG is not soluble in water and would completely vaporize shortly after being spilled, the LNG could not mix with or contaminate groundwater.

During operation, the jurisdictional LNG terminal and related facilities and the non-jurisdictional South Dunes Power Plant and SORSC combined would occupy a total of 251 acres, of which about 34 acres would be covered by impervious surface materials, such as asphalt and concrete. This surface cover would reduce the area available for groundwater recharge to the Dune-Sand Aquifer, and potentially cause a decrease in the shallow, water-bearing zone underlying the LNG terminal. However, in comparison to the total 12,480-acre area of the Dune-Sand Aquifer, this

[44] The preliminary draft Spill Plan was included in Jordan Cove's May 2013 application to the FERC as Appendix K.2 to Resource Report 2. The Final Spill Plan was submitted February 12, 2015.

0.03 percent area reduction would not likely result in an adverse effect on the level of groundwater in the area. Through use of the measures discussed above, we conclude that impacts on groundwater resources at the Jordan Cove LNG terminal would be minimized to the extent practicable and would not be significant.

4.4.1.2 Pacific Connector Pipeline

Groundwater depths would vary throughout the project area crossed by the Pacific Connector pipeline route, depending on the local topography as well as on the different underlying aquifers. As identified in table N-4 in appendix N of this EIS, approximately 46 miles (or 20 percent) of the pipeline route would cross areas of shallow groundwater where the water table ranges from zero to 6 feet bgs. Approximately 36 of those 46 pipeline miles would be located in areas that have seasonally high groundwater (fall through spring), 10 of those 46 pipeline miles, primarily in the Klamath Basin (MPs 191.3 to 214.0), would be located in areas with shallow groundwater year-round.

Aquifers

The pipeline and associated aboveground facilities would not overlie any EPA-designated SSAs. The nearest EPA-designated SSA, and the only one in Oregon, is the North Florence Dunal Aquifer (EPA 2013a), which is in Lane County, approximately 40 miles to the north of the pipeline.

There are four general aquifer types within the project area defined by their geologic and hydrologic characteristics: unconsolidated-deposit, pre-Miocene rock, volcanic and sedimentary rock, and Pliocene and younger basaltic rock. The following aquifer descriptions are taken from the USGS Groundwater Atlas (USGS 1994). Surface geology is discussed in section 4.2.2.1 of this EIS.

Unconsolidated-deposit Aquifers – The pipeline would overlie unconsolidated-deposit aquifers for approximately 7.6 miles in and around Coos Bay (between MPs 1.5R and 23.4), 3.1 miles in Douglas County between MPs 55.3 and 69.7, and 23.0 miles in the Klamath Basin between MPs 191.8 and 214.9. Many of the large lower-gradient streams in the area flow through unconsolidated deposits. These aquifers consist primarily of sand and gravel and are the most productive and widespread aquifers in Oregon. These unconsolidated-deposit aquifers typically provide freshwater for most public-supply, domestic, commercial, and industrial purposes (USGS 1994).

Pre-Miocene Rock Aquifers – The majority of the pipeline route between MPs 23.5 and 155.8 would overlie aquifers of pre-Miocene rocks. These aquifers consist of undifferentiated volcanic rocks, undifferentiated consolidated sedimentary rocks, and undifferentiated igneous and metamorphic rocks principally in the mountainous areas crossed by the pipeline. Within and west of the Cascade Range, the consolidated sedimentary rocks are of marine origin and commonly yield salt water. At depth, the salt water can contaminate overlying freshwater aquifers. Permeability of the aquifers varies greatly. Water from wells completed in these aquifers is used mostly for domestic and agricultural (livestock watering) supplies (USGS 1994).

Volcanic and Sedimentary Rock Aquifers – East of Medford, the pipeline route enters a groundwater area of volcanic and sedimentary rock aquifers for about 8.2 miles between MPs 134.2 and 156.9. These aquifers consist of a variety of volcanic and sedimentary rocks and are

not as productive as the unconsolidated-deposit, Pliocene and younger basaltic-rock or Miocene basaltic-rock aquifers. Volcanic- and sedimentary-rock aquifers generally yield fresh water but locally yield salt water. About 30 percent of the fresh groundwater withdrawals are used for public supply, about 20 percent are used for domestic and commercial, and about 50 percent are used for agricultural (primarily irrigation) purposes (USGS 1994).

Pliocene and Younger Basaltic-rock Aquifers – In the Klamath Basin, between MPs 191.9 and 228.1, the pipeline route passes south of Brown Mountain through an area of Pliocene and younger basaltic-rock aquifers while passing in and out of unconsolidated deposit aquifers. Pliocene and younger basaltic-rock aquifers consist primarily of thin, basaltic lava flows and beds of basaltic ash, cinders, and sand and yield fresh water that is used mostly for agricultural (primarily irrigation) purposes (USGS 1994).

Water Supply Wells and Springs

Public Supply Wells – According to the ODEQ, groundwater is the only source of drinking water for about 95 percent of the rural areas in Oregon (2012a). The 1996 federal Safe Drinking Water Act (SDWA) requires Source Water Assessments for all public water systems that have at least 15 hookups, or serve more than 25 people year-round. The Oregon Health Authority and the ODEQ Drinking Water Protection Program jointly manage the SDWA assessment requirements. ODEQ maintains the Drinking Water Protection database, which includes public drinking water source areas for groundwater and surface water, as well as the locations of public water system intakes and public groundwater wells (ODEQ 2012b). According to the ODEQ database, there are no groundwater wells that supply public drinking water systems within 400 feet of the proposed route and associated facilities.

ODEQ has identified and established wellhead protection areas (WHPAs) to protect public drinking water sources. The SDWA defines a WHPA within the recharge area of a well as the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such a water well or well field. The pipeline would cross six WHPAs as shown in table 4.4.1.2-1 (ODEQ 2012b).

TABLE 4.4.1.2-1

Wellhead Protection Areas Crossed by the Pacific Connector Pipeline

Starting Milepost	Ending Milepost	County	Public Groundwater Source Area	Public Drinking Water System ID
6.38R	6.74R	Coos	Kentuck Golf Course	4190858
195.09	196.29	Klamath	Production Metal Forming, Inc	4195058
197.35	197.77	Klamath	Timber Resource Services LLC	4193994
198.45	199.62	Klamath	Collins Products LLC	4193995
199.26	199.66	Klamath	Columbia Plywood Corp	4194403
200.54	201.12	Klamath	Crossroads Mobile Home Park	4100446

Private Wells –- As shown in table 4.4.1.2-2, eight private wells permitted for irrigation purposes are located within 150 feet of the construction work area (OWRD 2013). Two private wells were found within the construction work area: one in a temporary work space and another within the construction right-of-way.

TABLE 4.4.1.2-2

Private Wells in Klamath County Within 150 Feet of the Pacific Connector Construction Work Area

Milepost	Permit Number	Use	Distance to Construction Area (feet)
190.83	10354	Irrigation	99.73
203.75	15818	Irrigation	0.00 a/
201.08	15997	Supplemental Irrigation	116 c/
212.07	16733	Supplemental Irrigation	71.68
217.34	3957	Irrigation	61.68
223.44	15416	Supplemental Irrigation	0.00 b/
224.04	12433	Supplemental Irrigation	78.75
224.04	365	Irrigation	78.75

a/ Well located within temporary extra work space
b/ Well located within construction right-of-way
c/ Well located within 150 feet of a temporary extra work space

Other Groundwater Wells – There are several types of groundwater wells in Oregon that are exempt from obtaining any kind of permit, and are therefore not registered or identified in a state database. These include wells for single or group domestic purposes not exceeding 15,000 gallons per day.

Springs and Seeps – A spring is a concentrated discharge of groundwater appearing at the ground surface as a current of flowing water. Seeps, as distinguished from springs, are areas that indicate a slower movement of groundwater to the ground surface. Water seepage areas may pond and evaporate or flow, depending on the magnitude of the seepage, the climate, and the topography. Pacific Connector surveys have identified a number of springs and seeps as noted in appendix N of this EIS. Pacific Connector has stated that it would further verify exact locations of springs and seeps during easement negotiations with landowners.

Construction Impacts and Proposed Mitigation Measures

Construction of the pipeline would require trenching to depths between 6 and 11 feet bgs, depending on the site-specific conditions (see section 2.4.2.1). Construction activities such as trench excavations, grading, and filling of the excavated trench could cause minor fluctuations in shallow groundwater levels, increase turbidity within shallow groundwater adjacent to the construction activity, or alter the flow path of springs and seeps. When the pipeline is located in areas of shallow groundwater, Pacific Connector has stated that it would follow the FERC's *Procedures* requiring the use of trench breakers or installation of trench plugs in areas of shallow groundwater and on slopes. Trench breakers (or plugs) would prevent local shallow groundwater and recharge (via precipitation) from flowing along the pipeline trench. Trench plugs are installed after the pipeline is installed in the trench and prior to trench backfilling.

Dewatering the Trench

Approximately 65 miles of the pipeline route would cross areas where the groundwater is zero to 6 feet bgs. Pacific Connector has stated that in areas where the trench may be continually flooded and dewatering would not be feasible, it would float the pipeline into place and install it using the push-pull method (see section 2.4.2.2). While the installation of trench breakers and trench dewatering by pumps to an upland area may be feasible for small areas of seasonally high groundwater, we note that some of these shallow groundwater areas could extend over 4 miles (see table N-4 in appendix N), making the float and push-pull construction technique

impracticable. For longer stretches of the pipeline route, trench dewatering through a well point pumping system with a groundwater treatment plan may be the best option depending on if the groundwater is emanating from a pressurized or non-pressurized source point.

Soil Compaction

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final cleanup activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts. Pacific Connector would test for soil compaction in agricultural (e.g., active croplands, hayfields, and pastures), residential areas, and on federal lands. The EI would be responsible for conducting soil compaction testing and determining corrective measures, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers.

Potentially Contaminated Groundwater Sites

As discussed in section 4.3.2.3, of the nine sites investigated by the ODEQ for contaminants that the Pacific Connector Pipeline Project could affect, three potentially have groundwater contamination. As recommended, information filed by Pacific Connector with the FERC on February 13, 2015, includes specific plans detailing how contaminants at these three sites would either be avoided or removed.

Accidental Spills of Hazardous Materials

Pipeline construction necessitates the use of heavy equipment and associated fuels, lubricants, and other potentially hazardous substances that, if spilled, could affect shallow groundwater and/or unconsolidated aquifers. A spill could reach different aquifer layers in these areas. Accidental spills or leaks of hazardous materials associated with vehicle fueling, vehicle maintenance, and construction materials storage would present the greatest potential contamination threat to groundwater resources. Soil contamination resulting from these spills or leaks could continue to add pollutants to the groundwater long after a spill occurs. Implementation of proper storage, containment, and handling procedures would minimize the chance of such releases.

Pacific Connector's SPCCP[45] addresses the preventive and mitigative measures that would be implemented to avoid or minimize the potential effects of hazardous material spills during construction. These measures include, but are not limited to:

- regular inspection of containers and tanks for leaks;
- use of secondary containment of fuel storage tanks and hazardous materials containers 55-gallons or greater;

[45] The SPCCP was included in Pacific Connector's June 2013 application to the FERC as Appendix 2B to Resource Report 2. A revised SPCCP was submitted in the February 13, 2015, Supplement.

- implementation of emergency response procedures, including spill reporting procedures; and
- use of standard procedures for excavation and off-site disposal of any soils contaminated by spillage.

Prior to construction, Pacific Connector would include in the SPCCP the types and quantities of hazardous materials that would be stored or used during construction. Project personnel would be trained and prepared to demonstrate their ability to implement the SPCCP to federal, state, or local inspectors. As discussed in section 2.5.1, Pacific Connector would employ EIs to ensure compliance with the SPCCP and other specifications during construction and restoration. In accordance with the FERC's *Plan*, the EIs would have the authority to stop work and order corrective actions for activities that violate the environmental conditions of our Certificate and other permit authorizations.

Pacific Connector developed a *Contaminated Substances Discovery Plan*, Appendix E to the POD, in the event of an unanticipated discovery of contaminated soil, water, or groundwater during construction. The plan outlines practices to protect human health and worker safety and measures that would be taken to prevent further contamination, including:

- all construction work in the immediate vicinity of areas where hazardous or unknown wastes are encountered would be halted;
- all construction, oversight, and observing personnel would be evacuated to a road or other accessible upwind location until the types and levels of potential contamination can be verified;
- if an immediate or imminent threat to human health or the environment exists, one of Pacific Connector's emergency response contractors identified in the SPCCP or the National Response Team would be notified and mobilized; and
- the contaminated material would be removed and properly disposed of in accordance with appropriate regulations and ordinances and in accordance with the SPCCP.

In addition, the Forest Practices Act Division 620 for chemical and other petroleum product rules may be applicable. Certain requirements apply to the use of chemical and other petroleum products such as fuels and lubricants on any forest operation to protect soil, air, or waters of the state.

Blasting

Pacific Connector identified a number of locations along the proposed route where blasting may be required for pipeline installation (see section 4.2.2.5). Blasting could affect groundwater quality by temporarily changing groundwater levels and increasing groundwater turbidity near the construction right-of-way. Pacific Connector has developed a *Blasting Plan*[46] to minimize potential adverse impacts on the environment, nearby water sources, structures, or utilities. As stated in the *Blasting Plan*, licensed blasting contractors would conduct the blasting activities in accordance with all applicable federal, state, and local regulations. Pacific Connector would obtain all necessary permits if blasting is required.

[46] The *Blasting Plan* was included in Pacific Connector's June 2013 application to the FERC as Appendix C of the POD.

Pacific Connector's blasting contractor would prepare blasting plans specific to the area to avoid potential effects. The blasting plans would be reviewed and approved by appropriate agencies. The blasting contractor would conduct appropriate pre-construction investigations, as needed, and develop specific blasting operation and monitoring plans to address site variables (soil and rock types, etc.), which would incorporate locations of existing groundwater wells or springs and seeps. Limits would be set for blast peak particle velocity to a level that would protect water wells, springs, and other nearby structures from any structural damage. As noted in Pacific Connector's *Geologic Hazards and Mineral Report*,[47] potential effects, if any, are expected to be temporary and localized because of the small amount of blasting agents generally needed for trenching.

In its *Groundwater Supply Monitoring and Mitigation Plan*,[48] Pacific Connector states that should it be determined after construction that there has been an effect to groundwater supply (either yield or quality), Pacific Connector would provide a temporary supply of water, and if determined necessary, would replace the affected supply with a permanent water supply. Mitigation measures would be coordinated with the individual landowner to meet the landowner's specific needs.

Drain Tiles

In a tile drainage system, a sort of "plumbing" is installed below the surface, effectively consisting of a network of below-ground tiles that allow subsurface water to move out from between soil particles, into the tile line, and ultimately into surface water points—lakes, streams, and rivers—located at a lower elevation than the source. In agricultural areas, drain tiles remove excess water from the soil subsurface as too much subsurface water can prevent root development, inhibiting the growth of crops.

Approximately 20 miles of the pipeline route through Klamath County would cross agricultural fields containing drain tiles. Pacific Connector has not identified the exact locations of the drain tiles but would identify the presence of drain tiles on individual properties during right-of-way easement acquisition.

Pacific Connector would ensure that any drain tiles cut or damaged by the pipeline would be repaired before backfilling. If either damage or repair causes a discharge to waterways under federal jurisdiction, a water quality permit would be required from ODEQ under Section 401 of the CWA. All drain tiles crossed by the Pacific Connector pipeline would be probed prior to right-of-way restoration to check for damage, and a qualified specialist would test tiles for damage and conduct any necessary repairs. Pacific Connector would restore any damaged drain tiles to the same condition that existed prior to construction.

Water Use and Quality

Trenching and dewatering could result in adverse effects to the water supply of wells, springs, and seeps if extensive pumping is needed in the immediate vicinity of those groundwater sources. Disruption to groundwater well supplies would likely be temporary and well recharge

[47] Stand-alone report attached to Pacific Connector's application to the FERC in June 2013.
[48] The *Groundwater Supply Monitoring and Mitigation Plan* was included in Pacific Connector's application to the FERC as Appendix 2F of Resource Report 2.

should occur when dewatering stops. Trench excavations, the use of trench plugs to remove groundwater from a trench, grading, and filling could alter the flow path of springs and seeps. Nearby springs and seeps supplied by deeper pressurized groundwater zones would generally not be affected by the trenching activities or trench plugs. Spring and seeps supplied by shallow groundwater, however, may be effected by the pipeline project, particularly if the pipeline is directly up-gradient of a spring or seep location.

In order to identify, monitor, minimize, and mitigate for potential effects to groundwater, Pacific Connector has developed a *Groundwater Supply Monitoring and Mitigation Plan.* Landowners would be supplied with documentation that explains the proposed pipeline construction methods, and outlines the pre-construction field investigation for the identification and monitoring of groundwater supplies. Pre-construction surveys would be conducted to confirm the presence and locations of all groundwater supplies for landowners within and adjacent to the proposed pipeline right-of-way.

The landowner would be provided with a point of contact with Pacific Connector to report potential problems with wells, springs, and seeps believed to be the result of construction. We note that neither the *Groundwater Supply Monitoring and Mitigation Plan* nor Pacific Connector's Resource Report 2 contain language regarding physical protection for groundwater supplies during construction. Groundwater wells should be fenced off to avoid being affected by construction equipment. Springs and seeps, along with their associated discharge areas, should be protected by a minimum of one row of silt fence.

All groundwater wells, springs, and seeps within 150 feet of the proposed right-of-way would be considered potentially susceptible to impacts from pipeline construction and would be included in the monitoring program. In order to determine the final number of wells, spring, or seeps potentially affected by the Project, and protect those wells or springs, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and approval by the Director of OEP, a revised *Groundwater Supply Monitoring and Mitigation Plan* that identifies the location by MP of all wells, springs, and seeps within 150 feet of the construction right-of-way, including direction and distance (in feet) from the pipeline centerline, and outlines measures that would be implemented to avoid or reduce impacts on those features.**

The following information would be documented for groundwater wells: date and time, location, weather (if outside), water level, flow rate (calculating gallons per minute), horsepower of existing pump and number of samples taken. Similar information would be documented for springs and seeps but would also include proximity to other sources, presence of barriers, and other pertinent information (i.e., fisheries significance).

If a groundwater supply (either yield or quality) has been affected by the Project, Pacific Connector would work with the landowner to provide a temporary supply of water; if determined necessary, Pacific Connector would provide a permanent water supply to replace affected groundwater supplies. Mitigation measures would be coordinated with the individual landowner to meet the landowner's specific needs and be specific to each property. Pacific Connector has stated that within 30 days of placing the facilities in service, it would file a report with the

Secretary discussing whether any complaints were received concerning the water yield or water quality and how each was resolved.

The proposed compressor station, meter stations, MLVs, communication towers, access roads, TEWAs, and contractor yards would be in the same general vicinity as the pipeline. The measures Pacific Connector has proposed to minimize the potential effect of the pipeline on groundwater (e.g., adherence to the measures included in Pacific Connector's ECRP, SPCCP, and our *Plan* and *Procedures*) would apply to these areas as well. Additionally, although some clearing and grading activities may be associated with the TEWAs, contractor yards, and access roads, trenching and drilling would not take place in these areas, thereby reducing the potential for impact. If groundwater is encountered during construction, Pacific Connector would follow the same dewatering techniques as described above.

The depth of excavation necessary for construction of the Klamath Compressor Station is dependent on soil conditions at the site. We note that the compressor station would be located in an area of high blast potential (see section 4.2.2.5). If blasting is required, it would be conducted in accordance with the *Blasting Plan* as described above. Blasting could temporarily affect shallow groundwater at the site and would not persist beyond the end of construction affecting the subsurface.

Operational Impacts of Aboveground Facilities and Proposed Mitigation Measures

The proposed piping associated with aboveground facilities would be fixed to belowground structures, coated in accordance with the DOT standards, and hydrostatically tested prior to the commencement of operation to avoid leaks. Pacific Connector would conduct monitoring in accordance with the DOT requirements during operations to minimize the potential of corrosion and leaks.

For the operation of its aboveground facilities, Pacific Connector is required to provide a SWPPP to the ODEQ in order to obtain an NPDES permit. The SWPPP would include a listing of hazardous materials associated with operation of the aboveground facilities and BMPs to avoid, minimize, and mitigate the spill of any hazardous substances that could affect shallow groundwater and/or unconsolidated aquifers. Pacific Connector has stated that its NPDES permit application would be submitted one year prior to scheduled pipeline construction.

Conclusions About the Potential Pipeline Project Effects on Groundwater Resources

No long-term effects to groundwater are anticipated from construction or operation of the pipeline and aboveground facilities because disturbances would be temporary, erosion controls would be implemented, natural ground contours would be returned as close to preconstruction conditions as possible, and the right-of-way revegetated. Implementation of Pacific Connector's ECRP and our *Plan* and *Procedures* would limit impacts from construction on groundwater resources. Our review indicates that potential effects to drinking water wells are unlikely and would be mitigated if they occur.

Temporary, minor, and localized effects could result during trenching activities in areas with shallow groundwater (depth less than 10 feet below the ground surface) crossed by the pipeline. The greatest threat posed to groundwater resources would be a hazardous material spill or leak into groundwater supplies. Pacific Connector developed an SPCCP to minimize impacts on ground water resources in the event of an inadvertent spill during construction. We do not

anticipate any significant impacts on aquifers by the pipeline given the shallow depth of the trench. Because of the reasons cited above, we conclude that the construction or use of the aboveground facilities, access roads, TEWAs, and contractor yards would not significantly impact groundwater resources.

4.4.2 Surface Water

There are federal and state laws and regulations pertaining to impacts on waterbodies. Section 10 of the RHA prohibits the creation of any obstruction to the navigable capacity of any waters of the United States without specific approval of the COE. Under Section 404 of the CWA the COE regulates the discharge of dredged or fill material into waters of the United States. The limits of COE regulatory jurisdiction extend landward up to the mean high water mark in tidally influenced areas and to the ordinary high water mark in non-tidal, navigable waters. The term "waters of the United States" includes the territorial seas and tidally influenced waters. "Waters" also include all other waters that are part of a surface tributary system to and including navigable (non-tidal) waters of the United States. Wetlands adjacent to these waters are also "waters of the United States." On October 15, 2013, Jordan Cove and Pacific Connector submitted a single comprehensive JPA to the COE for the Project.[49]

There are seven RHA Section 10 navigable waterways as regulated by the COE located within the project limits. These waterways include:

- Rogue River (river mile [RM] 0 to RM 27.1);
- Umpqua/South Umpqua River (RM 0 to RM 122.2);
- Coos River (RM 0 to RM 15.6);
- Coquille River (RM 0 to RM 36.3);
- Catching Slough (RM 0 to RM 7.0);
- Haynes Inlet (RM 0 to RM 2.0); and
- The Pacific Ocean (territorial sea boundary/baseline to 3 miles offshore).

There is one CWA Section 404 navigable waterway located within the project limits:

- Rogue River (RM 27.1 to RM 157.5).

The EPA's CWA Section 404(b)(1) Guidelines (Guidelines) are binding regulations to the COE Regulatory Program and provide the substantive environmental standards by which all Section 404 permit applications are evaluated. COE's regulatory authority (under the RHA) is rooted in the navigable capacity of a river, and in the agency's responsibilities to maintain and restore the chemical, physical, and biological integrity of the nation's waters. The Guidelines specifically require that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse effects." The burden of proving no practicable alternative exists is the sole responsibility of the applicant. The Guidelines outline a process whereby a proposed action is analyzed to assess and ensure the "Least Environmentally Damaging Practicable Alternative" is adopted. A project-scale and individual-impact scale Guidelines analysis would be required prior to obtaining applicable

[49] A copy of the single comprehensive JPA was filed with the FERC by Jordan Cove on November 6, 2013.

permits prior to construction. Jordan Cove prepared a "Supplemental Alternatives Analysis Report" in May 2015 that includes the alternatives analysis requested by the COE.

The Project would also need to comply with Section 401 of the CWA. The applicant would be required to obtain an individual Section 401 water quality certification demonstrating that the discharges associated with the project comply with federal and state water quality standards. The ODEQ is the state agency responsible for Section 401 water quality. For example, Section 401 would pertain to a stormwater management system to gather runoff from impervious surfaces at the LNG terminal.

Construction activities including clearing, grading, excavation, and stockpiling that would disturb 1 or more acres and may discharge to surface waters or conveyance systems leading to surface waters of the state would be regulated by the ODEQ under ORS 468B.050 and Section 402 of the CWA.

ODSL regulates removal or fill material in waters of the state under the Oregon Removal-Fill Law (ORS 196.795-990). The purpose of the law is to protect public navigation, fishery, and recreational uses of the waters of the state.

Through the notification process, provisions for surface water quality under the Forest Practices Act and rules will be addressed, if applicable. Details would be submitted in either a written plan or alternate plan to include specific provisions for meeting the Forest Practices Act.

4.4.2.1 Jordan Cove LNG Terminal

The Jordan Cove LNG import terminal would be located on the bay side of the North Spit of Coos Bay, about 7.5 miles up the bay from its mouth. The planned South Dunes Power Plant and the proposed Jordan Cove natural gas processing plant would be located on the north side of geographic Jordan Cove, which is part of Coos Bay. On the east side of the power plant site is Haynes Inlet, which is also part of Coos Bay.

Coos Bay is an inland estuary. The surface area of the estuary covers about 12,380 acres measured at mean high water. Coos Bay is fed by about 30 tributaries, including the Coos River, Millicoma River, Catching Slough, Isthmus Slough, Pony Slough, South Slough, North Slough, Kentuck Slough, and Haynes Inlet. The estimated average annual discharge at the mouth of Coos Bay is 2.2 million acre-feet of fresh water (Roye 1979).

The estuary lies within the USGS-designated watershed, Coos Bay (USGS HUC: 17100304; EPA 2012). The watershed covers an area of approximately 739 square miles of Oregon's southern coastal range, and is included in the larger South Coast Watershed Basin (ODEQ 2012c).

There is an existing navigation channel in Coos Bay that would be used as part of the waterway for LNG vessels transiting to the Jordan Cove terminal. Between the existing navigation channel and the terminal marine slip, Jordan Cove would create a dredged new access channel in the bay. The Oregon Institute of Marine Biology (OIMB) sampled physical oceanographic data in Coos Bay, specifically in the area of the terminal access channel, from August 2009 through December 2010 (Shanks et al. 2010, 2011). The OIMB physical oceanographic data set included salinity, temperature, and Chlorophyll a. The data provide some insight into the effect of tidal flow and

season on the characteristics of the water flowing past the terminal location. On those dates when the 24-hour sampling took place during the dry season (October 2009 and 2010, and July 2010), there is little variation exhibited in salinity during the tidal cycle, but slightly lower and higher salinities during low and high tides, respectively. In contrast, temperatures are markedly higher during low tides than high tides. In the rainy season (sampled in March 2010), the pattern reverses. There is little change in temperature over the tidal cycle, but large variations in salinity with low salinities during low tides and high salinities during high tides. May is a transition month. There is still enough flow from the Coos River to cause variation in salinity within the estuary and solar warming of the shallow waters up the estuary and cooling of the coastal waters due to upwelling caused variation in the temperature signal. During low tides, the waters passing the Project site area were warmer and less salty than during the rising tides. In effect, the results of the OIMB sampling program indicate that there is a great amount of variability in the physical oceanographic data of the waters of Coos Bay in the vicinity of the terminal.

Jordan Lake is an upland waterbody on the North Spit, located approximately 0.4 mile to the east of the LNG terminal site. Jordan Lake would potentially be affected by construction of the access/utility corridor bridge span.

Surface Water Quality

The ODEQ's Integrated Report identified Coos Bay on the Section 303(d) list (in CWA) for not meeting the criteria for shellfish growing since 2004, due to elevated fecal coliform measurements. Coos Bay is listed as Category 5, water quality limited, and a Total Maximum Daily Load (TMDL) is needed (ODEQ 2012d). Wastewater generated during construction and operation of the Jordan Cove terminal would be treated by the City of North Bend's wastewater treatment system via a new sewer line, and therefore the Project is not likely to add fecal coliform to Coos Bay.

Dredging the Access Channel

At the terminal marine slip, created from an existing upland, about 2 mcy would be dredged by Jordan Cove. While the marine slip is dredged, it would be separated from the bay by an earthen berm. Therefore, those activities would have no effect on the waters of the Coos Bay.

Project-related dredging in the bay, including removal of the berm, would result in temporary siltation and sedimentation impacts similar to those that currently occur during maintenance dredging activities by the COE for the existing navigation channel. On average, the COE removes approximately 900,000 cy of dredge material from Coos Bay every year. The COE indicated that average turbidity in Coos Bay ranges between 20 and 49 nephelometric turbidity units (NTU) and believes its maintenance dredging activities in the existing navigation channel below NCM 12 do not significantly increase ambient bay turbidity levels (Roye 1979).

Jordan Cove would dredge approximately 1.8 mcy in the bay during the removal of the berm and creation of the access channel. The duration of turbidity created would be temporary, lasting only as long as the dredging activities occurred in the bay. This would be between 4 to 6 months. All work in the bay would be done during the ODFW recommended in-water window between October 1 to February 15. Turbidity caused by dredging would be localized, dissipating to minor levels of suspended sediments within 200 feet, as discussed below.

Jordan Cove submitted its *Report on Turbidity Due to Dredging* (provided in Appendix F.2 to Resource Report 2 of its May 2013 application to the FERC) that included a modeling analysis of the turbidity that would be generated by the dredging operation at the access channel. The model was developed on the basis of a sediment analysis conducted at the site of the dredging and took into consideration wind, tidal currents, and seasonal flows. The ambient turbidity levels in the water (generated by flows, waves and ship traffic) create a background level of turbidity ranging by season from 3.7 to 18.1 NTUs or 5.7 to 45.7 milligrams per liter (mg/l) total suspended solids (TSS). The model indicated that the hydraulic cutterhead dredge to be used by Jordon Cove would generate TSS levels up to a maximum of 500 mg/l in the vicinity of the dredge. However, the turbidity would rapidly reduce to a maximum of 14 mg/l by a distance of 60 meters (200 feet) with a current of 1.0 meter per second (m/s).

Resuspension of sediments during dredging operations can be a significant source of turbidity. However, through proper operational controls and the potential use of physical barriers, this source can be controlled to minimize the concentration and dispersion of TSS in order to meet the water quality criteria required in the CWA Section 401 water quality certificate to be issued by the ODEQ. Operational controls include cessation of dredging, decreasing cutterhead speed, increasing suction flow rate and using a different size or type of dredge, lowering the crest elevation and/or avoiding stockpiling during peak ebb conditions. Physical barriers include silt curtains which are suspended vertically in the water with floats and are anchored, typically extending to within 2 feet of the bottom.

Jordan Cove has stated that because of the possible presence of buried woody debris in the near-shore area of the proposed access channel, clamshell dredging rather than hydraulic dredging may be required to construct some portions of the access channel. During clamshell dredging, sedimentation and turbidity may be higher than that predicted for a hydraulic dredging operation. Clamshell dredging is proposed for maintenance dredging of the slip and access channel, and potential effects are discussed below in the Maintenance Dredging and Disposal section.

Analysis of sediment transport modeling results indicated that, for all design conditions, no changes in existing patterns of shoreline erosion and rates of bottom depth changes in Coos Bay are expected because of the construction of the Jordan Cove access channel and terminal marine slip.[50] Creation of the access channel and marine slip would not cause large waves that would erode the shoreline of the bay, nor would construction of the access channel and marine slip result in the additional deposition of sediments that would greatly modify the depths of the bottom of the bay.

Modeling was conducted by CHE to determine the potential effects of slip excavation and the construction of the Pacific Connector pipeline through Haynes Inlet should these activities occur at the same time. The results of this modeling are presented in two volumes: CHE (2010b) and CHE (2011b, provided as Appendix H.2 of Jordan Cove's Resource Report 2). Construction of the slip and the dredging of the access channel would produce no or negligible impacts on tidal flow circulation near Jordan Cove and Haynes Inlet. As expected, the result of the tidal flow circulation modeling and analysis has shown that there would be a localized reduction of

[50] See Coast & Harbor Engineering, March 9, 2011, *Technical Report – Draft – Volume 2 – Jordan Cove Energy Project and Pacific Connector Gas Pipeline Coastal Engineering Modeling and Analysis*, attached as Appendix H.2 to Resource Report 2 included with Jordan Cove's May 2013 application to the FERC.

velocities at the Project site and a small localized increase of velocities downstream and upstream of the Project site. As there are small localized changes in tidal velocities and sediment transport predicted by the model, water quality would not be affected, and no water quality and geomorphic changes cascading up and down the bay or into the tributaries would occur based on model analysis (CHE 2010b).

Maintenance Dredging and Disposal

The volume of spoil dredged from the slip and access channel for routine maintenance would be approximately 360,000 cy during the first 10 years of the operation of the terminal, and approximately 330,000 cy during the second 10 years. Future maintenance dredging of the slip and access channel would likely be conducted using a mechanical clamshell dredge, which consists of a close-lipped bucket operated from a floating barge. A close-lipped bucket is specifically designed to reduce sediment resuspension into the overlying water column by forming a seal when the bucket surfaces. The material removed by clamshell dredging would be placed on either a flat-deck barge with watertight sideboards, or a bin-barge with one or multiple cells. The material would be transported to the offshore Site F for disposal.

Maintenance dredged material would be deposited at Site F, in the Pacific Ocean, about 1.75 miles north-northwest of the north jetty at the mouth of Coos Bay. This is an existing EPA-designated and managed offshore placement site, used by the COE since 1986 to dispose of materials dredged during maintenance of the Coos Bay navigation channel, in accordance with Section 103 of the MPRSA. The site was expanded in 1989, 1995, and 2006, so that it now encompasses about 3,075 acres, with water depths ranging from 20 to 160 feet. Jordan Cove included a *Slip and Access Channel Excavated and Dredged Material Management Plan* with its COE Permit Application (Appendix H.7 of Jordan Cove's Resource Report 7). This plan outlines procedures for the disposal of materials resulting from maintenance dredging of the LNG terminal access channel and slip at Site F, to ensure that the site capacity is not significantly inhibited. It considers the needs and characteristics of Site F defined by the COE and EPA, addresses the types and volumes of materials to be deposited, methods of disposal, and location.

Maintenance dredging and spoil disposal would occur during in-water work windows established by the ODFW and NMFS. No dewatering of dredge material would occur in Coos Bay.

Based on the turbidity modeling conducted for this maintenance dredging (Appendix F.2 in Jordan Cove's Resource Report 2), the effects are predicted to be localized and relatively short term. During maintenance dredging activities, the dredged material is presumed to comprise primarily fine particles (mud, clay silt). According to the DREDGE model, the use of an open "clamshell" dredge for maintenance dredging would result in the maximum TSS concentrations of about 830 mg/l in the vicinity of the dredge, decreasing to 125 mg/l at 660 feet away.

According to the Mike21 simulations, maintenance dredging may result in a turbidity plume for up to 1.9 miles from the dredging location at highest ebb or flood currents. However, the duration of high tides and currents may not last more than a 2-hour period, and time-averaged TSS concentrations would not exceed natural ambient concentrations (10 to 30 mg/l) outside the dredging area. As a result of the modeling of fine materials, we do not expect the turbidity plume to contain TSS in excess of 50 mg/l.

Terminal Water Supply and Discharges

Water to be used for both construction and operation of the Jordan Cove terminal would come from the existing CBNBWB lines. CBNBWB obtains water from groundwater wells located on the North Spit and two reservoirs. Jordan Cove proposes to use the existing industrial wastewater line to discharge water used to hydrostatically test the LNG storage tanks during construction of the terminal. Jordan Cove would not use surface water sources during construction or operation of the terminal, and all waters discharged from the site would be treated prior to release. Permits would be obtained for all wastewater discharges as required by ODEQ.

Volumes of wastewater generated by the Project are included in table 4.4.2.1-1.

There are no process water discharges from the liquefaction process. There would be some wastewater discharges from the oily water separators that would be directed to the industrial wastewater pipeline. There are no anticipated changes to water temperature, salinity, and current/hydrology in Coos Bay channel from the release of wastewater from the LNG terminal.

TABLE 4.4.2.1-1

Wastewater Generated from Construction Areas and Operational Facilities

Location	Volume of Wastewater
Construction	**Million Gallons - Total**
South Dunes Power Plant	5.35 a/
Operation	**Gallons per day**
LNG Terminal	144,000
South Dunes Power Plant	238,400
North Point Workforce Housing	68,400 b/

a/ Value is for system flushing and chemical cleaning for steam blows
b/ Value is based on an average workforce of 792 using 87 gallons per day each.

Stormwater Runoff

During construction of the LNG terminal facilities, stormwater runoff could erode disturbed soils, creating sediment in nearby surface waters. To minimize potential impacts, construction activities would be conducted in compliance with the NPDES permit (1200-C) for stormwater discharges during construction activities. Stormwater runoff from the disturbed portions of the site would be managed in accordance with a site-specific ESCP, which incorporates stormwater pollution prevention. A draft of the site-specific Preliminary ESCP is provided as Appendix I.2 of Jordan Cove's Resource Report 2. Jordan Cove would install all necessary erosion and sedimentation control structures in compliance with the ESCP. Following appropriate treatment such as electro-coagulation, chemical flocculation, or filtration, if needed, all construction stormwater from the proposed LNG terminal site would be directed towards the slip. An on-site concrete batch plant would be used in the construction of the LNG storage tanks. To minimize the potential for accidental discharges during construction, Jordan Cove would implement its SWPCP for the concrete batch plant. Jordan Cove has filed a preliminary plan in accordance with the ODEQ and DOGAMI Storm Water Discharge Permit for Concrete Batch Plant (General Permit Number 1200-A). Jordan Cove would finalize the plan prior to construction and provide a copy to ODEQ with the general permit application. A copy of the Preliminary SWPCP is included in Appendix J.2 of Jordan Cove's Resource Report 2.

Jordan Cove would design and construct a stormwater management system, to gather runoff from impervious surfaces within the terminal and direct the flow to designated areas for disposal. Stormwater drainage and collection would be accomplished by a system of ditches and swales. Stormwater collected in areas that have no potential for contamination would be allowed to flow or be pumped to ditches that ultimately drain to the slip. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to the oily water collection sumps. Collected stormwater from these sumps would flow to the oily water separator packages before discharging to the industrial wastewater pipeline. Jordan Cove would apply for a new NPDES permit for this discharge. No untreated stormwater collected in areas that are potentially contaminated with oil or grease would be allowed to enter federal or state waters.

The NPWHC would incorporate percolation for treatment and disposal of stormwater. Parking surfaces would be constructed with permeable asphaltic pavement to let stormwater percolate through the surface into a gravel base and then into a sandy substrate. Surfacing for the bus depot area would include a more durable but less permeable surface treatment. Consequently, the bus depot area would be equipped with a storm system designed to capture run-off and treat flow before being discharged to the environment by incorporating oil-water separators in catch basins and a stormwater detention pond to capture and retain up to a two-year rainfall event. Larger storm events would be detained and slowly released via percolation and overflow to the existing north point bioswale/drainage system. With the exception of the bus depot, all other roadways for the NPWHC would be constructed to accommodate large trucks using an open graded durable rock surfacing, which would allow incipient rainfall to infiltrate into the sandy substrate. Housing units would use "on-site infiltration sumps" installed alongside each housing unit to percolate downspout drainage. Sump installation would follow local standards of practice and would accommodate a 10-year storm event before allowing localized ponding during peak flows. All NPWHC on-site improvements would be 50 feet or more from the estuary, with a vegetated buffer for any surface water runoff not captured by on-site stormwater facilities.

Accidental Spills or Leaks of Hazardous Materials at the Terminal

Spills, leaks, or other releases of hazardous materials during construction of the LNG terminal could also adversely affect water quality. Hazardous materials entering Coos Bay resulting from material spills being flushed into waterbodies with stormwater runoff or entering Coos Bay directly from leaks or spills at the LNG unloading berth could have an adverse impact on water quality.

Because of the design of the terminal, it is highly unlikely that there would be a spill or release of LNG. Within the terminal would be a system of curbs, drains, and basin that would collect LNG if any spilled or leaked. Jordan Cove prepared a draft ERP (included as Appendix P.2 in Resource Report 13) for the operational phase of the terminal to minimize the potential for accidental releases of hazardous materials and to establish proper protocol concerning minimization, containment, remediation, and reporting of any releases that might occur. If LNG spilled or leaked, it would turn to vapor when exposed to the warmer atmosphere, and these vapors would rise as lighter than air. LNG is not soluble, would not mix with water, and would not contaminate surface water.

The most likely source of hazardous liquids that may spill or leak during construction and operation of the terminal, with the potential to contaminate surface water, would include oils and gasoline from equipment. Spill-related impacts from the construction of the LNG terminal facilities are mainly

associated with fuel storage, equipment refueling, and equipment maintenance. These potential impacts can be avoided or greatly reduced by regulating storage and refueling activities, and by requiring immediate cleanup should a spill or leak occur. Jordan Cove prepared a site-specific *Preliminary Draft Spill Plan* (Appendix K.2 in Jordan Cove Resource Report 2) for the construction phase of the Project to minimize the potential for accidental releases of hazardous materials and to establish proper protocol concerning minimization of, containment of, remediation of, and reporting of any releases that might occur. In addition, Jordan Cove prepared a Preliminary SPCCP for the design, construction, and operation of the Project (Appendix N.2 in Jordan Cove's Resource Report 2) to describe the preventive measures that would be implemented to avoid spills and leaks, as well as the mitigation measures utilized to minimize potential effects should a spill or leak occur. Jordan Cove's proposed measures to reduce the risk of hazardous material spills and minimize impacts should a spill occur include, but are not limited to:

- all employees handling fuels and other hazardous substances would be properly trained;
- hazardous substances, including chemicals, oils, and fuels, would not be stored within 150 feet of a waterbody or wetland boundary;
- all equipment would be parked overnight and fueled at least 150 feet from a waterbody or in an upland area at least 150 feet from a wetland boundary;
- secondary containment or diversionary devices would be required for all containers 55 gallons or larger. Discharge prevention measures include dikes, retaining walls, curbing, weirs, booms, diversion ponds, retention ponds, and absorbent materials. The secondary containment systems would be adequate to contain the content of the largest container plus sufficient freeboard for precipitation (i.e., 110 percent); and
- all drainage of accumulated stormwater from containment systems would be inspected to ensure no visible sheen is present and the condition documented prior to discharge.

Upon finalization, the SPCCP would designate refueling areas; spill response procedures, materials, and training; mitigative measures/response; and hazardous liquids quantities, storage, and disposal. Should a spill occur, Jordan Cove would implement containment actions identified in the SPCCP and notify the appropriate agencies based on the type, volume, and location of the spill. While a hazardous material spill has the potential for significant adverse environmental impacts, adherence to the SPCCP would greatly reduce the likelihood of such impacts, as well minimize the resulting impacts should a spill occur. As such, significant adverse impacts to surface water due to contamination from hazardous material spills or releases are unlikely.

Vessel Propeller Wash and Waves

Propeller wash from LNG vessels and tug boat propellers associated with the Project, as well as ship wakes (waves) breaking on shore, could cause increased erosion along the shoreline and resuspend the loose sediment along shallow shoreline area, resulting in a temporary increase in turbidity in the bay. Resuspension of bottom sediments and resulting increases in turbidity are considered temporary short-term impacts. Use of shallow draft tugs to assist LNG vessels throughout the mooring and departure operations may result in some resuspension of bottom sediments and increase turbidity over the short term until the bottom sediments become stabilized.

The possible magnitude and effects of the Project on shoreline erosion were approximated by Jordan Cove through model studies by Moffat & Nichol (2008) and by CHE (2011b).[51] Details of the model parameters and results are discussed in section 4.6. The Moffat & Nichol (2008) report indicated that along most of the route (approximately from NCM 1 to the new facility entrance) sediment resuspension caused by propellers would be slight within the navigation channel as the increased velocity would be similar to maximum tidal currents. The CHE (2011b) report also modeled likely bottom disturbance from existing deep-draft cargo ship (assumed 106 trips annually) in the bay and found that bottom velocity from these would be slightly greater than that of the LNG vessels (projected 113 trips annually). Turbidity would likely be slight due to the coarse characteristics of the navigation channel sediment that is resistant to current-induced suspension.

The CHE (2011b) report modeled velocities and likely effects on sediment scour at the terminal slip from the tugboat pushing of vessels to the dock. The modeled estimated maximum velocity on the far bank (about 275 feet from the propeller) would be mostly less than 2.0 ft/sec, which would be unlikely to erode the bank. Furthermore, the slip would be armored to minimize erosion. Near the bottom, maximum velocity in the access channel and slip would be about 2.16 ft/sec. Sediment analysis suggests that over 95 percent of the bottom material (mostly silt/clay size) in the channel would be susceptible to suspension at this velocity. The report also estimated that bottom scour would be limited to about 2 inches over a limited bottom area (approximately 100 by 50 feet) in the channel. Some bottom disturbance would likely occur during docking, but in most cases is likely to be much less than estimated because of the conservative assumptions used for this model. Therefore, turbidity increases near the bottom may occur at the terminal slip from the tugboat propeller. The turbidity increase would be local and settle once the propellers stopped.

The CHE (2011b) report indicated some additional shore sediment movement could occur from the waves generated by the passage of LNG vessels through Coos Bay. However, the overall effects would be small because increased waves would occur infrequently, contribute a very small portion of total annual wave energy and sediment transport, and be within the normal magnitude of waves that naturally occur within the bay.

Release of Hazardous Materials from LNG Vessels

Spills, leaks, or other accidental releases of hazardous materials during operation from the LNG vessel and escorts during transit in the waterway could adversely affect water quality of the bay. These vessels contain LNG, fuel, and oil. LNG would vaporize rapidly upon contact with the warm air and water. Because LNG is not soluble in water it could not mix with or contaminate water. It is unlikely that LNG would spill from a vessel in transit in the waterway because of the hull design and containment structures on board.

A spill or leak of fuel or oil into Coos Bay during LNG vessel transit is also unlikely because of vessel design and on-board spill kits. The International Maritime Organizations Marine Environmental Protection Committee published Shipboard Oil Pollution Emergency Plan requirements in 2000 (78 FR 60099). These include mitigating activities that are also included in the Coast Guard requirements. Resource requirement are based on the vessel's fuel oil capacity

[51] Appendix H.2 in Resource Report 2 attached to Jordan Cove's May 2013 application to the FERC.

(33 CFR 151). Spills of fuel or other oils are more likely to be released into surface waters during fueling or bunkering at the dock when the hazardous materials are being transferred onto the vessel. To reduce the risk of spills during fuel transfer, procedures should be followed by the chief engineer familiar with the system to be involved in operations (78 FR 60099). With the implementation each vessel's shipboard oil pollution emergency plan, impacts resulting from the spill of fuel, or oil, or other hazardous liquids would be minimized.

Water Releases from LNG Vessels at the Terminal Berth

LNG vessels at the Jordan Cove terminal berth would release ballast water and engine cooling water into the marine slip. No wastewater would be discharged from the LNG vessels into the slip. The LNG vessels may arrange with licensed private entities for refueling, provisioning, and collection of sanitary and other waste waters contained within the vessel. The licensed private entities would transport the waste to a permitted treatment facility. Discharges from vessels are subject to regulation by EPA. EPA currently regulates discharges incidental to the normal operation of vessels operating in a capacity as a means of transportation with the Vessel General Permit. This general permit became effective December 2013 and includes general effluent limits applicable to all discharges; general effluent limits applicable to 26 specific discharge streams; narrative water-quality based effluent limits; inspection, monitoring, recordkeeping, and reporting requirements; and additional requirements applicable to certain vessel types. Vessels of 300 gross tons or more or that have the ability to hold or discharge more than 8 cubic meters of ballast must submit a notice of intent in order to receive permit coverage. Jordan Cove would provide permitting requirements to the LNG vessels calling on the Project.

Ballast Water

The Coast Guard mandates a ballast water exchange (BWE) process for vessels arriving at U.S. ports. The BWE process includes complete exchange of ballast water in the open sea at least 200 miles from U.S. waters. Therefore, the ballast water discharged by LNG vessels at the Jordan Cove terminal would have originated in the open sea rather than a foreign port.

LNG vessels at the terminal slip would discharge ballast concurrently with the LNG cargo loading. The amount of ballast water discharged must, at a minimum, be adequate to maintain the LNG ship in a positive stability condition and with an adequate operating draft while the LNG cargo is loaded. Jordan Cove expects its terminal to be visited by 90 LNG vessels per year. Each LNG vessel would discharge approximately 9.2 million gallons of ballast water during the loading cycle to compensate for 50 percent of the mass of LNG cargo loaded.[52]

The LNG loading rate is designed to be 10,000 m^3/hr (with a peak capacity of 12,000 m^3/hr), or 4,600 metric tons per hour (t/hr) (5,520 t/hr peak), consequently the ballast water discharge rate would be approximately 20,250 gpm. Typical LNG vessels have three ballast water pumps, each capable of 3,000 m^3/hr (13,210 gpm) rated capacity. The typical LNG vessel has an upper and a lower ballast water discharge on each side of the hull, referred to as sea chests. The lower unit is just above the keel, approximately 10 meters (33 feet) below the water line. The typical ballast

[52] One cubic meter of LNG is 0.46 metric tons (t), which for the maximum size of LNG vessel authorized to call on the LNG terminal (148,000 m^3) would be 68,080 t of LNG per ship. Assuming 1 t of seawater is 1.027 m^3, the amount of seawater ballast discharged (50 percent of the weight of the LNG loaded) would be approximately 34,959 m^3 (approximately 9.2 million gallons).

water discharge port or sea chest is approximately 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 20 to 25 mm.

A potentially notable difference that may be observed in water quality could be salinity. Coos Bay is an estuary where freshwater runoff from upland rives meets seawater. According to Roye (1979), the zone of change in salinity in Coos Bay occurs at about NCM 8. The findings of the sampling conducted by OIMB (Shanks et al. 2010, 2011) in the bay near the LNG terminal indicated a wide range in salinity between seasons and tidal cycles. Salinity ranged from approximately 16 practical salinity units (psu) at low tide in winter to approximately 33 psu during high tide between May and September. On average, seawater in the world's oceans has a salinity of about 35 psu. Shanks et al. (2010, 2011) estimated the volume of water passing through Coos Bay in the vicinity of the Jordan Cove terminal during lower tidal levels to be 106 million m^3. Therefore, any increase in salinity from the 9.2 million gallons (34,825 m^3) of ballast water discharge would be approximately 0.3 percent of the water passing by the terminal. Consequently, virtually no change in salinity would occur in Coos Bay.

Another physio-chemical water quality parameter that may be influenced by the introduction of ballast water is the dissolved oxygen level. Dissolved oxygen levels are a critical component for the respiration of aquatic organisms. Among many other factors, dissolved oxygen levels in water can be influenced by water temperature, water depth, phytoplankton, wind, and current. Typical water column profiles indicate a decrease in dissolved oxygen with an increase in depth. Some factors that often influence this stratification include sunlight attenuation for photosynthetic organisms that can produce oxygen, wind, wave, and current that results in mixing. ODEQ records indicate that dissolved oxygen is rarely below the 6 mg/l standard below NCM 13 in Coos Bay (Roye 1979).

Water that is collected within the ballast tanks of a ship would lack many of these important influences and could suppress dissolved oxygen levels. However, ballast water that is discharged is not expected to be anoxic (i.e., lacking all oxygen), just lower than what levels would likely be at the surface. In addition, ballast water would be discharged near the bottom of the slip where dissolved oxygen levels may already be lower. Therefore, no significant impacts are likely to occur as a result of discharging ocean water with potentially suppressed dissolved oxygen levels.

Water temperatures and pH in Coos Bay are not likely to be significantly altered as a result of the release of ballast water by LNG vessels in the Jordan Cove marine slip. The temperature of the water in Coos Bay undergoes both seasonal and diurnal fluctuations. In December and March, the ocean and fresh water entering the estuary had similar temperatures, around 50°F. In summer, low stream flows results in a rise of temperatures in the bay, to above 60°F in September at NCM 8 (Roye 1979). Since ballast water is stored in the ship's hull below the waterline, water temperatures are not expected to deviate much from ambient temperatures of the surrounding bay water. The pH of the ballast water (reflective of open ocean conditions) may be slightly higher as compared to that of freshwater estuaries. However, this slight variation is not expected to have any impacts on existing marine organisms.

LNG Vessel Engine Cooling Water

The LNG vessels would also re-circulate water for engine cooling while loading LNG at the berth. No chemicals would be added to the cooling water. The amount of cooling water to be re-circulated is a function of the propulsion system of the LNG vessel. For purposes of this analysis, typical cooling water flow rates were used. Cooling water flows while at the berth are approximately 1,300 m^3/hr (343,421 gallons per hour or 5,723 gpm). For a 148,000 m^3 vessel, this would total approximately 6.1 million gallons while at berth (for 17.5 hours). The intake port for this engine cooling water is approximately the same size and at the same location as the ballast water intake port, 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 25 mm and approximately 32 feet below the water line, or 5.6 feet from the keel of the LNG vessel. The velocity across this port is approximately 0.28 ft/sec with a temperature differential of 3°C.

The effects of engine cooling water discharged by an LNG vessel at the terminal berth on the temperature of the water in the marine slip were evaluated (CHE 2011b). The engines would be running to provide power for standard hotelling activities as well as running the ballast water pumps. The activities that would require LNG vessel power and the assumptions used to develop the engine cooling water flow requirements are as follows:

- hotelling operations require the generation of 1.9 MW of power during the entire time that the LNG vessel remains in the slip. The vessel is anticipated to be within the slip for a total of 17.5 hours; and
- a typical auxiliary power unit for an LNG vessel is the Wartsila 34DF. This is a dual-fuel (liquid and natural gas) unit that is a complete primary driver/generator package capable of being sized upwards to 6.9 MW output. Fuel to power conversion is 7,700 kilojoules per kilowatt-hour (kJ/kWh) (7,305 British thermal units per kWh [Btu/kWh]). This system has an overall fuel to power efficiency of 46.7 percent, thereby resulting in the rejection of 3,893 Btu of heat into the cooling water for each kWh of power generated.

All calculations that follow are based upon the transfer of 148,000 m^3 of LNG from the LNG storage tanks to the LNG vessel. The 148,000 m^3 vessel is set as the basis because it represents the largest vessel authorized by the Coast Guard to call on the LNG terminal.

The total gross waste heat discharged into the slip from the cooling water stream would be due primarily to the hotelling operations (including the power required to run the ballast water discharge pumps) because the shore-side LNG pumps would be used to transfer the LNG from the LNG storage tanks to the LNG vessel. The hotelling operations were assumed to be as follows:

- hotelling operations – 17.5 total hours x 1,900 kW x 3,983 Btu/kWh = 132.5 MMBtu; and
- the total amount of heat discharged into the slip during each vessel call is approximately 132.5 MMBtu.

Two models (the 3-D UM3 model and the DKHW model) were used to study possible slip temperature changes resulting from the discharge of engine cooling water by an LNG vessel at the Jordan Cove berth. The models simulate hydrodynamic mixing processes of submerged discharges and predict temperature fields and dispersion of non-conserved substances in ambient waterbodies. Cooling water numerical modeling requires input of steady-state flow velocity in

the modeling domain. The results of tidal flowing modeling using the SELFE model showed that ambient current velocities inside the slip vary, depending on tidal stage. Peak current speeds in the berth only exceed approximately 0.32 fps less than 2 percent of the time. Therefore, for cooling water modeling, two steady state ambient flow velocities were assumed and used further in the analysis: high velocity = 0.32 fps and typical velocity = 0.16 fps.

The modeling assumptions are conservative in that a steam-powered ship was used. Steam-powered ships tend to be older than the newer more modern dual-fuel diesel electric ships that require lower quantities of cooling water.

Results of the modeling showed that for typical ambient flow conditions at a distance of 50 feet from the discharge point (LNG vessel sea chest), temperatures would not exceed 0.3ºC (0.54ºF) above the ambient temperature (CHE 2011b). This temperature difference would decrease with distance from the point of discharge. Considering the volume of water in the Jordan Cove marine slip (an estimated 4.8 cy), and tidal mixing in Coos Bay, the release of heated water from LNG vessel engine cooling operations would not substantially increase water temperatures.

Also ameliorating the impact of the release of warm engine cooling water from an LNG vessel at the Jordan Cove berth would be the decrease in temperature of the surrounding slip water due to the cooling effect that would occur from the addition of LNG cargo to the vessel. The cold LNG cargo could moderate effects on slip water temperature. Because of the extreme differential of the temperature of the cargo in the LNG vessel (-260°F) and that of the surrounding bay water (nominally 50°F) there is a constant uptake of heat by the LNG vessel. This heat uptake is manifested by the amount of LNG cargo that changes state from liquid to vapor on a daily basis. The typical LNG vessel sees 0.25 percent of its liquid cargo converted to the gaseous state each 24 hours because of this warming. In this process, 219 Btu of heat is absorbed for each pound of LNG converted to vapor. This results in a total of 53 MMBtu absorbed by a typical 148,000 m^3 LNG vessel during the 17.5 hours it is within the slip. It is reasonable to assume that 50 percent or more of the heat uptake by the vessel is extracted from the water.[53]

In addition, ballast water discharged from the LNG vessel would also comprise some portion of the water withdrawn for cooling and affected by its discharge. As the greatest predicted temperature increase from the release of engine cooling water is only about 0.5°F and that increase would be reduced further in proximity to the LNG vessel, we conclude that the thermal effect of LNG vessel operations at the berth would have very minimal impact on background water temperatures.

4.4.2.2 Pacific Connector Pipeline

The Pacific Connector pipeline would cross six subbasins including the Coos, Coquille, South Umpqua, Upper Rogue, Upper Klamath, and Lost River. Within the six subbasins, 19

[53] This assumption is further reinforced by the fact that the heat transfer coefficient between water and steel is significantly higher than the heat transfer coefficient between air and steel. Therefore, it is estimated that 26.5 MMBtu would be removed from the water in the slip by the LNG vessel during its stay. Thus, a portion of the 132.5 MMBtu of thermal energy discharged into the slip from the cooling water is offset by the uptake of 26 MMBtu by the LNG vessel itself, resulting in a net heat input to the slip of 106.5 MMBtu per 148,000 m^3 LNG vessel call.

hydrologic units at the HUC 10 level, otherwise referred to as a fifth-field watershed, would be crossed by the pipeline as listed in table 4.4.2.2-1.

TABLE 4.4.2.2-1

Subbasins and Fifth-Field Watershed Crossed by Proposed Pacific Connector Pipeline

Subbasin	Fifth-Field Watershed Name	HUC	Miles Crossed a/
Coos	Coos Bay- Frontal Pacific Ocean	1710030403	20.6
Coquille	Coquille (Middle Main) River	1710030505	2.0
	North Fork Coquille River	1710030504	8.3
	East Fork Coquille River	1710030503	9.7
	Middle Fork Coquille River	1710030501	15.8
South Umpqua	Olalla Creek-Lookingglass Creek	1710030212	8.8
	Clark Branch - South Umpqua River	1710030211	13.5
	Myrtle Creek	1710030210	8.7
	Days Creek - South Umpqua River	1710030205	19.8
	Elk Creek	1710030204	3.3
	Upper Cow Creek	1710030206	5.3
Upper Rogue	Trail Creek	1710030706	10.7
	Shady Cove - Rogue River	1710030707	8.1
	Big Butte Creek	1710030704	5.1
	Little Butte Creek	1710030708	32.9
Upper Klamath	Spencer Creek	1801020601	15.1
	John C. Boyle Reservoir - Klamath River-	1801020602 b/	5.4
Lost River	Lake Ewauna-Upper Klamath River	1801020412	16.1
	Mills Creek - Lost River	1801020409	22.6
		Total	**231.8**

a/ Mileages are rounded to nearest tenth of a mile.
b/ There are no waterbodies crossed in the Klamath River-John C. Boyle Reservoir Fifth-Field Watershed.

The following section provides additional information on applicable regulations, affected waterbodies, and on the potential impacts associated with the construction and operation of the Project.

Oregon Water Quality Regulations and Standards

Section 303(c) of the CWA requires states to establish, review, and revise water quality standards for all surface waters. To comply with these standards, the ODEQ has developed its own unique classification system to describe the highest beneficial use(s) and associated minimum water quality standards of identified surface waterbodies within the state. The Oregon Water Quality Standards include beneficial use(s), fish use designations, narrative and numeric criteria to support the beneficial use(s), and anti-degradation policies. The purpose of the Anti-degradation Policy is to guide decisions that affect water quality such that unnecessary further degradation from new or increased point and nonpoint sources of pollution is prevented, and to protect, maintain, and enhance existing surface water quality to ensure the full protection of all existing beneficial uses (Oregon Secretary of State 2012).

The state-designated beneficial use classifications for the basins crossed by the proposed Pacific Connector pipeline are shown in table 4.4.2.2-2.

TABLE 4.4.2.2-2

Designated Beneficial Uses for Basins Crossed by the Proposed Pacific Connector Pipeline

	South Coast		Umpqua		Rogue			Klamath	
Beneficial Use	**Estuaries and Adjacent Maine Waters**	**All Streams and Tributaries Thereto**	**South Umpqua River Main Stem**	**All Other Tributaries to Umpqua, North and South Umpqua Rivers**	**Rogue River Main Stem From Estuary to Lost Creek Dam**	**Rogue River Main Stem above Lost Dam and Tributaries**	**All Other Tributaries to Rogue River and Bear Creek**	**Klamath River from Klamath Lake to Keno Dam**	**Lost River and Lost River Diversion Channel**
Public Domestic Water Supply		X	X	X	X	X	X	X	X
Private Domestic Water Supply		X	X	X	X	X	X	X	X
Industrial Water Supply	X	X	X	X	X	X	X	X	X
Irrigation		X	X	X	X	X	X	X	X
Livestock Watering		X	X	X	X	X	X	X	X
Wildlife and Hunting	X	X	X	X	X	X	X	X	X
Fishing	X	X	X	X	X	X	X	X	X
Boating	X	X	X	X	X	X	X	X	X
Water Contact Recreation	X	X	X	X	X	X	X	X	X
Aesthetic Quality	X	X	X	X	X	X	X	X	X
Hydro Power		X	X	X		X	X	X	
Commercial Navigation and Transportation	X				X			X	
Fish and Aquatic Life a/	X	X	X	X	X	X	X	X	X

Source: ODEQ (2006a)
a/ See additional discussion in section 4.6.2 of this EIS.

Studies requested by ODEQ are part of a broad evaluation of potential water quality, stream channel stability, and riparian impacts resulting from pipeline construction and maintenance. GeoEngineers have conducted studies including a stream crossing risk analysis, hyporheic exchange impacts analysis, and a study on the impact to turbidity, nutrients, and metals along the streams crossed by the pipeline (GeoEngineers 2013c, d, and b, and 2015). The intent of the evaluations is to focus resources on those waterbody pipeline crossings that present the greatest risk of impacts to beneficial uses. ODEQ's regulatory authority under the CWA and OAR is provided to maintain beneficial uses through enforcement of water quality standards.

Through the notification process, provisions for surface water quality under the Forest Practices Act and rules will be addressed, if applicable. Details would be submitted to the ODEQ in either a written plan or alternate plan to include specific provisions for meeting the Forest Practices Act.

Water Quality Limited Waters

Each state is required, under Section 305(b) of the CWA, to submit a report to the EPA describing the status of surface waters in the state biennially. Waterbodies are assessed to determine if their use is "fully supported," "fully supported but threatened," "partially supported," or "not supported" in accordance with the water quality standards. A use is said to

be "impaired" when it is not supported or only partially supported. A list of waters that are impaired is required by Section 303(b) of the CWA and included in the 305(b) report. To restore a waterbody to its use classification, a state may elect to impose restrictions more stringent than those normally required by the NPDES or other permitting programs, or even deny a permit for activities that adversely affect an "impaired" waterbody.

States are also required to develop TMDLs for the impaired waterbodies. TMDLs describe the amount of each pollutant a waterbody can receive and not violate water quality standards. To comply with EPA requirements, the State of Oregon recently produced a combined report entitled Oregon's 2010 Integrated Report on Water Quality (Integrated Report). The report includes an assessment database containing information on the water quality status of waters in Oregon, the assessment methodology used to evaluate data, the 2010 303(d) list, and a schedule for developing TMDLs for waters on the Section 303(d) list (ODEQ 2012e, 2012d). EPA approved the report on March 15, 2012.

The Integrated Report designates waterbodies according to five Water Quality Assessment Categories, which are:

1. All standards are met (this category is not used).
2. Attaining - some of the pollutant standards are met.
3. Insufficient data to determine whether a standard is met.
   - 3a. Potential concern: Some data indicate non-attainment of a criterion, but data are insufficient to assign another category.
4. Water quality is limited but a TMDL is not needed. This includes:
   - 4a. TMDL approved: TMDLs needed to attain applicable water quality standards have been approved.
   - 4b. Other pollution control requirements are expected to address all pollutants and will attain water quality standards.
   - 4c. Impairment is not caused by a pollutant (e.g., flow or lack of flow is not considered a pollutant).
5. Water quality is limited (303d list) and a TMDL is required.

To address water quality concerns in the Umpqua and Rogue River Basins, the ODEQ issued TMDLs in 2006 and 2008, respectively. For nonpoint sources (which includes near stream vegetation disturbance), heat allocations are translated into effective shade surrogate measures (stream side vegetation objectives) to provide site-specific targets for land managers. Attainment of these measures ensures compliance with the nonpoint source allocations (ODEQ 2006b, 2008b). Compliance with Oregon water quality standards and applicable TMDLs would be addressed during the CWA Section 401 water quality certification processes prior to construction.

The GIS coverage for the 2010 Integrated Report was reviewed to determine the locations of the water quality limited waters for both Water Quality Assessment Categories 4 and 5 to determine if they are in the vicinity of Project components. Based on the ODEQ 2010 Integrated Report GIS coverage, 35 Category 4 and 5 water quality impaired waterbodies would be crossed by the pipeline and are listed in table 4.4.2.2-3 (ODEQ 2012d). TMDLs for the South Umpqua subbasin were

completed in October 2006. TMDLs for the Upper Rogue subbasin were completed in December 2008. TMDLs for the Upper Klamath River, and Lost River subbasins were approved in December 2010. TMDLs for the Coos and Coquille Subbasins are in progress. Pacific Connector proposes to cross 29 of these impaired waterbodies using dry/diverted open-cut crossing techniques. Conventional boring, DP, or HDD methods would be used to cross 5 of the impaired waterbodies. Only Haynes Inlet in the Coos Bay estuary would be crossed using wet open-cut trenching.

All stream crossings would be completed under the terms of a COE CWA Section 404 permit, the NPDES Construction Stormwater Permit (CWA Section 402), and CWA Section 401 water quality certification requirements. Construction would be carried out under a Construction General Permit (NPDES permit 1200-C) for stormwater discharges during construction activities. Stormwater runoff from the disturbed portions of the site would be managed in accordance with a site-specific ESCP, which incorporates stormwater pollution prevention and includes the development of BMPs to protect surface water from stormwater runoff.

During the ODEQ CWA Section 401 process, Pacific Connector would develop a source-specific implementation plan in accordance with OAR 340-042-0080 for areas with existing TMDLs, and Pacific Connector would be identified as a new nonpoint source. The source specific implementation plan would be reviewed and approved by ODEQ.

BMPs to minimize sedimentation during construction would be employed on all streams. However, for water quality impaired streams, additional BMPs should be installed for additional protection. For temperature-impaired streams, additional buffers should be utilized to avoid removal of woody riparian vegetation where possible. Riparian vegetation would have to be removed in the right-of-way for all pipeline crossings. Further discussion on temperature changes in streams is discussed below. Overall, the small reduction in shade is not likely to change stream temperatures substantially downstream of the pipeline crossing. However, removal of vegetation that once shaded the stream may cause local and temporary (daily) increases in temperature during the hot summer months. This may or may not exceed the TMDL on temperature-impaired streams. Assessment of individual stream crossings for temperature-impaired streams may be needed to identify the risk of exceeding the TMDL for temperature if woody riparian vegetation will be removed. Pipeline crossings may also affect streams impaired due to habitat modification. Mitigation for habitat fragmentation or modification of habitat may require off-site mitigation to offset loss of habitat at the crossing. Site-specific assessments for water quality impaired streams should identify appropriate mitigation for each TMDL that is at risk.

TABLE 4.4.2.2-3

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
Coast Range Ecoregion, Coos Subbasin Coos Bay-Frontal Pacific Ocean Fifth-field Watershed, Coos County				
Coos Bay	Wet Open-Cut	Major	Estuary	Fecal Coliform/Year-Round - 5
Kentuck Slough	Conventional Bore	Intermediate	Perennial	Fecal Coliform/Year-Round – 5; Dissolved Oxygen/Year-Round – 5 Habitat Modification – 4C
Willanch Slough	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year-Round - 5
Echo Creek	Dry Open-Cut	Intermediate	Intermittent	Fecal Coliform/Year-Round - 5
Coos River	HDD	Major	Perennial	Fecal Coliform/Year-Round - 5
Stock Slough	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year-Round - 5
Catching Slough	Conventional	Major	Perennial	Fecal Coliform/Year-Round - 5

TABLE 4.4.2.2-3

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
	Bore			
Ross Slough	Dry Open-Cut	Minor	Perennial	Temperature/Year-Round - 5
Catching Creek	Dry Open-Cut	Minor	Perennial	Fecal Coliform/Year-Round - 5
Coast Range Ecoregion, Coquille Subbasin, Coquille River Fifth-field Watershed, Coos County				
Cunningham Creek	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year Round - 5; Dissolved Oxygen/Year Round – 5; Habitat Modification – 4C; Flow Modification – 4C
Coast Range Ecoregion, Coquille Subbasin, North Fork Coquille River Fifth-field Watershed, Coos County				
North Fork Coquille River	Dry Open-Cut	Intermediate	Perennial	Biological Criteria/Year-Round – 5 Dissolved Oxygen/Year-Round (ns) – 5 Temperature/Year-Round (ns) - 5 Habitat Modification – 4C
Middle Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Year-Round (ns) - 5
Coast Range Ecoregion, Coquille Subbasin, East Fork Coquille River Fifth field Watershed, Coos County				
East Fork Coquille River	Dry Open-Cut	Intermediate	Perennial	Temperature/Summer - 5 Habitat Modification – 4C
Elk Creek	Dry Open-Cut	Minor	Perennial	Temperature/Year-Round (ns) -5
Coast Range Ecoregion, Coquille Subbasin, Middle Fork Coquille River Fifth field Watershed, Coos County				
Upper Rock Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Summer (ns) – 5 Habitat Modification – 4C
Klamath Mountains Ecoregion, Coquille Subbasin, Middle Fork Coquille River Fifth field Watershed, Douglas County				
Middle Fork Coquille River	Dry Open-Cut	Intermediate	Perennial	Dissolved Oxygen/Year-Round – 5 E. Coli/Year Round – 5 Temperature/Summer (ns) – 5 Habitat Modification – 4C
Klamath Mountains Ecoregion, South Umpqua Subbasin, Olalla Creek-Lookingglass Creek Fifth field Watershed, Douglas County				
Olalla Creek	Dry Open-Cut	Intermediate	Perennial	Biological Criteria - 5; Temperature/Year-Round – 4A; Iron/Year-Round - 5 Flow Modification – 4C
Klamath Mountains Ecoregion, South Umpqua Subbasin, Clark Branch-South Umpqua River Fifth field Watershed, Douglas County				
Kent Creek	Dry Open-Cut	Intermediate	Perennial	Flow Modification – 4C Habitat Modification – 4C
Rice Creek	Dry Open-Cut	Major	Perennial	Temperature/Summer (ns) -4A Habitat Modification – 4C Flood Modification – 4C E. Coli/Summer – 4A
Willis Creek	Dry Open-Cut	Intermediate	Perennial	Flow Modification – 4C
South Umpqua River	Direct Pipe Level 2	Major	Perennial	Fecal Coliform/Summer - 5; Biological Criteria - 5; Aquatic Weeds or Algae/Summer – 4A; Dissolved Oxygen/Year Round (ns) – 4A; Dissolved Oxygen/May 15-Oct 15 (s) – 5 Temperature/Year-Round (ns) - 5; Chlorophyll a/Summer – 4A; E Coli/Summer – 4A; pH/Summer – 4A Chlorine/Year-Round – 4B Flow Modification – 4C Habitat Modification – 4C

TABLE 4.4.2.2-3

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
Klamath Mountains Ecoregion, South Umpqua Subbasin, Myrtle Creek Fifth-field Watershed, Douglas County				
Bilger Creek	Dry Open-Cut	Minor	Perennial	E. Coli/Year-Round – 5 Dissolved Oxygen/Year-Round - 5
North Myrtle Creek	Dry Open-Cut	Intermediate	Perennial	Biological Criteria/Year-Round – 5 Dissolved Oxygen/Oct. 15-May 15 - 5 Temperature/Year-Round (ns) – 4A; E Coli/Summer – 4A Habitat Modification – 4C Flow Modification – 4C
South Myrtle Creek	Dry Open-Cut	Intermediate	Perennial	E. Coli/Summer – 5 Dissolved Oxygen/Oct. 15-May 15 - 5 Temperature/Year-Round (ns) – 4A Flow Modification – 4C
Klamath Mountains Ecoregion, South Umpqua Subbasin, Days Creek – South Umpqua River Fifth field Watershed, Douglas County				
Fate Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Year-Round (ns) – 4A
Days Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Year-Round (ns) – 4A Habitat Modification – 4C Flow Modification – 4C
Cascades Ecoregion, South Umpqua Subbasin, Days Creek – South Umpqua River Fifth field Watershed, Douglas County				
Saint John Creek	Dry Open-Cut	Intermediate	Perennial	Flow Modification – 4C
South Umpqua River	Diverted Open-Cut	Major	Perennial	Dissolved Oxygen/Oct 15-May 15; - 5; Temperature/Year-Round (ns) – 4A; pH/Summer – 4A Flow Modification – 4C Habitat Modification – 4C
Cascades Ecoregion, Upper Rogue Subbasin, Trail Creek Fifth field Watershed, Jackson County				
West Fork Trail Creek	Dry Open-Cut	Intermediate	Perennial	Dissolved Oxygen/Summer – 5 Flow Modification – 4C
Cascades Ecoregion, Upper Rogue Sub-basin, Shady Cove-Rogue River Fifth field Watershed, Jackson County				
Rogue River	HDD	Major	Perennial	pH/Summer - 5
Cascades Ecoregion, Upper Rogue Subbasin, Little Butte Creek Fifth field Watershed, Jackson County				
Lick Creek	Dry Open-Cut	Intermediate	Intermittent	Dissolved Oxygen/Summer - 5; Biological Criteria/Year Round - 5 E Coli/Summer - 4A
Salt Creek	Dry Open-Cut	Intermediate	Perennial	E Coli/Year-Round - 4A
North Fork Little Butte Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Summer – 4A; E Coli/Year Round – 4A pH/Summer - 5
Eastern Slopes Ecoregion, Upper Rogue Subbasin, Little Butte Creek Fifth field Watershed, Jackson County				
South Fork Little Butte Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Summer -4A b/; E Coli/Summer – 4A b/; Sedimentation – 5 b/ Habitat Modification – 4C b/ Flow Modification – 4C b/
Eastern Slopes Ecoregion, Upper Klamath River Subbasin, Spencer Creek Fifth field Watershed, Klamath County				
Spencer Creek	Dry Open-Cut	Minor	Intermittent	Biological Criteria - 5; Sedimentation - 5; Temperature/Year-Round - 5 Habitat Modification – 4C Flow Modification – 4C
Clover Creek	Dry Open-Cut	Minor	Intermittent	Sedimentation – 5 Habitat Modification – 4C

TABLE 4.4.2.2-3

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
Eastern Slopes Ecoregion, Lost River Subbasin, Lake Ewauna-Klamath River Fifth field Watershed, Klamath County				
Klamath River	HDD	Major	Perennial	Dissolved Oxygen/Year-Round (ns) - 5; Ammonia/Year-Round - 5; Chlorophyll a/Summer - 5; pH/Summer - 5 Habitat Modification – 4C Flow Modification – 4C
Eastern Slopes Ecoregion, Lost River Subbasin, Mills Creek – Lost River Fifth field Watershed, Klamath County				
Lost River	Dry Open-Cut	Major	Perennial	Dissolved Oxygen/Year-Round (ns) - 5; Ammonia/Year-Round - 5; Chlorophyll a/Summer – 5 E. Coli/Summer – 5 Temperature/Year-Round – 5 Habitat Modification – 4C Flow Modification – 4C

a/ Minor waterbody includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of construction; intermediate waterbody includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of construction; and major waterbody includes all waterbodies greater than 100 feet wide at the water's edge at the time of construction.
b/ Water quality limited within one mile of crossing, not at point of crossing.
ns – non-spawning

A potential new nonpoint source of nutrients and/or oxygen demanding pollutants would be the use of fertilizer for revegetation of disturbed areas. Any monitoring required for nutrients at locations where fertilizer is likely to contribute to run-off to waterbodies will be addressed in the state permit process and be included in a source-specific implementation plan as required by OAR 340-042-0080.

Contaminated Surface Water or Sediments

A review of ODEQ's ECSI database (ODEQ 2013b) revealed that the Pacific Connector Pipeline Project would impact nine sites investigated by the ODEQ for the release of hazardous substances into the site's environment. Of those nine sites, an online review of site notes shows that ODEQ has determined that four of those sites require no further action. The remaining five sites, as shown in table 4.3.2.3-2, potentially contain hazardous substances. Four of those sites are proposed as contractor/pipe storage yards; the fifth site on Jordan Point would contain the Jordan Cove Meter Station, the pipeline from MP1.5R-1.64R, a TEWA, and a pipeyard. See section 4.3.2.3.

However, the chance for unanticipated discovery of contaminated sediments remains. In rural areas, potential sources for contamination of sediments in waterbodies are agricultural fields containing fertilizers and pesticides, and leachate from feed lots and sanitary fields. In urban areas, contaminated stormwater runoff, wastewater discharges, erosion or leachate from industrial sites such as mineral processing or mining, petroleum refining, treatment plants, or landfills may contribute to the sediment contamination in waterbodies.

A records search has not indicated any known hazardous waste sites in Coos Bay that would be crossed by the pipeline, so toxic effects from resuspended sediment should not occur. However development, including boat painting with toxic compounds (e.g., lead, tributyltin), has occurred in Coos Bay in the past. There are records of elevated levels of tributyltin in the sediment of

Catching Slough (Elgethun et al. 2000), which the pipeline would cross under using a bore at about MP 11.1. The sediment characterization assessment for the proposed alignment across Haynes Inlet (GeoEngineers 2010) concluded that contaminants of concern have not been identified near the project area within Coos Bay at concentrations greater than Sediment Evaluation Framework screening levels and, therefore, it is unlikely that the project activities would present unacceptable risks to the receptors of concern identified in the Conceptual Site Model.

Pacific Connector, in consultation with the BLM and Forest Service, developed a *Contaminated Substances Discovery Plan*. This plan outlines practices to protect human health and worker safety and to prevent further contamination in the event of an unanticipated discovery of contaminated soil, water, or groundwater during construction of the pipeline.

Drinking Water Source Areas

The pipeline route would cross or be adjacent to 12 surface water public drinking water source areas (DWSAs; ODEQ 2012e). Table 4.4.2.2-4 lists the locations where the pipeline route would cross source areas. In some locations, the pipeline route is within a particular source area for several miles, but in other locations the route travels along ridgelines meandering in and out of source areas. Where the pipeline route meanders in and out of source areas, two source areas are shown in table 4.4.2.2-4 for that length of the pipeline route.

TABLE 4.4.2.2-4

Surface Water Public DWSAs Crossed by the Proposed Pacific Connector Pipeline

Starting Milepost	Ending Milepost	County	Drinking Water Source Area a/	Public Drinking Water System ID	Source Water
19.86	35.81	Coos	City of Myrtle Point	4100551	N. F. Coquille River
35.81	38.42	Coos	City of Coquille	4100213	Coquille River
38.42	42.48	Coos	City of Myrtle Point	4100551	N.F. Coquille River
			City of Coquille	4100213	Coquille River
42.48	53.21	Coos	City of Coquille	4100213	Coquille River
53.21	64.71	Douglas	Winston-Dillard Water District	4100957	S. Umpqua River
64.71	70.52	Douglas	Roseburg Forest Products-Dillard	4194300	S. Umpqua River
70.52	74.86	Douglas	Clarks Branch Water Association	4100548	S. Umpqua River
			Roseburg Forest Products-Dillard	4194300	
74.86	82.74	Douglas	Clarks Branch Water Association	4100548	S. Umpqua River
82.45	86.38	Douglas	Tri-City Water District	4100549	S. Umpqua River
			Clarks Branch Water Association	4100548	
86.38	95.42	Douglas	Tri-City Water District	4100549	S. Umpqua River
95.42	101.78	Douglas	Milo Academy	4100250	S. Umpqua River
			Tri-City Water District	4100549	
101.78	102.74	Douglas	Tiller Elementary SD #15	4192139	S. Umpqua River
			Tri-City Water Distract	4100549	
102.74	108.	Douglas	City of Glendale	4100323	Cow Creek
	97		Tiller Elementary SD #15	4192139	S. Umpqua River
108.97	111.111	Douglas	City of Glendale	4192139	S. Umpqua River
111.11	124.61	Jackson	Country View Mountain Home Estates	4100808	Rogue River
124.61	135.04	Jackson	Anglers Cover /SCHWC	4100808	Rogue River
			Country View Mountain Home Estates	4100513	
135.04	168.01	Jackson	Medford Water Commission	4100513	Rogue River

a/ The proposed route meanders in and out of Surface Water DWSAs where there are two DWSAs listed.

Public Drinking Water Intakes

Table 4.4.2.2-5 lists the public water systems that have surface water intakes within 3 miles downstream of waterbodies that would be crossed by the pipeline (ODEQ 2013a). The downstream

distance from the waterbody crossing to the intake is also provided in table 4.4.2.2-5 in addition to the source water. The surface water intake for Roseburg Forest Products in Dillard on the South Umpqua River is 0.8 mile downstream of the crossing of Rice Creek at MP 65.76 and 1.8 miles downstream of the crossing of Willis Creek at MP 66.95. Pacific Connector would provide written notification to the authorities of the surface water supply intakes in table 4.4.2.2-5 at least one week before beginning in-water work or as otherwise specified by the appropriate authorities.

TABLE 4.4.2.2-5

Public Surface Water Drinking Water Intakes within 3 Miles Downstream of Proposed Waterbody Crossings for the Pacific Connector Pipeline

Intake	Public Water System	Source Water for Intake	Waterbody Crossing	Distance Downstream	County
4194300	Roseburg Forest Products –Dillard	S. Umpqua River	Rice Creek – MP 65.76 Tributary to S. Umpqua River	0.8 mile	Douglas
4194300	Roseburg Forest Products –Dillard	S. Umpqua River	Willis Creek MP 66.95 Tributary to S. Umpqua River	1.8 miles	Douglas
4100808	Country View Mountain Home Estates	Rogue River	Rogue River MP 122.65	1.4 miles	Jackson
4101483	Anglers Cove Subdivision	Rogue River	Rogue River 122.65	Approx. 3 miles	Jackson

There are 10 rock source and disposal sites, 26 contractor and pipe storage yards, 9 TARs, 10 PARs, and 9 aboveground facilities located within surface water public DWSAs. In the event of an inadvertent spill, or a disruption of flow and sediments are introduced into these waters, Pacific Connector would notify potable water intake users of the conditions so that necessary precautions could be implemented. Prior to construction, Pacific Connector would consult with all surface water intake operators listed in table 4.4.2.2-5 with active intakes located within 3 miles downstream from a stream crossing location and establish a process for advanced notification of instream work. A summary of the consultations would be filed with FERC prior to construction of the pipeline.

Points of Diversion

There are locations along the Project route where surface water is diverted (point of diversion) for uses such as irrigation. A total of 57 point of diversion locations are within 150 feet of the construction work area. These are listed in table 4.4.2.2-6. Of these 57 points of diversion, 16 are located within the construction work area. The State of Oregon uses 4 in Douglas County for irrigation, and the other 12 are private and used for industrial/manufacturing uses, fire protection, livestock watering, irrigation, or domestic uses. A total of 12 of the points of diversion are located within pipe yards or TEWAs. A total of 4 of the 16 points of diversion are located within the construction right-of way. Pacific Connector would consult with the landowner if the point of diversion could not be avoided and identify an alternate location for the diversion prior to construction. Should it be determined that there has been an impact on the water supply, Pacific Connector would work with the landowner to ensure a temporary supply of water, and if determined necessary, Pacific Connector would replace the affected water supply with a permanent water supply. Mitigation measures would be specific to each property, and would be determined during landowner negotiations. Points of diversion (both public and private) beyond 150 feet of the construction work areas are not expected to be affected by the pipeline.

TABLE 4.4.2.2-6

Points of Diversion within 150 feet of Pacific Connector Construction Work Area

Water Right Type	Water Right Owner	County	Nearest Milepost	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion	Number of Water Rights
Storage	Private	Douglas	60.73	44288	Stream	Perron Creek	Livestock	35.90	-	1
			65.35	T 6708	Stream	South Umpqua River/Reservoir 1	Industrial/manufacturing uses	0.00	Pipe Yards	1
			67.12	R 14589	Stream	Unnamed Stream	Multiple purpose	108.39	-	2
			74.20	69536	Winter Runoff	Runoff/Reservoir 13	Fire protection	0.00	Construction Right-of-Way	1
			74.20	69536	Winter Runoff	Runoff/Reservoir 13	Livestock	0.00	Construction Right-of-Way	1
			75.49	17241	Stream	Sutherlin Creek	Industrial/manufacturing uses	0.00	Pipe Yards	1
			75.49	30362	Stream	Sutherlin Creek	Industrial/manufacturing uses	0.00	Pipe Yards	1
									Storage Total	***8***
Surface Water	Private	Coos	12.07	53679	Stream	Unnamed Stream	Domestic including Lawn and Garden	79.83	-	1
			13.80	36042	Spring	A spring	Domestic	0.00	Construction Right-of-Way	1
			29.48	S 44450	Stream	Stemmler Creek	Domestic including Lawn and Garden	134.81	-	1
			29.48	S 44450	Stream	Stemmler Creek	Livestock	134.81	-	1
			29.86	60877	Stream	East Fork Coquille River	Irrigation	56.92	-	1
			30.00	39940	Stream	East Fork Coquille River	Irrigation	0.00	Construction Right-of-Way	1
		Douglas	49.53	44065	Stream	Lang Creek	Irrigation	109.26	-	1
			58.64	S 54735	Stream	Olalla Creek	Domestic Expanded	117.96	-	1
			67.19	15423	Stream	South Umpqua River	Irrigation	132.51	-	1
			67.19	22390	Stream	South Umpqua River	Irrigation	67.80	-	1
			67.19	23826	Stream	South Umpqua River	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			70.36	29340	Stream	South Umpqua River	Irrigation	120.06	-	1
			70.36	65231	Stream	South Umpqua River	Irrigation	64.53	-	1
			70.36	68634	Stream	South Umpqua River	Irrigation	64.53	-	1
			75.49	15598	Stream	Sutherlin Creek	Industrial/Manufacturing Uses	0.00	Pipe Yards	2
			75.49	17292	Stream	Camas Swale/Log Pond	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			75.49	30363	Stream	Sutherlin Cr/Pond	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			81.23	55163	Stream	South Myrtle Creek	Irrigation	67.96	-	1
			82.27	80544	Stream	South Umpqua River	Irrigation	0.00	Pipe Yards	1
			88.16	43561	Stream	Fate Creek	Irrigation	90.46	-	1
			88.16	52977	Stream	Fate Creek	Irrigation	90.46	-	1
			88.52	56872	Stream	Fate Creek	Irrigation	147.03	-	1
		Jackson	122.67	34473	Stream	Rogue River	Irrigation	132.95	-	1
			122.83	65482	Stream	Rogue River	Irrigation	22.39	-	1
			145.77	2170	Stream	Little Butte Creek	Irrigation	100.10	-	1

TABLE 4.4.2.2-6

Points of Diversion within 150 feet of Pacific Connector Construction Work Area

Water Right Type	Water Right Owner	County	Nearest Milepost	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion	Number of Water Rights
			145.77	2470	Stream	Little Butte Creek	Irrigation	129.80	-	1
			145.77	57753	Stream	North Fork Little Butte Creek	Irrigation	129.80	-	1
			145.82	17215	Stream	North Fork Little Butte Creek	Irrigation	103.16	-	1
		Klamath	199.96	67512	Stream	Klamath River	Fire Protection	23.69	-	1
	State	Coos	22.30	9712	Spring	A spring	Domestic	119.11	-	1
			27.20	60812	Stream	Middle Creek	Irrigation	127.86	-	1
		Douglas	67.19	S 51632	Stream	South Umpqua River/Con 18714	Primary and Supplemental Irrigation	0.00	Pipe Yards	1
			67.30	S 51924	Reservoir	South Umpqua/Galesville	Supplemental Irrigation	0.00	Pipe Yards	1
			70.36	S 52930	Stream	South Umpqua River	Primary and Supplemental Irrigation	0.00	Pipe Yards	1
			71.31	S 51924	Stream	South Umpqua River	Irrigation	0.00	Temporary Extra Work Space	1
		Jackson	128.61	73043	Stream	Indian Creek	Anadromous and Resident Fish Rearing	9.87	-	12
			135.65	41308	Reservoir	Reservoir	Wildlife	100.42	-	1
									Surface Water Total	***49***
									Grand Total	**57**

Nationwide Rivers Inventory

The Nationwide Rivers Inventory is a listing of more than 3,400 free-flowing river segments in the United States that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance. Under a 1979 Presidential directive, and related CEQ procedures, all federal agencies must seek to avoid or mitigate actions that would adversely affect one or more Nationwide Rivers Inventory segments.

Three rivers crossed by the pipeline are listed on the Nationwide Rivers Inventory (NPS 2013):

- The North Fork of the Coquille River from its headwaters in Section 16, T.26S., R.10W. to the confluence with the South Fork Coquille River in Section 5, T.29S., R.12W. It was listed in 1993 for outstandingly remarkable fish, wildlife, and cultural (prehistoric Indian sites) values. The Pacific Connector pipeline would cross this section of river at MP 23.1. Pacific Connector developed a site-specific crossing plan for the North Fork Coquille River using a dry open-cut method to contain disturbed sediments.
- The East Fork of the Coquille River from its headwaters in Section 18, T.28S., R.8W. to the confluence with the North Fork of the Coquille River in Section 36, T.28S., R.12W. It was listed in 1993 for outstandingly remarkable fish, wildlife, boating and fishing. The proposed Pacific Connector pipeline alignment crosses this section of river at MP 29.9. Pacific Connector developed a site-specific crossing plan for the East Fork Coquille River using a dry open-cut method to contain disturbed sediments.
- The South Umpqua River from Tiller (Section 33, T.30S., R.2W.) to the confluence with the North Umpqua River at River Forks (Sections 31 and 32, T.26S., R.6W.). It was listed in 1993 for outstanding and remarkable fish and historical values. It supports outstanding fishery-related recreation. The pipeline would cross this section of river twice: at MP 71.3 and MP 94.7. Pacific Connector developed a site-specific crossing plan for the western South Umpqua River crossing using a DP to eliminate an open-cut and minimize impacts by drilling under the river and I-5 in a single operation. Pacific Connector developed a site-specific crossing plan for the eastern South Umpqua River crossing using a diverted open-cut to limit water quality impacts by creating a "dry" working area.

Floodplains

EO 11988 (10 CFR 1022) requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Potential effects of the project located within a floodplain should be evaluated and project design should consider flood hazards and floodplain management. It is reasonable to assume that all watercourses that convey natural flows, whether mapped as floodplains, flood hazard areas, or not, present some level of flood hazard. The flood hazard is not limited to inundation; bank erosion and bed scour (a lowering or destabilization of the channel bed during a flow event) are also hazards that can occur due to flooding.

Some of the streams that would be crossed by the Pacific Connector Pipeline Project have delineated 100-year floodplains designated by FEMA. The 100-year floodplain is the area that would be inundated by a flood with a recurrence interval of once in 100 years, on average.

Approximately 7.5 miles of the pipeline is located within an area inundated by 100-year flooding and approximately 0.1 mile is located in an area characterized as inundated by 500-year flooding, or 100-year flooding with average depths of less than 1 foot, or an area protected by levees from 100-year flooding. These areas are identified in table 4.4.2.2-7.

TABLE 4.4.2.2-7

Floodplain Areas Crossed by the Proposed Pacific Connector Pipeline

Starting Milepost	Ending Milepost	Fifth-Field Watershed	Zone a/	Miles of Pipeline b/
1.7 R	4.2 R	Coos Bay-Frontal Pacific Ocean	A	2.5
6.2 R	6.5 R	Coos Bay-Frontal Pacific Ocean	A	0.3
8.3 R	8.5 R	Coos Bay-Frontal Pacific Ocean	A	0.2
11 R	11.1 R	Coos Bay-Frontal Pacific Ocean	A	<0.1
11.1 R	8.8	Coos Bay-Frontal Pacific Ocean	A	1.5
10.1	10.4	Coos Bay-Frontal Pacific Ocean	A	0.3
10.4	10.4	Coos Bay-Frontal Pacific Ocean	A	<0.1
11	11.4	Coos Bay-Frontal Pacific Ocean	A	0.4
11.8	11.9	Coos Bay-Frontal Pacific Ocean	A	<0.1
15.7	15.7	Coos Bay-Frontal Pacific Ocean	A	<0.1
22.8	23.1	North Fork Coquille River	A	0.3
27	27.1	North Fork Coquille River	A	<0.1
29.7	29.9	East Fork Coquille River	A	0.2
58	58.8	Olalla Creek-Lookingglass Creek	A	0.8
65.7	65.8	Clark Branch-South Umpqua River	A	<0.1
66.9	67	Clark Branch-South Umpqua River	A	<0.1
71.2	71.4	Clark Branch-South Umpqua River	A	0.1
71.4	71.4	Clark Branch-South Umpqua River	X500	<0.1
94.7	94.8	Days Creek-South Umpqua River	A	0.1
122.6	122.8	Shady Cove-Rogue River	A	0.2
122.8	122.9	Shady Cove-Rogue River	X500	0.1
145.7	145.8	Little Butte Creek	A	0.1
		Total		**7.6**

a/ Zone A: An area inundated by 100-year flooding, for which no Base Flood Elevations have been determined.
Zone X500 - An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 100-year flooding.
b/ Mileages are rounded to the nearest tenth of a mile; values less than 0.1 mile are noted as <0.1. Column may not sum correctly due to rounding.

Building is permitted in flood-prone areas with certain restrictions. For instance, buildings are to be elevated such that the lowest floor is above the 100-year flood level, and an area of the watercourse is typically set aside for flow conveyance (the floodway). Encroachment of a Project structure into a flood path could result in flooding of or erosion damage to the encroaching structure, diversion of flows and increased flood risk for adjacent property, or increased erosion on adjacent property.

The pipeline within a flood hazard area subject to scour or lateral movement of a stream channel would be buried beneath the 50-year scour depth. Since the pipeline would be buried, a majority of the project footprint that would affect floodplains would be permanent facilities and PARs. To minimize effects to the floodplain and effects from flooding that would require floodplain management, permanent Project facilities and PARs should be located outside of the floodplain as much as practicable. If it is not possible to avoid placing permanent structures within the floodplain, permanent structures would be designed to manage flood watercourses and designed to withstand effects from flooding. The Project is not likely to substantially impact flood flows

in each watershed as a result of the small footprint of the Project within each watershed floodplain.

Surface Waterbody Crossings

Because of the pipeline's linear nature, it is not possible to avoid crossing waterbodies and riparian areas. However, the number of stream crossings required for the pipeline was minimized by Pacific Connector's identification of a pipeline route that follows ridgelines and watershed boundaries to ensure the long-term safety, stability and integrity of the pipeline as it crosses the Coast and Cascade mountain ranges.

The pipeline route would cross 19 fifth-field watersheds, with proposed access roads crossing an additional 5 watersheds. The construction of the pipeline would affect waterbodies at 265 locations; 35 of these locations are not crossed by the pipeline but are located within the right-of-way or workspaces. Of the 265 locations where waterbodies would be affected, 106 are perennial, 151 are intermittent, 5 are ponds (including stock ponds), plus 1 industrial pond and 1 excavated pond, and 1 is an estuary (Haynes Inlet in Coos Bay). [54]

In Coos County, the project would affect 59 perennial and 41 intermittent waterbodies, 1 stock pond, and the estuary. In Douglas County, the project would affect 31 perennial and 36 intermittent waterbodies. In Jackson County, the pipeline would affect 13 perennial and 55 intermittent waterbodies, and 3 ponds. In Klamath County, the pipeline would affect 3 perennial and 19 intermittent waterbodies, and 1 pond, plus 1 industrial pond, and 1 excavated pond. A table of crossings with the proposed crossing method is included in appendix N (table N-3).

This section describes proposed waterbody crossing methods. Pacific Connector would follow its consultant's *Stream Crossing Risk Analysis* (GeoEngineers 2013c),[55] and the *Stream Crossing Risk Analysis Addendum* (GeoEngineers 2015)[56] which identified design guidance, contingency measures, and monitoring protocol specific to each crossing. All waterbodies would be crossed in accordance with the FERC's *Procedures*, as well as according to the COE, ODSL, ODEQ, Forest Service, BLM, Reclamation, and ODFW approvals.

GeoEngineers (2015) applied the FWS's Pipeline Screening Matrix to all stream crossings that display fluvial characteristics and streams that are of special concern to the BLM and Forest Service. The analysis identified 131 sites needing pre-construction surveys. Surveys were completed for 60 stream crossings sites that were accessible between May and August 2014 to observe current site conditions, ground-truth date from the 2013 desktop study, and to provide a basis for developing site-specific approaches for restoration planning. Sites not accessible during the 2014 surveys would be surveyed by Pacific Connector prior to construction following approval of access agreements of the landowners.

As described in GeoEngineers (2013c), once the Project is approved and all permits and route access obtained, all stream crossings would have a pre-construction survey to confirm and clarify conditions developed in the risk analysis. This survey would be done by a team of professionals qualified to

[54] The values reported here for waterbody crossings differs from those reported in section 4.6, because that section does not analyze ditches.
[55] Attached as a stand-alone report in Pacific Connector's June 2013 application to the FERC.
[56] Provided as Attachment 23 in Pacific Connector's February 13, 2015, submittal in response to recommendations in the DEIS.

assess terrestrial and aquatic habitat and the geotechnical and geomorphic conditions relative to pipeline construction across stream channels and ditches. Following these surveys, if significant changes occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If a change in a waterbody crossing were deemed to be necessary based on the survey, Pacific Connector would file a variance with the FERC and contact other relevant regulatory agencies prior to construction. With all regulatory approvals, Project construction would then move forward.

As a follow-up measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector would conduct on-the-ground monitoring of all stream crossings, regardless of risk, quarterly for 2 years after construction. Any adverse issues found during the monitoring with channel stability or habitat would be remediated. Additional monitoring would occur periodically over a 10-year period with implementation of remediation as needed.

Non-Flowing Streams and Ditches

Pacific Connector proposes to use several different methods to install the pipeline across waterbodies depending on site-specific conditions. Many of the waterbodies crossed by the pipeline are minor intermittent streams or ditches that are expected to be dry or nonflowing at the time of construction. For all intermittent waterbodies without flow at the time of construction, Pacific Connector would utilize standard upland, cross-country construction methods identified in Pacific Connector's ECRP. At these crossings, the depth of cover would be 5 feet (from the top of pipe to the bottom of streambed). In instances where the pipeline is below scour depth in bedrock, the top of pipe may be at any elevation below scour depth.

Flowing Streams and Waterbodies

For perennial waterbodies and intermittent waterbodies that are flowing at the time of construction, Pacific Connector has proposed the following crossing methods. These construction methods, along with FERC's *Procedures*, are designed to maintain water flow and minimize changes in waterbody flow characteristics.

Temporary Bridges at Stream Crossings

On most waterbodies, a temporary bridge would be installed prior to construction of the crossing to allow equipment and personnel to cross the waterbody. These temporary bridges would be removed when construction and restoration are completed for the project. If water is present in streambeds at the time of construction, Pacific Connector would utilize temporary construction bridges during all phases of construction to cross the waterbodies. In general, equipment/temporary bridges would not be installed on intermittent waterbodies which are dry at the time of construction; however, if a storm occurs that results in water in the streambed of the otherwise intermittent waterbody, no equipment would cross the waterbody until the streambed is dry or until a bridge is installed. Any proposed culverts and temporary bridges on federal lands would require design, review and approval by a Professional Engineer licensed in Oregon. Designs, including drawings, specifications, and other relevant materials, shall be approved by the agency of jurisdiction prior to installation of any temporary bridges. Site restoration details shall also be submitted for approval by the agencies as part of any temporary bridge or major culvert crossing plans on federal lands.

Soil would not be used to stabilize bridges, and the bridges would be constructed to span the entire OHWM of the waterbody. If it is not possible to span the OHWM with the bridges, a temporary culvert or pier may be required. The temporary crossings may be constructed of:

- equipment mats and culvert(s);
- equipment mats or railroad car bridges without culverts;
- clean rock fill and culverts; or
- flexi-float or portable bridges.

Minor or Intermediate Waterbody Crossings

We define minor crossings as waterbodies less than 10 feet across, while intermittent streams are between 10 and 100 feet wide. Virtually all minor or intermittent waterbodies (91 of the 97 perennial streams) would be crossed using dry open-cut methods as discussed below.

Dry Open-Cut Crossing Methods

Flume. The flume method typically is used to cross small to intermediate flowing waterbodies that are either fish-bearing or non-fish-bearing streams. The flume technique involves diversion of stream flow into a carefully positioned steel pipe of suitable diameter to convey the maximum flow of the stream across the work area, and ensures that stream flow rate is not interrupted.

Dam-and-Pump. With the dam-and-pump method, stream flow is diverted around the work area by pumping water through hoses over or around the construction work area. The goal of this technique is to create a relatively "dry" work area to avoid or minimize the transportation of heavy sediment loads and turbidity downstream of the crossing. This crossing method may be used on all waterbodies where stream flow can be diverted by pumping around the work area.

It is anticipated that most Reclamation facilities, including drains and laterals, would be dry or contain relatively little water at the time of construction. These crossings would generally be completed using a dry open cut crossing method (typically flume or dam and pump), but may be crossed using trenchless conventional bore methodology depending on actual conditions at the time of construction. Reclamation canal crossings would be completed using conventional bore methodology.

Major Waterbody Crossings

We define major waterbodies as being more than 100 feet wide. These waterbodies include, from west to east along the pipeline route, Coos Bay, Kentuck Slough, Coos River, Catching Slough, South Umpqua River, Rogue River, and Klamath River. The methods for crossing these major waterbodies are discussed below. Coos Bay is the only waterbody that would be crossed using a wet open-cut method. Kentuck Slough and Catching Slough would be crossed using conventional bores. The Coos River, Rogue River, and Klamath River would be crossed using an HDD. The South Umpqua River would be crossed using DP technology for the western crossing, and a diverted open-cut for the eastern crossing.

Wet Open-Cut Crossing Method

The wet open-cut method involves trench excavation, pipeline installation, and backfilling through a waterbody without controlling or diverting streamflow (i.e., the stream flows through

the work area throughout the construction period). The pipeline across the Haynes Inlet portion of Coos Bay, between about MPs 1.7R and 4.1R, would be constructed as a wet open-cut. The proposed route mostly avoids eelgrass beds and commercial oyster-growing colonies. This portion of Coos Bay has water depths between 10 and 3 feet; however, it becomes dry mudflats during low tides. A shallow water lay barge would be used to install the pipeline using "pipe push" methods. During the pipe push, the lay barge would remain stationary and the pipe joints would be floated out into the pre-dug trench. The pipe joints, which would be concrete coated, would be welded on the barge. The trench would be mostly be dug by marsh excavators with tracks around pontoons. Where deeper water allows, a bucket dredge would be used for trenching. The pipeline would be buried 5 feet deep; which would be below anticipated scour depth. Pipeline construction in Coos Bay would be limited to the ODFW recommended in-water work window between October 1 and February 15, when tides are lowest. Pacific Connector estimated it would take the duration of the fish window to install the pipeline across Haynes Inlet due to logistics of tidal fluctuations, potential mechanical issues affecting production, materials and supply and operation access to lay barges, and accommodation of other boat traffic. Work would be done in accordance with the *Report on Preliminary Pipeline Study Haynes Inlet Water Route.* That plan included the following BMPs:

- the contractor would develop a turbidity monitoring and management plan;
- where water depths allow, the dredge bucket would be kept below the water surface while placing excavated spoil along the trench in order to minimize turbidity;
- the trench would be backfilled quickly after the pipeline is lowered in to minimize the spreading of excavated spoil from tidal influence;
- turbidity curtains may be deployed, as practicable, in certain areas to protect sensitive resources such as oyster and eel grass beds;
- turbidity would be monitored, and not allowed to exceed the levels established in the CWA Section 401 water quality certification issued by the ODEQ;
- fueling of equipment would be done more than 150 feet way from open water, where practicable; and
- biological monitoring would be conducted in accordance with state and federal permit requirements.

If the water quality criterion is exceeded, ODEQ would ask for work to cease and BMPs to be adapted to ensure that the criterion would no longer be exceeded.

Diverted Open-Cut Crossing

The diverted open-cut crossing method would require an instream tie-in, but it would be made in the dry behind the diversion structure. During the crossing, initial trenching would first occur on the dry side of the river; however, depending on the water levels during the season, it may be necessary to install a diversion to push or divert the flow to at least the middle of the river. Pacific Connector is proposing a diverted open-cut at the eastern crossing of the South Umpqua River at MP 94.7 because the river is too wide to utilize other dry crossing methods (flume or dam-and-pump).

The South Umpqua River channel is sufficiently flat, wide, and shallow to divert all of the river flow to one side or bank of the river while work is proceeding in the dry on the opposite bank.

The eastern crossing of the South Umpqua River would require TEWAs to be located in the river and would require equipment to work in the river to place the diversion structures or dams to divert the river flow from one side of the river and then to the other. The diversion could be constructed using portadams, aqua dams, steel plates, plastic sheeting, and/or sand bags to divert the river's flow temporarily away from the work area in order to minimize contact between streamflow and the excavation and backfill activities. This would require Pacific Connector to place equipment within the stream to install, maintain, and ultimately remove the diversion structures. Pacific Connector estimates the crossing would take a minimum of 14 days to complete, including 3 to 4 days of instream work to install, rearrange, and remove the diversion structures.

Once the construction right-of-way has been isolated by the diversions and/or sediment control devices, trenching would proceed to approximately the middle of the river. Trench spoil would be stored within the stream channel below the diversion or sediment control structures to ensure that sedimentation from saturated materials does not flow back into the river. After the trench has been completed, a section of pipe would be placed in the trench. Trench boxes or another marker form would be placed at the end of the pipe section in the middle of the riverbed for the tie-in. The trench would be backfilled and the streambed restored to the original contour configuration, except for the immediate area around the tie-in.

The diversion structure would then be removed and rearranged to divert the flow temporarily to the other side or dry side of the river in order to minimize contact between streamflow and the excavation and backfill activities. This would again require Pacific Connector to place equipment within the stream in order to rearrange the diversion structures. Once the diversion structures have been properly reconfigured and extended beyond the tie-in location and the river flow diverted to the opposite side of the river, excavation for the other section of pipe would begin. Trenching would proceed across the river bed to the tie-in point in the middle of the river where it would be uncovered. Once the excavation is complete, the second pipe section would be carried in and tied into the first section. After the tie-in has been made, the streambed would be restored to its original contours and configuration and the diversions structures would be removed. Streambanks would be re-established and stabilized.

During the diverted open-cut at the eastern crossing of the South Umpqua River, multiple discharge pumps would be required to keep the tie-in area dry while the welds are being made and to control any flow seepage in the work areas. The discharge from this activity would occur to a straw bale discharge structure located in an upland area as far away from the river as possible to prevent any silt-laden water from flowing into the river.

The eastern crossing of the South Umpqua River was given a turbidity score of 4 – moderate. The evaluation concluded that turbidity generated during construction may exceed the Oregon water quality standard for short distances and short durations downstream from each crossing, either coinciding with construction across perennial waterbodies or in intermittent streams coincidental with autumn precipitation. There would be short-term turbidity increases for several hours during portions of the installation and removal of the diversion structures for the proposed diverted open-cut crossing of the South Umpqua River.

Direct Pipe Techniques

DP installation is a developing trenchless technology that can overcome problematic issues associated with the HDD crossing method because it provides a continuously supported hole during the excavation process; reduces pressure of drilling mud; and eliminates the borehole reaming and pullback requirements of an HDD. Pacific Connector proposes to go under I-5, the western crossing of the South Umpqua River (MP 71.3), Dole Road, and a railroad using a single DP operation. The DP at this location would be about 2,000 feet long and would be about 40 feet below the surface of the river. Being so deep under the river, the DP technique should avoid direct impacts on the aquatic environment.

DP techniques combine microtunnelling and HDD. An articulated, steerable microtunnel boring machine mounted on the leading end of the product pipe or casing would be jacked into position using a pipe thrusting machine mounted at or near the ground surface. To reduce the frictional resistance between the pipe and surround soil, over cutting would be employed (typically 1 to 2 inches). A slurry of bentonite clay would be used between the pipe and soil to reduce the frictional resistance as well as reducing the risk of collapse of the annulus around the pipe. Feasibility studies were conducted to verify that the DP installation would work at this location. Through proper design, inadvertent returns of the bentonite slurry would be reduced. Further geotechnical subsurface analysis would be conducted to refine the design prior to construction. Construction procedures would be implemented to prevent inadvertent returns of the bentonite slurry which include monitoring and maintaining the volumes, slurry fluid properties, and penetration rates.

Because the DP technology would install the pipeline deep beneath the river, there would be no direct effects to surface water. Work areas at entry and exit points may require grading during construction. As with all work areas near waterbodies, BMPs would be implemented to minimize effects to surface water. To contain and control inadvertent returns of the bentonite slurry at the entry and exit work zones, a berm would be built that may include hay bales or silt screen. Inadvertent returns would be cleaned and hauled or pumped to one of the drilling mud storage pits at the closest drilling site. In the event that slurry is detected in the river, appropriate resource agencies would be notified, and approved containment methods implemented to minimize impacts.

Conventional Borings

Boring is frequently utilized at road and railroad crossings. Conventional bores are proposed at Kentuck Slough (MP 6.3R), Catching Slough (MP 11.1), and the Medford Aqueduct (MP 133.4). The specific type of bore (i.e., jack and bore, slick bore, hammer, etc.) that would be utilized would be determined during a subsequent (refining) design phase of the Project and depends on construction characteristics, the type of soils present and the contractor's familiarity with the method. A successful bore under a waterbody would avoid impacts.

During a standard boring operation a bore pit is excavated on either side of the feature to be crossed at a depth sufficient to provide the desired depth of cover between the top of the pipeline and bottom of the feature to be crossed. A boring machine excavates the bore hole, spoil material is passed into the bore pit, and trackhoes then remove this spoil from the bore pit. Pipe is welded up and eventually pulled through the bore hole. Each section of the pipe is joined using full-penetration welding procedures and 100 percent of the welds are inspected using non-destructive testing procedures (x-ray) to form a continuous pipeline segment. Because conventional boring does not limit water migrating into the bore, an important factor in the design of launching and receiving pits is groundwater control. Dewatering systems using deep

wells or well points installed around the bore holes are frequently used. Trench boxes or sheet piling are often used to support the pit walls and to cut off groundwater inflows. Because bore pits on either side of the crossing would be required, there is some risk that high water tables may cause groundwater to infiltrate the bore pit walls, or create pressure from the exterior of the pit walls and cave in the bore pits. Shoring would be used as required to prevent bore pit cave in, and pit dewatering would be conducted as required. Water pumped from the pit would be discharged to an upland location designed to prevent turbid waters from reaching a waterbody. Erosion control measures would be implemented to prevent surface erosion at the pump discharge point.

Horizontal Directional Drills

The HDD method involves drilling under a feature and pulling the pipeline into place through the drillhole that has been reamed to accommodate the diameter of the pipeline. This procedure involves three main phases, pilot hole drilling, subsequent reaming passes, and pipe pullback. Pacific Connector is proposing to use the HDD method for the crossing of the Coos River (MP 11.1R), the Rogue River (MP 122.7), and the Klamath River (MP 199.4). By drilling deeply under a river, an HDD can avoid impacts. However, to deal with the potential for HDD failure or the possible release of drilling mud during an HDD, Pacific Connector developed two separate plans: *Failure Mode Procedures for the HDD Pipeline Installation Method* and *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*.[57]

Pacific Connector developed site-specific waterbody crossing plans.[58] The plan for the HDD under the Coos River showed it would be about 1,700 feet long, with a maximum depth of -80 feet under the river. The HDD under the Rogue River would be about 3,050 feet long, with the pipeline reaching a maximum depth of about -80 feet below the river. The HDD under the Klamath River would be about 2,300 feet long, with a maximum depth of about -80 feet under the river.

The HDD method has the potential for inadvertent releases of drilling mud into the waterbody. If a fault or crack in the overburden is encountered, the drilling mud can escape to the surface. This is referred to as a "frac-out." Drilling mud typically comprises bentonite clay and water, and can include additional additives specific to each drilling operation and would therefore be considered a pollutant. Pacific Connector would approve any additive compounds prior to use by the drilling contractor to ensure compliance with all applicable environmental and safety regulations. Toxic additives would not be used in the bentonite drilling mud for the Pacific Connector HDDs.

If an inadvertent return occurs, the HDD operation would be stopped temporarily to determine an appropriate response plan. Pacific Connector would attempt to determine the cause of the hydraulic fracture and inadvertent return and would implement procedures to correct or mitigate the situation. Those procedures may include:

- increasing the drill fluid viscosity;

[57] These plans were included in Appendix 2H attached to Resource Report 2 filed with Pacific Connector's June 2013 application to the FERC.
[58] These plans were included in Appendix 2E attached to Resource Report 2 filed with Pacific Connector's June 2013 application to the FERC.

- introduction of lost circulation materials back into the hole;
- installation of steel casings; or
- use of a grout mixture.

Any inadvertent release of drilling mud into a river would be monitored, and the appropriate agencies would be contacted, and approved corrective measures would be implemented.

GeoEngineers (2013h)[59] indicated that an HDD of the Coos, Rogue, and Klamath Rivers could be successfully implemented at the proposed crossing locations. However, Pacific Connector considered procedures to be implemented in the event of a failure. If the pilot hole collapsed, material falls into the hole, pipe becomes lodged in the hole, or there is a mechanical breakdown of the rig, the contractor would remove the pipe, and the HDD would be reattempted at the same location, or slightly offset. Pacific Connector would provide a technical consultant on-site during the HDD process to keep adequate documentation describing the events leading up to the failure. Pacific Connector would then submit this documentation to the necessary agencies for review and approval that the drill has failed at the present alignment. If the hole has to be abandoned, the contractor would grout the top 5 vertical feet of the hole on both the entry and exit side of the crossing with a cement type grout and the top 12 inches of the hole would be filled with native material or in accordance with the permit requirements.

Upon successful HDD completion, impacts on aquatic species and water quality would be avoided. The segment of the Rogue River at the pipeline crossing is not designated as a Wild and Scenic river segment. The Forest Service reviewed the crossing and determined that there would be no impact or effect to the Wild and Scenic River resources. Specifically, as the HDD crossing of the Rogue River would be underground, there is no potential to affect free-flow, scenery, recreation, fish, or wildlife values present in the river corridor, and therefore a Section 7 determination is not required (Macwhorter 2014).

General Pipeline Construction Impacts on Waterbodies and Proposed Mitigation Measures

Construction of the pipeline could result in minor, short-term impacts to waterbodies. These impacts could occur because of instream construction activities, use of access roads, or construction on slopes and riparian areas adjacent to stream channels. Clearing and grading of streambanks, removal of riparian vegetation, instream trenching, trench dewatering, and backfilling could result in the following potential effects:

- streambank modification;
- channel simplification;
- change in channel cross-sectional shape due to a decrease in natural bank stability;
- lateral channel migration resulting from decreased bank stability and loss of riparian vegetation;
- increased vertical streambed variability due to localized scour and fill in the area of disturbed streambed material, potentially resulting in disconnection with the floodplain possibly exposing the pipeline, thus resulting in additional in-channel work;

[59] The *HDD Feasibility Study* was attached as Appendix 2G of Resource Report 2 included with Pacific Connector's June 2013 application to the FERC.

- floodplain disturbance and riparian impacts resulting from both the initial construction work, which will require vegetation removal, and future impacts due to the management of woody vegetation in the vicinity of the pipeline;
- removal of spawning gravel from the streambed;
- temporary or permanent blockage of fish access due to physical changes of the stream channel;
- increased sedimentation;
- turbidity;
- increase in temperature, decreased dissolved oxygen concentrations;
- releases of chemical and nutrient pollutants from sediments; and
- introduction of chemical contaminants such as fuel and lubricants.

An increase in soil compaction and vegetation clearing could potentially increase runoff and subsequent streamflow or peak flows. Surface waters could be affected due to alteration of groundwater flow where the pipeline intersects waterbodies. To minimize potential adverse impacts along the construction right-of-way and at waterbody crossings, Pacific Connector would implement its ECRP during construction, restoration, and operation of its proposed facilities. Pacific Connector's ECRP is mostly compatible with the FERC's *Plan* and *Procedures*. Alternative measures requested by Pacific Connector are identified and reviewed in appendix I. For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans included as a supplement to appendix J (NSR 2014) would be used as directed by BLM and Forest Service monitors in conjunction with the FERC's EIs.

Construction activities at waterbody crossings would be conducted in accordance with all federal and state regulations and permit requirements. Pipeline installation at waterbodies would be conducted during low-flow periods whenever possible, and within the ODFW and NMFS recommended in-water construction windows. Construction during low flows would minimize sedimentation and turbidity, minimize streambank and bed disturbances, and limit the time it takes to complete instream construction. Specific impacts and proposed mitigation measures are discussed further below. Permits required for instream work may contain mitigation measures in addition to those discussed here. Pacific Connector would work with the COE and ODEQ to address impacts to water quality at stream crossings as part of the CWA Sections 401, 402, and 404 application process.

Turbidity

To minimize increases in turbidity and suspended sediment at waterbody crossings, Pacific Connector would utilize the dry crossing methods (i.e., flume and dam-and-pump) for most of the flowing waterbodies crossed by the pipeline (91 of the 97 perennial waterbodies). The remainder would be crossed by conventional bore, diverted open-cut, HDD, DP, and one instance of wet open-cut in the Coos Bay estuary. Turbidity and sedimentation impacts associated with dry open-cut methods are generally minor and temporary, lasting typically for only a few hours, and are associated with (1) installation and removal of the upstream and downstream dams used to isolate the construction area; (2) water leaking through the upstream dam and collecting sediments as it flows across the work area and continues through the downstream dam; (3) movement of in-stream rocks and boulders to allow proper alignment and installation of the flume and dams; and (4) when streamflow is returned to the construction work

area after the crossing is complete and the dams and flume are removed. Both "dry" techniques produce much less sediment in the water than alternative "wet" open-cut methods (Reid and Anderson 1999; Reid et al. 2002; Reid et al. 2004). Dry methods have been reported to produce one-seventh the suspended sediment in streams than "wet" methods (Reid et al. 2002). According to Pacific Connector, during construction of Williams Northwest Pipeline's Capacity Replacement Project in Washington State (completed in 2006), a total of 67 waterbodies were crossed using dry open-cut crossing methods (fluming and/or dam and pump). During these crossings, there was only one event where state water quality turbidity limits were exceeded. The exceedance occurred through a failure of the pumps during the night when a monitor was not on site to restart the pump.

Some turbidity would result during instream activities and when the water is diverted to the backfilled areas. GeoEngineers (2011) evaluated the potential risk of turbidity during construction across waterbodies. The qualitative evaluation was based on each affected waterbody's hydroperiod, presence of erodible clay and loam soils in streambanks, presence of clay in streambed (suspended clay contributes to turbidity), long-term stability of stream channels, and level/duration of construction effort and stabilization measures likely added at the time of construction. The turbidity risk was scored from 1 (low) to 5 (high). Of 420 waterbodies evaluated, 150 were scored with a low risk (score of 1 or 2) of turbidity increase over a 24-hour period and 270 were scored with a moderate risk (score of 3 or 4), generally due to soil erosion potential, presence of clay or mud, and/or the presence of steep slope or an incised channel that would require construction of a deep trench (GeoEngineers 2011).

Reid et al. (2004) measured suspended sediment downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings in North American streams. The study estimated that suspended sediment concentrations averaged 99 mg/l for flumed crossings and 23 mg/l at the dam-and-pump crossings. Reid et al. (2002) found that below four separate dam-and-pump crossings, mean suspended sediment was less than 20 mg/l within 30 meters (100 feet) downstream. Pacific Connector estimated that suspended sediment concentrations produced during pipeline construction during summer low-flow conditions may be highest for the six waterbodies crossed within the Coquille River fifth-field watershed (see Table 3.2-21 in Pacific Connector's Resource Report 3). However, even for these streams, nearly all dry crossing estimates of TSS would be less than 100 mg/l within 10 meters downstream of the crossing site. For the other fifth-field watershed crossings where estimates could be made, the average suspended sediment concentrations produced during fluming and dam-and pump construction would be near background suspended sediment levels (about 2 mg/l). Nearly all estimates were less than 10 mg/l between 10 and 100 meters downstream from construction sites.

Potential effects from turbidity from construction across streams are expected to be temporary and minor for the following reasons:

- all but six crossings of perennial streams would be completed either using dry open-cut crossing methods or methods that avoid direct impacts altogether;
- crossings would be completed during ODFW and NMFS recommended in-water work periods when the flow volumes and velocities will be low;
- most dry open-cut crossings would be completed in less than 48 hours;
- headwater streams are typically dominated by gravel/cobble substrates reducing the potential to generate turbidity during crossings;

- crossings would be scheduled individually, several days apart, and not completed concurrently; and
- erosion control BMPs, as outlined in Pacific Connector's ECRP, would be implemented to minimize the potential for erosion and sedimentation.

The *Turbidity-Nutrients-Metals Water Quality Impact Analysis* (GeoEngineers 2011) concluded that turbidity may exceed Oregon numerical water quality standards for short distances and short durations downstream from each crossing, either during and shortly after construction (in perennial waterbodies) or after fall rains begin (for intermittent and ephemeral streams). Such exceedances are allowed as part of the narrative turbidity standard if recognized in a CWA Section 401 water quality certification as long as every practicable means to control turbidity has been used.

Trenching within Coos Bay would result in elevated levels of TSS for the short-term period during the pipeline installation. Modeling was conducted using the DREDGE model of TSS during dredged material placement using an open clamshell dredge at different locations along the pipeline in Haynes Inlet (CHE 2013b). Model results suggest that concentrations of TSS over 50 mg/l would be limited to a region within 100 feet from actual placement. Concentrations of TSS up to about 15 mg/l would be limited to likely less than 300 to 500 feet from actual trenching, which are normal ranges for turbidity in Coos Bay during the fall and winter (Moffat & Nichol 2006a). Model results also indicated that suspended sediment concentrations would not exceed ambient suspended sediment concentrations by more than 10 percent within 350 feet or less of actual trenching. Pacific Connector estimated that assuming 800 feet of trench excavation per day with approximately 1,600 feet of trench open at any given time, modeling results indicated that turbidity would not exceed regulatory requirements at the point of measurement. The raised levels of turbidity in the bay would occur over the construction period (October 1 through February 15) to traverse the 2.5 miles across Haynes Inlet.

Streambank Protection and Restoration

During pipeline construction, clearing and grading of vegetative cover could increase erosion adjacent to streambanks. Alteration of the natural drainage or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks and the transportation of sediment carried by runoff water into the waterbodies. The extent of the impact would depend on sediment loads, stream velocity, turbulence, streambank composition, streambank vegetation, stream type, scour depth, and sediment particle size. To minimize these impacts, equipment bridges and mats would be used, as necessary, to provide stable work areas and isolate equipment from direct impact on waterbodies. TEWAs for spoil storage and pipe staging would be set back from the bank as discussed in the following paragraph, and temporary sediment barriers would be installed around disturbed areas, where necessary, in accordance with Pacific Connector's ECRP.

To restore streambanks on non-federal lands, Pacific Connector would explore options such as tree revetments, stream barbs/flow deflectors, toe-rock, and vegetation riprap before using hard bank protection. Streambanks would be returned to their preconstruction contours or shaped to a stable angle. Erosion control fiber fabric or matting would be installed on slopes adjacent to streams. On some banks, depending on site-specific conditions, fiber rolls may also be installed to stabilize bank toes. The streambanks would be seeded and woody riparian vegetation planted

for stabilization according to Pacific Connector's ECRP. Pacific Connector does not anticipate that riprap would be required for streambank stabilization, but if used would be limited to the areas where flow conditions preclude effective vegetation stabilization techniques. Bioengineering would be preferred, so riprap would be a last resort intended to limit damage.

For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans, included as a supplement to appendix J (NSR 2014), would be used as directed by BLM and Forest Service monitors in conjunction with the FERC's EIs. These restoration plans have been designed to ensure that restoration and revegetation of these crossings are consistent with ACS objectives as described in the relevant BLM and Forest Service LMPs.

Sedimentation Control

Pacific Connector would install temporary equipment bridges across perennial or intermittent waterbodies flowing at the time of construction to prevent sedimentation caused by construction and vehicular traffic. The ECRP outlines the erosion control procedures that Pacific Connector would utilize.

Trench spoil excavated from within the waterbody would be placed at least 10 feet from the water's edge or in a TEWA. In some waterbodies, native washed streambed boulders, cobbles, and gravels removed from the surface of the trench may be stored within the construction right-of-way in the streambed in areas isolated from streamflow (i.e., within the dammed area for flumes or dam-and-pump crossing). Storing this material in the streambed would minimize handling and help to ensure the material would be available for backfill and streambed restoration. However, those specific cases would require a modification from Section V.B.4.a. of the FERC's *Procedures* (which require spoil store more than 10 feet from the edge of waterbody). Staging areas and additional spoil storage areas would be located at least 50 feet away from waterbody boundaries, where topographic conditions and other site-specific conditions allow. Where topographic conditions do not allow a 50-foot setback, spoil storage areas would be located at least 10 feet from the water's edge. Sediment control devices, such as silt fences and straw bales, would be placed around the spoil piles to prevent spoil flow back into the waterbody.

Trench Dewatering

During construction, the open trench may accumulate water either from groundwater intrusion or precipitation. Intermittent streams and ditches that are dry on the surface may contain water below the surface. As such, the trench may require dewatering to allow for proper and safe construction. However, the construction schedule would generally coincide with the period when the soils in these areas are dry, thereby minimizing the amount of trench dewatering. During trench dewatering, water would be pumped from the trench into stable, vegetated areas through a straw bale structure or filter bag. Typically, dewatering activities are only necessary in localized high groundwater areas for short-term periods (a few days) to allow access to the trench, such as where tie-in welds are required. Therefore, potential effects from dewatering activities (i.e., erosion/sedimentation effects) are temporary. No vegetation clearing outside of the approved work spaces would be required. Trench dewatering structure locations would be selected in the field in response to actual conditions encountered. The rate of flow from dewatering pumps would be regulated to prevent erosion from runoff, and dewatering would be conducted in a manner designed to ensure that water is allowed to infiltrate into the ground rather

than flow over the surface whenever possible. If trench dewatering does result in surface runoff, it would be conducted to ensure that turbid water does not reach a surface water of the state, and does not result in the deposition of sand, silt, and/or sediment. All materials used to filter water from the trench would be cleaned up and the site restored after dewatering is complete. The ECRP provides additional information regarding dewatering and the BMPs that would be implemented to minimize potential sedimentation.

Pacific Connector proposes a winter construction schedule for the Klamath Basin area between approximately MPs 188 and 228.13 to minimize impacts to agricultural activities and to minimize construction across areas of high groundwater due to irrigation activities that would increase the instances of trench dewatering. The *Winter Construction Plan for the Klamath Basin* is included in Appendix 1E of Pacific Connector's June 2013 FERC Application.

Potential sedimentation impacts would be reduced due to the dry climate of the area and the colder winter climate of the area would reduce runoff potential during frozen periods. Additionally, Pacific Connector would utilize BMPs as necessary as discussed in the ECRP to prevent sedimentation into waterbodies or wetlands. Mulch would also be used to apply effective ground cover to minimize erosion potential. Effective ground cover is considered to be the amount of cover necessary for maintaining a disturbed site in a low hazard category for erosion.

Blasting

Blasting may be required for pipeline construction in areas where hard, non-rippable bedrock occurs within the trench profile (see section 4.2.2.5). Blasting could alter the in-channel characteristics and hydrology of the stream, potentially decreasing flows due to increased infiltration where bedrock would be fractured. Where blasting is required in streambeds, Pacific Connector proposed to utilize the dam-and-pump crossing method so that blasting activities can be completed in the dry to avoid or minimize potential impacts to aquatic species during in-water blasting. State permits would be obtained for blasting in waters of the state in coordination with ODFW and ODEQ.

Pacific Connector developed a *Blasting Plan* in consultation with the BLM, Forest Service, and Reclamation. Blasting-related operations including obtaining, transporting, storing, handling, loading, detonating, and disposing of blasting material, drilling, and ground-motion monitoring would comply with applicable federal, state, and local regulations and permits. To reduce impacts, a site-specific blasting plan would be developed by the blasting contractor prior to work. The site-specific blasting plans would be reviewed and approved by appropriate agencies. A permit from the COE or ODEQ may be required for any in-water blasting. Additional discussion of potential blasting impacts and Pacific Connector's proposed measures to minimize impacts is included in section 4.6.2, where the effects of in-stream blasting on fish are discussed.

Spills of Hazardous Materials

Spills of hazardous materials could occur during equipment fueling and storage of oil, fuel, or other materials near waterbodies. Leaks from equipment and vehicles could cause potential impacts on surface water quality.

Hazardous materials, chemicals, fuels, and lubricating oils would be stored in accordance with Pacific Connector's ECRP and SPCCP. Pacific Connector has developed a general SPCCP that describes measures to be implemented by Pacific Connector's personnel and contractors to prevent and, if necessary, control any inadvertent spill of hazardous materials such as fuels, lubricants, and solvents that could affect water quality. This general SPCCP would be updated with site-specific information before construction. All Project employees would receive SPCCP training.

The SPCCP includes a measure to prohibit the storage of hazardous substances, chemicals, fuels, and lubricating oils within 150 feet of waterbody banks or wetlands. Restricted areas for storage of these materials would be clearly marked in the field. These activities would only occur closer if the EI finds, in advance, no reasonable alternative and the contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill and the procedures outlined in Pacific Connector's SPCCP are followed. Pacific Connector has proposed containment structures for pumps to prevent fuel spills from entering waterbodies. All hazardous materials would be handled in accordance with the SPCCP.

Channel Migration and Scour

Fluvial erosion represents a potential hazard to the pipeline where streams are capable of exposing the pipe as a result of channel migration, avulsion, widening, and/or streambed scour. Pacific Connector had a consultant conduct a study of stream migration and scour for the waterbodies crossed by the pipeline route.[60] Ten crossings were identified as Level 2 (listed below on table 4.4.2.2-8), which have large or complex channels with a high potential for migration, avulsion, or scour, and required site-specific additional analyses.

TABLE 4.4.2.2-8

Streams Crossed by the Pacific Connector Pipeline Route That Have a High Potential For Scour or Migration

Watershed	Stream Name	MP	Maximum Scour Depth	Other Hazards	Mitigation Measures
Coquille	Middle Park Creek	27.0	10.5 feet	Channel widening	Dry open-cut
Coquille	South Fork Elk Creek	34.5	6.0 feet	Channel widening	Bury in bedrock
S. Umpqua	Olalla Creek	58.8	7.5 feet	Migration	Bury in bedrock
S. Umpqua	Western Crossing of the South Fork Umpqua River	71.3	unknown	unknown	DP
S. Umpqua	North Myrtle Creek	79.1	6.5 feet	Migration	Bury in bedrock
S. Umpqua	South Myrtle Creek	81.2	unknown	Migration	Bury in bedrock
S. Umpqua	Eastern Crossing of the South Fork Umpqua River	94.7	8.7 feet	unknown	Diverted open-cut
Rogue	West Fork Trail Creek	118.9	unknown	unknown	Bury in bedrock
Rogue	Rogue River	122.7	6.9 feet	Migration	HDD
Rogue	North Fork Little Butte Creek	145.7	unknown	unknown	Dry open-cut

GeoEngineers (2013f) made the following recommendations to mitigate for scour or channel migration at the 10 waterbody crossings with high risk factors:

- bury the pipeline in bedrock, where feasible;

[60] GeoEngineers, Inc., 29 May 2013, *Channel Migration and Scour Analysis for the Pacific Connector Gas Pipeline Project in Southern Oregon*, prepared by E.T. Barnett, J.M. Ambrose, and T. Hoyles, filed with Pacific Connector's June 2013 application to the FERC as a stand-alone attachment to the copy of the JPA.

- where bedrock is not encountered, bury the pipeline below the estimated depth of streambed scour; and
- within floodplains adjacent to migrating streams, bury the pipeline below the 50-year channel projections.

We conclude that these measures should adequately mitigate the risk of stream scour on the pipeline.

Dust Control

While it is not possible to know how much water would be needed for dust suppression on the pipeline construction right-of-way, during dry seasons, Pacific Connector estimates that there would be approximately five 3,000-gallon water trucks per construction spread on a given day. Pacific Connector anticipates using five construction spreads, which would total 75,000 gallons for 25 water trucks per day. Watering trucks would spray only enough water to control the dust or to reach the optimum soil moisture content to create a surface crust. Runoff should not be generated during this operation. Water may be obtained through municipal sources or withdrawn from surface water or groundwater sources on non-federal lands. All appropriate permits/approvals would be obtained prior to withdrawal. Table 4.4.2.2-9 lists potential dust control water sources that have been identified by Pacific Connector.

TABLE 4.4.2.2-9

Potential Dust Control Water Sources for the Pacific Connector Pipeline

County	Approximate MP	Source
Coos	16.5	Aqueduct Lake
Coos	37.0	Brewster Lake (WI-602)
Douglas	50.2	Lang Creek Reservoir
Douglas	79.0	Big Lick Reservoir
Jackson	128.0	Indian Lake Reservoir
Jackson	133.4	Eagle Point Irrigation Canal Crossing
Jackson	141.0	Star Ranch Lake
Jackson	144.0	Unnamed Reservoir
Jackson	145.0	Gardener Reservoir
Klamath	228.5	High Line Canal
Klamath	228.7	Capek Reservoir
Klamath	229.4	Low Line Canal

Additionally, Pacific Connector has indicated it may utilize a synthetic product such as Dustlock®, in addition to water, for dust control. Dustlock is a naturally occurring byproduct of the vegetable oil refining process. Dustlock penetrates into the bed of the material and bonds to make a barrier that is naturally biodegradable, ensuring that the surrounding ground and water are not contaminated, and minimizing any potential effects to fish and wildlife. According to the product safety data sheet, there are no known health risks to fish and wildlife resources by the use of Dustlock. However, Pacific Connector would not use Dustlock within 150 feet of riparian areas. Pacific Connector developed a *Fugitive Dust Plan* in consultation with BLM and Forest Service.

Hydrostatic Testing

After backfilling, the pipeline would be hydrostatically tested in accordance with DOT regulations to ensure that the system is capable of operating at the maximum operating pressure. Pacific Connector estimates that approximately 62 million gallons of water would be required to test the pipeline.

Water for hydrostatic testing would be obtained from commercial or municipal sources, private supply wells, or from surface water right owners (see table 4.4.2.2-10). If water for hydrostatic testing would be acquired from any source other than a municipality, including surface water sources, Pacific Connector would obtain all necessary appropriations and withdrawal permits, including from the ODWR, prior to use. As part of this process, ODWR would have the applications reviewed by ODEQ and ODFW to determine if there are concerns about the impact water withdrawals may have on water resources, (including concerns relating to the timing, seasonality, and method of withdrawal), as well as water quality and/or fish and wildlife species and the habitat, respectively. ODWR would provide public notice and opportunity to comment on the applications.

TABLE 4.4.2.2-10

Potential Hydrostatic Source Locations

County	MP	Source		Owner	Volume (gal)
Coos Bay Frontal Pacific Ocean (1710030403)					
Coos	1.47R	Coos Bay -North Bend Water Board		Coos Bay North Bend Water Board	14,204,643
Middle Fork Coquille River (1710030501)					
Douglas	50.20	Water Impoundment	Kinnan Lake	5-J Limited Partnership, Donald R. Johnson 29080601300	2,098,651
Olalla Creek-Lookingglass Creek (1710030212)					
Douglas	55.90	Water Impoundment	Ben Irving Reservoir	Douglas County Public Works/ Looking Glass Olalla Water District/ Winston-Dillard Water District	1,390,902
Douglas	58.75	Looking Glass Olalla Water District (Olalla Creek Crossing)		Looking Glass Olalla Water District	2,098,699
Clark Branch-South Umpqua River (1710030211)					
Douglas	71.30	S. Umpqua River Crossing #1		Oregon Department of Water Resources	5,572,843
Days Creek-South Umpqua River (1710030205)					
Jackson	94.73	S. Umpqua River Crossing #2		Oregon Department of Water Resources	6,695,648
Shady Cove-Rogue River (1710030707)					
Jackson	122.5	Rogue River Crossing		Oregon Department of Water Resources	8,770,257
Little Butte Creek (1710030708)					
Jackson Jackson	146.70	N. Fork Little Butte Creek Crossing		Medford Irrigation District/ Rogue River Valley Irrigation District	1,883,276
Jackson	161.40	Water Impoundment	Fish Lake	United States, Bureau of Reclamation	3,420,951
Fourmile Creek (1801020302)					
Klamath	168.90	Water Impoundment	Lake Of The Woods National Forest Lake	Oregon Department of Water Resources (Bureau of Reclamation)	4,102,136
John C Boyle Reservoir-Klamath River (1801020602)					
Klamath	184.30	Water Impoundment	John C. Boyle Reservoir	Oregon Department of Water Resources	2,282,231

TABLE 4.4.2.2-10

Potential Hydrostatic Source Locations

County	MP	Source		Owner	Volume (gal)
Lake Ewauna-Klamath River (1801020412)					
Klamath	189.00	Water Impoundment	Keno Reservoir	Oregon Department of Water Resources	3,359,703
Klamath	199.20	Klamath River			3,308,134
Mills Creek–Lost River (1801020409)					
Klamath	228.1	High Line Canal		Malin Irrigation District	2,923,230
				Total	**62,111,304 (190.61)**

The pipeline would be tested in approximately 75 sections, each with varying lengths and water volume requirements. During the test, it may be necessary to discharge water at each of the section breaks; however, discharges would be minimized and water would be conserved as much as practical by cascading water between test sections when feasible (pumping from one segment to the next). When discharged, the test water would be released adjacent to the construction right-of-way through an energy dissipating device and a straw bale filter or sediment bag. Test water would not be discharged directly into surface waters. Pacific Connector would apply for permission to discharge the hydrostatic test water with ODEQ. Hydrostatic discharge locations have been located in upland areas where feasible, and at an appropriate distance from wetlands and waterbodies to promote infiltration and to ensure that sedimentation of wetlands, waterbodies, or other sensitive areas do not occur (identified in table D-3 in appendix D). Pacific Connector's EIs would visually monitor the release of hydrostatic test water and trench dewatering activities to ensure that no erosion or sedimentation occurs. In addition, the EIs would ensure that turbid water is not discharged to waters of the state. If an EI determines that a discharge is occurring from trench dewatering, the receiving water would be visually monitored for turbidity. If a turbidity plume is observed, the trench dewatering operations would be immediately adjusted/reinstalled/ maintained to ensure that the discharge of sediment to surface water is stopped and water quality standards are not exceeded.

In addition to the 75 test header section breaks located within the construction right-of-way or TEWAs (identified in table D-3 in appendix D), Pacific Connector identified seven potential hydrostatic discharge locations outside of the construction right-of-way and TEWAs. In these seven locations, small brush or trees may be cleared by a rubber-tired rotary or flail motor (brush hog) or by hand with machetes/chainsaws. A rubber-tired or track hoe would be utilized to lay the discharge line and to remove the saturated hay bales or filter bags upon completion of hydrostatic discharge.

Pacific Connector developed a *Draft Hydrostatic Testing Plan* in consultation with the BLM and Forest Service as well as the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute (Portland State University). The plan includes measures to prevent the transfer of aquatic invasive species and pathogens from one watershed to another. Where possible, test water would be released within the same basin from which it was withdrawn. However, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same basin where the water was withdrawn in all cases. Pacific Connector originally proposed to test the water to be used for the absence of a potential invasive species or forest pathogen. However, the test results would only confirm the absence in the sample aliquot and would not confirm the potential presence of an invasive species within the entire waterbody source. Since it would be

impractical to test the entire volume of hydrostatic test water required, it was concluded that Pacific Connector should assume that all non-municipal test water sources could contain a potential invasive species and that water treatment methods should be implemented to prevent the potential spread of aquatic invasive species or forest pathogens. Therefore, if hydrostatic test source water cannot be returned to the same water basin from where it was withdrawn, Pacific Connector would employ an effective and practical water treatment method (chlorination, filtration, or other appropriate method) to disinfect the water that would be transferred across water basin boundaries. The hydrostatic test water would be treated after it is withdrawn and prior to hydrostatic testing. The hydrostatic test water treatment process would incorporate screening during water withdrawal that would meet NMFS and ODFW criteria to prevent the entrainment of small fish. Based on the various chlorine treatment methods for the various aquatic invasive species and pathogens that potentially may occur within identified water sources, Pacific Connector proposes to use a treatment of 2 mg/l free chlorine residual with a detention time of 30 minutes. Chlorinated water would be discharged upland at least 150 feet from wetlands and waterbodies and not directly to surface water features or wetlands. Water would be discharged according to ODEQ requirements for chlorinated water discharges as noted in the *Hydrostatic Test Plan*. All discharge locations would be monitored after construction for potential noxious weed establishment and treated if necessary.

Restoration of Streambeds

After the pipeline has been installed, the trench would be backfilled with the native material that was excavated from the trench. Backfill material would match the natural streambed material size, gradation, and composition as closely as possible. The streambed profile would be restored to pre-existing contours and grade conditions. Section V.C.1 of the FERC's *Procedures* requires that the upper 1 foot of the trench should be backfilled with clean gravel or native cobbles in all waterbodies that contain cold water fisheries. However, Pacific Connector has requested a modification, where the existing substrate is not gravel or cobbles and site access is limited, only native materials removed from the stream be used for backfill. We have recommended that Pacific Connector provide site-specific justifications from this modification to our *Procedures*. Any subsequent need to place fill within a stream would require a permit from COE under Section 404 of the CWA and ODSL under the ORS.

For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans included as a supplement to appendix J (NSR 2014) would be used as directed by BLM and Forest Service monitors in conjunction with FERC's EIs. These restoration plans have been designed to ensure that restoration and revegetation of these crossings are consistent with ACS objectives as described in the relevant BLM and Forest Service land management plans.

Peak Flows

Vegetation management or clearing activities that create sizable canopy openings can increase water yields (Forest Service 2000). Compared to locations lacking large canopy openings, sizeable canopy openings can result in decreased evapotranspiration (due to decreased leaf area), decreased interception by the canopy, increased snow accumulation and melt rates, greater snow accumulation and more rapid snowmelt, resulting in increased peak flows (Forest Service 2008). Clearing can also reduce cloud water interception, having the opposite effect (Forest Service 2008). The pipeline would cross 15 fifth-field watersheds with portions located in the transient

snow zone (2,000- to 5,000-foot elevation range), affecting a total of 2,121 acres within the transient snow zone. The portion affected within the transient snow zone represents about 0.16 percent of the total acreage of these 15 watersheds. Increases in peak flows generally diminish with decreasing intensity of percentage of watershed harvested and the magnitude of any effect diminishes with increasing basin size (Forest Service 2008). In other words, increased harvesting causes more extreme peak flows, and the larger the basin size, the lower the magnitude of effects if comparing from the same harvest acreage in a smaller basin. Only clearing that permanently alters canopy cover could affect long-term peak flows; disturbance in existing agricultural and rangeland areas, grasslands, and shrubs (where the restored vegetation would provide similar cover) would have no long-term effects. Therefore, when only considering forest clearing within these 15 watersheds, pipeline disturbance to forested vegetation types would represent only 0.07 percent of the total area of these watersheds.

The greatest forest clearing disturbance within the transient snow zone on a percentage basis would occur within the Spencer Creek watershed. The pipeline would disturb a total of about 126 acres of forest within the 21,913-acre transient snow zone within the 54,242-acre watershed. The pipeline would disturb 0.57 percent of the watershed that is within the transient snow zone. When considering forest vegetation disturbance within the transient snow zone, the pipeline would also have the highest percentage of forested disturbance within the Trail Creek Watershed, disturbing about 107 acres of forested vegetation types within the 30,107-acre transient snow zone in the 35,343-acre Trail Creek watershed, which represents 0.36 percent of the total watershed area in the transient snow zone (see Table 2A-11 in Pacific Connector's Resource Report 2).

The Little Butte Creek fifth-field watershed would have the largest area disturbed by the Project that is located within the transient snow zone with about 434 acres, including 298 acres of forested vegetation, 54 acres of grass-shrub-sapling or regenerating young forest, 33 acres of Oregon white oak forest, and 103 acres of grasslands or shrublands. Thirty-two acres of disturbance would occur within two minor land use types including industrial areas and roads. The forest clearing (about 298 acres) in the transient snow zone represents 0.19 percent of the total watershed area (see Table 2A-11 in Pacific Connector's Resource Report 2).

Because of the pipeline's linear nature, disturbance within the transient snow zone would occur across a broad number of watersheds and various vegetation types and affect a relatively small percentage of the watersheds and the total area of the watershed within the transient snow zone. Although permanent canopy removal in forested areas along the right-of-way would increase the potential for snow accumulation, it is not expected that forest clearing within any of the watersheds would have a measurable influence on peak flows. In addition, Pacific Connector's proposed design measures are intended to ensure that impacts would have an immeasurable effect on forest hydrology. These measures include:

1. Where feasible, the pipeline route has been primarily aligned along ridgelines and watershed boundaries where it would traverse the Coast and Cascade Mountain Ranges. This alignment would minimize clearing effects within any single watershed.
2. The size of construction work areas have been minimized to the extent practical to minimize clearing.

3. After construction, disturbed areas would be returned to a stable, approximate original contour configuration, to restore preconstruction drainage patterns.
4. BMPs would be used to minimize runoff and erosion and to promote infiltration. These BMPs include:
   - compactions mitigation, surface roughening, and use of waterbars on slopes to promote onsite infiltration and to minimize runoff;
   - applying slash or mulch on disturbed areas to ensure effective ground cover requirements are achieved; and
   - replanting cleared forested areas in temporary construction areas during restoration.

Stream Temperatures

During pipeline construction, removal of riparian vegetation along streambanks that serves as shade can increase the temperature of waterbodies. However, available information on the effects of linear pipeline crossings of streams on water temperature indicates there is little to no change. Typically pipeline rights-of-way are narrow, and water would flow quickly past the crossing locations, with greater volumes in larger streams. Therefore, streamwater exposure to the lack of shade at pipeline crossings would be temporary and limited. In addition, stream temperatures are influenced by the infusion of fresh water from springs, seeps, and other groundwater sources, in addition to surface tributary runoffs, both upstream and downstream of pipeline crossings.

Pacific Connector conducted its own research on the potential for its pipeline crossings to increase stream water temperatures. One study (NSR 2009) was conducted on six streams on NFS lands and is discussed later in this section (section 4.4.4.2). Another study (GeoEngineers 2013i)[61] examined 13 stream crossings on non-federal lands, listed on table 4.4.2.2-11.

TABLE 4.4.2.2-11

Predicted Temperature Modeling at Selected Stream Crossings Along the Pacific Connector Pipeline Route

MP	Watershed	Stream	Width	Ambient Water Temperature	Post-Construction Water Temperature
10.3	Coos	Stock Slough	16 feet	56.30 °F	56.32°F
17.5	Coos	Catching Slough	257 feet	56.30°F	56.30°F
23.1	Coquille	North Fork Coquille River	21 feet	74.30°F	74.23°F
29.2	Coquille	Tributary to East Fork Coquille River	6 feet	58.82°F	58.78°F
29.5	Coquille	Tributary to East Fork Coquille River	6 feet	59.72°F	59.72°F
29.9	Coquille	East Fork Coquille River	62 feet	64.22°F	64.24°F
32.4	Coquille	Elk Creek	8 feet	58.46°F	58.47°F
58.8	South Umpqua	Ollalla Creek	78 feet	58.46°F	58.48°F
73.2	South Umpqua	Richardson Creek	21 feet	58.46°F	58.59°F
84.2	South Umpqua	Wood Creek	8 feet	58.46°F	58.5°F
94.7	South Umpqua	Eastern Crossing South Fork Umpqua River	205 feet	58.46°F	58.49°F
132.8	Rogue	Quartz Creek	2 feet	58.64°F	58.94°F
212.1	Lost River	Lost Rover	118 feet	70.70°F	70.68°F

[61] GeoEngineers, Inc., 29 May 2013, *Thermal Impacts Assessment, Pacific Connector Gas Pipeline Project, Coos, Douglas, Jackson, and Klamath Counties, Oregon*, prepared by E.T. Barnett, J.M. Ambrose, and T. Hoyles, attached as a stand-alone document with the copy of the JPA included in Pacific Connector's June 2013 application to the FERC.

GeoEngineers (2013i) modeled thermal impacts at representative stream crossings where riparian shading vegetation would be removed within the construction corridor and where it would be affected within the 30-foot maintenance corridor over the long term. The maximum predicted water temperature increase was 0.3°F at one crossing location (Quartz Creek). However, this was the smallest creek crossing examined; only two feet wide. Modeling results indicate that within a short distance downstream from all crossings, instream water temperatures would return to ambient conditions. Based on the predictive modeling presented in the GeoEngineers (2013i) report, the short-term post-construction increase in thermal loading in the South Umpqua basin based on the combined Cow Creek, Olalla/Lookingglass Creeks, and South Umpqua River was estimated at 0.022 percent at the basin-wide scale. The longer term thermal loading (prior to mitigation) is predicted to be 0.004 percent increase for the basin. Additional analysis regarding stream temperature impacts associated with perennial stream crossings can be found in section 4.6 and appendix J.

To minimize the potential effects of pipeline construction on stream temperatures by the removal of riparian vegetation, Pacific Connector has incorporated the following mitigation measures into its project design:

- narrowing the construction right-of-way at waterbody crossings to 75 feet where feasible based on site-specific topographic conditions;
- locating TEWAs 50 feet back from waterbody crossings to minimize impacts to riparian vegetation, where feasible; and
- replanting the streambanks after construction to stabilize banks and to re-establish a riparian strip across the right-of-way for a minimum width of 25 feet back from the streambanks.

Based on these mitigation measures and the studies provided by Pacific Connector, we conclude that the construction and operation of the pipeline would have no discernible effect on stream temperature.

Hyporheic Exchange

The hyporheic zone is a region beneath and alongside a stream bed where there is mixing of shallow groundwater and surface water. The flow dynamics and behavior in this zone is recognized to be important for surface water and groundwater interactions, as well as fish spawning, among other processes. Pacific Connector conducted a hyporheic exchange analysis on the waterbodies and ditches crossed by the pipeline (GeoEngineers 2013d). The assessment focused on determining if construction has the potential to affect the structure and function of the hyporheic zone, and if so, which stream crossing may be most sensitive to changes in hyporheic zone structure and organization. Historically, pipeline construction has not typically been considered as having a potential effect on hyporheic zone function, presumably because of the nature of the construction process having relatively limited, localized and temporary change to the subsurface conditions under streams and rivers. It is difficult to measure hyporheic exchange without detailed site-specific study, but qualitative observations of bed and bank material, stream gradient, location within a watershed, and morphological features can help indicate whether a stream has an active and functional hyporheic zone. GeoEngineers (2013d) developed weighting factors to assign criteria of high, moderate, and low sensitivity to the crossing locations. The

analysis used these qualitative parameters to rank how sensitive a stream crossing may be to potential hyporheic zone alteration.

Thirteen stream crossings were categorized as having a high sensitivity to hyporheic zone alteration, which would suggest a high likelihood of a functioning hyporheic zone, mostly associated with larger waterbodies with greater floodplain widths and instream morphologic features. Two of the 'high' sensitivity crossings, including the Coos River crossing at MP 11.13R and the Rogue River crossing at MP 122.65, would be crossed by HDD rather than open trenching across the stream channel.

A "moderate" sensitivity indicates that the stream crossing displays some indicators that a hyporheic zone is active and functional. Approximately 118 crossings fit this category, most of them upper to middle watershed streams. A "low" sensitivity indicates that the stream crossing does not likely support either an extensive or functional hyporheic zone. Approximately 169 stream crossings fit into this category. Many of these low scoring stream crossings are bedrock-controlled, are dominated by finer-grained material, or are canals and ditches. Eleven stream crossings were not assigned any point values or ranking due to there being no channel or channel forming processes observed at the crossing location in the field.

Water quality parameters, including water temperature and intragravel dissolved oxygen, might potentially be affected at crossings where hyporheic exchange is extensive and active. Thus, streams with a "high" and "moderate" sensitivity would be the streams where water quality could potentially be compromised due to alteration of the hyporheic zone. Those crossings with a 'low' sensitivity indicate that little hyporheic exchange is currently operating in the stream, and thus would not likely impact water quality. Overall, the majority of the Pacific Connector pipeline crossings fall into a "low" sensitivity category, where water quality (including water temperature and intragravel dissolved oxygen) is unlikely to be significantly or measurably altered by pipeline construction.

The pipeline construction methods and BMPs described in the GeoEngineers (2013d) report, as well as the site-specific restoration plans for crossings of perennial stream on federal lands (NSR 2014) further reduce the potential for pipeline construction to adversely alter the hyporheic zone. Specifically, the BMPs which are of particular importance to reduce the potential impacts to the hyporheic zone, include the following:

- native material that is removed from the pipeline trench during excavation across stream channels would be used to backfill once the pipe is in place in order to minimize potential changes to preconstruction permeability; and
- trench plugs would be installed at the base of slopes adjacent to wetlands and waterbodies and where needed to avoid draining of wetlands or affecting the original wetland or waterbody hydrology.

While the potential impact of pipeline construction on hyporheic exchange is considered to be low at all stream crossings considering the proposed construction methods, Pacific Connector proposes these additional measures to further reduce the potential for even localized impacts to water quality from hyporheic exchange at the stream crossings identified as having high hyporheic sensitivity:

- Document streambed stratigraphy prior to construction to aid in site restoration. Such documentation would be conducted by staff trained in recognizing and observing river channel processes. If done during construction, this may be performed by the EI after receiving suitable training.
- As described in the *Stream Crossing Risk Analysis* (GeoEngineers 2013c) and the *Site-Specific Stream Crossing Prescriptions for Perennial Streams on BLM and National Forest System Lands* (NSR 2014), once the Project is approved and all permits and route access obtained, all stream crossing would have a pre-construction survey to confirm and clarify conditions developed in the risk analysis. This survey would be done by a team of professionals (including representatives from the BLM, Forest Service, and Reclamation as appropriate for sites on federal lands) qualified to assess terrestrial and aquatic habitat and the geotechnical and geomorphic conditions relative to pipeline construction across stream channels and ditches. Following these surveys if significant changes occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If a change in a waterbody crossing were deemed to be necessary based on the survey, Pacific Connector would file a variance with the FERC and contact other relevant regulatory agencies prior to construction. For crossings on federal lands, the BLM would require Pacific Connector to comply with all conditions of the Right-of-Way Grant prior to authorization to proceed. With all regulatory approvals, Project construction would then move forward.
- Segregate active streambed gravels and cobbles from underlying streambed materials (including fractured bedrock) to their natural depth and replace gravels/cobbles to this natural pre-construction depth.
- Below active stream gravels, replace native material in a manner to match upstream and downstream stratigraphy and permeability to the maximum extent practicable.

Existing Access Roads

Of existing roads that would be used as access for the Project, approximately 59 segments would be within riparian areas (i.e., within 100 feet of a stream). Of these segments, 23 would cross streams, with approximately 6 of these on perennial streams, the rest on intermittent or ephemeral channels. All stream crossings are currently planned to use the existing crossing facility (e.g., bridge, culvert, ford), but possibly 15 of these may either use a temporary crossing bridge (13) or replace an existing culvert (2). In most areas, no additional riparian clearing would occur, but a total of 7 locations are expected to have some riparian vegetation removed, generally consisting of understory brush with no or few trees removed. Four riparian cleared areas would be on intermittent and 3 on perennial streams. The cleared areas would be small as they result from slight road widening or formations of turn-outs. Roads are typically 10 to 20 feet wide with turn-outs of lesser widths. While the use and expansion of these roads may contribute sediment in the stream crossing areas from the installation of temporary bridges, sediment effects should be minor at the site-specific levels.

Where road improvements would be required, Pacific Connector would ensure that existing drainage features (culverts, ditches, dips, grade sags, etc.) continue to function properly or would employ suitable substitute measures to ensure that drainage is controlled to prevent off-site erosion or other resource damage. Road surfaces during the late fall and winter are generally

more susceptible to rutting because of moisture conditions and freeze/thaw cycles and have a higher potential for increased erosion and sediment potential. To minimize potential resource damage, Pacific Connector would install appropriate erosion and sediment control BMPs along the access roads, as outlined in the ECRP, as determined necessary by Pacific Connector's EI. Paved roads would be kept free of mud and other debris that may be deposited by construction equipment.

New Temporary and Permanent Access Roads

Six of the 14 proposed new TARs would be located within 100 feet of a stream or ditch and there would be 6 new stream crossings (table 4.4.2.2-12).

TABLE 4.4.2.2-12

New Temporary and Permanent Access Roads Located within 100 feet of Waterbodies

TAR/PAR	Waterbody Name	Waterbody ID	Direction
TAR-29.88	East Fork Coquille River	BSP071	River is west of access road
TAR-81.37	Tributary to Myrtle Creek	BSP-259	Crossed
TAR-88.63	Days Creek	BSP-233	Crossed
TAR-88.67	Days Creek	BSP-233	Road is south of river
TAR-128.69	Tributary to Indian Creek	ASP-310	Crossed
TAR-212.50	Ditch	EDX054	Crossed
PAR-132.46	Ditch	AW243	Crossed
PAR 196.53	Ditch	ADX-31	Crossed

One permanent access road to MLV #12 (PAR-150.70) is located within the South Fork/North Fork Little Butte Creek Key Watershed within the Medford BLM District. This permanent access road would be installed within the permanent easement and is located adjacent to Heppsie Mountain Rock Quarry.

To minimize impact on waterbodies from construction of new temporary or PARs, Pacific Connector would install BMPs according to the ECRP. BMPs may include silt fence/straw bale sediment barriers or prefabricated construction mats to prevent rutting/compaction impacts. All TARs would be restored to preconstruction conditions following completion of construction.

Contractor and Pipe Storage Yards

Of the 31 surveyed yards, 12 yards contain drainage ditches or wetland features. Where drainage ditches occur at any of the proposed yard sites, Pacific Connector would avoid impacts to waterbodies by utilizing appropriate BMPs and working around them.

Conclusions about the Potential Pipeline Project Effects on Surface Water Resources

No substantial long-term effects to surface water are anticipated from construction or operation of the pipeline and aboveground facilities because disturbances would be temporary, erosion controls would be implemented, natural ground contours would be returned as close to preconstruction conditions as possible, and the right-of-way revegetated. Implementation of Pacific Connector's ECRP and our *Plan* and *Procedures* would limit impacts from construction on surface water resources.

Temporary, minor, and localized effects could result from clearing alongside streams in those areas of the pipeline corridor where there exists forested riparian vegetation. Turbidity increases due to stream crossings would be short term. Localized increases in turbidity would be minimized with the implementation of BMPs. Implementation of the ECRP with temporary and permanent erosion control measures and site specific mitigation measures for sensitive stream crossings would minimize effects. Based on the reasons cited above, we conclude that the construction or use of the aboveground facilities, access roads, TEWAs, and contractor yards would not significantly impact surface water resources.

Operation and Maintenance of the Pipeline

The operation of the new pipeline would not result in any adverse impacts to surface water use or quality. Associated pipeline facilities such as compressor stations and meter stations would be located outside of waterbodies to avoid impacts to surface waters. Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip of at least 25 feet, as measured from the waterbody's MHWM.

4.4.3 Wetlands

Wetlands are defined by the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands are considered to be ecologically important and can provide substantial biodiversity. They serve a variety of physical, biological, and chemical functions such as wildlife and fish habitat, flood flow moderation, groundwater recharge and discharge, water quality protection, and recreational opportunities.

Wetlands are regulated at the federal, state, and local level. At the federal level, wetlands may be deemed Waters of the United States (33 CFR 328.3) and may be subject to regulation through the CWA (i.e., the COE will determine which wetlands are regulated under the CWA). Sections 401 and 404 of the CWA were created specifically with the intent "to restore and maintain the chemical, physical, and biological integrity of our Nation's waters." The COE has authority under Section 404 of the CWA to review and issue permits for activities that would result in the discharge of dredged or fill material into wetlands or other jurisdictional waterbodies. Section 401 of the CWA requires that proposed dredge and fill activities under Section 404 be reviewed and certified by the designated state agency and that the Project meet state water quality standards. In this case, the ODEQ has been delegated this authority and is charged with verifying that the project meets state water quality standards.

In Oregon, wetlands are also regulated at the state level by the ODSL and at the local level by some city and county land-use ordinances. Most activities that affect more than 50 cy of material in wetlands are required to have a permit from ODSL, which administers Oregon's Removal-Fill Law (ORS 196.800) enacted in 1967 and 1971 to protect waterways and wetlands.

Through the State's notification process, provisions for wetlands under the ODF's Forest Practices Act and rules will be addressed, if applicable. Details would be submitted to the ODF

in either a written plan or alternate plan to include specific provisions for meeting the Forest Practices Act, including those related to wetlands.

On federally managed land, EO 11990 amended in 42 U.S.C. 4321 *et seq.*, requires the federal agencies "to avoid adverse impacts associated with the destruction or modification of wetlands wherever there is a practicable alternative" and to "include all practicable measures to minimize harm to wetlands." Further, the agencies are required to preserve and enhance the natural and beneficial values of wetlands in carrying out their responsibilities.

The *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) provides the standards for determining wetlands. Wetland delineations for the Project were conducted in accordance with these federal regulations and methodologies. Wetlands at the LNG terminal and associated facilities are discussed in section 4.4.3.1, while wetlands crossed by the pipeline are discussed in section 4.4.3.2 below.

4.4.3.1 Jordan Cove LNG Terminal

Jordan Cove (through their consultant SHN Consulting Engineers and Geologists, Inc.) conducted wetland delineations within the LNG terminal site as well as the South Dunes Power Plant site, temporary North Point construction worker camp, and other associated sites using wetland classifications based on Cowardin et al. (1979).[62] The location of the wetlands delineated during surveys is shown in figure 4.4-1. The COE has reviewed Jordan Cove's wetland delineation and determinations, and provided a Preliminary Jurisdictional Determination on March 13, 2014. Wetlands identified in the area include estuarine, palustrine unconsolidated bottom, palustrine emergent, palustrine scrub-shrub, and palustrine forested wetlands.

Estuarine wetlands are characterized by sandy or rocky substrate that is regularly inundated by brackish water and influenced by tidal flux, resulting in cycles of saturation and exposure. Plant life is not typically abundant within these types of wetlands, though macro- and micro-algae and phytoplankton thrive here and create a rich intertidal habitat environment that supports numerous species of mollusks, crustaceans, and shorebirds. Estuarine intertidal wetlands occur along the shore of Coos Bay across the mouth of the slip.

Palustrine unconsolidated bottom wetlands are wetlands have less than 30 percent vegetation cover and a surface with less than 25 percent of the particles smaller than stones. The closely related aquatic bed wetland class has less than 30 percent vegetation cover of plants growing on or below the water's surface for most of the growing season. This wetland type occurs along the South Dunes Power Plant and the access/utility corridor.

[62] The wetland delineation reports can be found in Appendix D2 of Resource Report 2 included in Jordan Cove's May 2013 application to the FERC.

Figure 4.4-1
Wetland Delineation of the LNG Project Site

Palustrine emergent wetlands are freshwater wetlands dominated by erect, rooted, herbaceous wetland plants that generally persist for most of the growing season. Plant species found in emergent wetlands include slough sedge (*Carex obnupta*), Hooker's willow (*Salix hookeriana*), toad rush (*Juncus bufonius*), dagger-leaved rush (*Juncus ensifolius*), tinker's penny (*Hypericum anagalloides*), devil's beggartick (*Bidens frondosa*), knotgrass (*Paspalum distichum*), Yorkshire fog (*Holcus lanatus*), creeping bent-grass (*Agrostis stolonifera*), yellow pond lily (*Nuphar lutea* ssp. *polysepala*), and floating-leaved pondweed (*Potamogeton natans*). Emergent wetlands occur in the northern portion of the LNG terminal project area.

Palustrine scrub-shrub wetlands are freshwater wetlands that include areas dominated by woody vegetation less than 20 feet tall and are vegetated with true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Species found within scrub-shrub wetlands on the LNG terminal project area include Hooker's willow, Sitka willow (*S. sitchensis*), Douglas spiraea (*Spiraea douglasii*), twinberry (*Lonicera involucrata*), slough sedge, spreading rush (*Juncus effusus*), dagger-leaved rush, toad rush, western bent-grass (*Agrostis exarata*), creeping bent-grass, reed canary grass (*Phalaris arundinacea*), northern willowherb (*Epilobium ciliatum*), tall mannagrass (*Glyceria elata*), and lowland cudweed (*Gnaphalium palustre*). Scrub-shrub wetlands occur in the northeast portion of the LNG terminal project area and in a small area near Jordan Lake. Henderson Marsh, which is located directly to the west of the site and would not be directly affected by the project (but which may be indirectly affected due to a minor reduction in water entering the marsh due to the construction of the tsunami berm on the west side of the slip), is composed partially of this wetland type.

Palustrine forested wetlands are freshwater wetlands that contain woody vegetation that is 20 feet or taller. Coniferous species found in the forested wetlands on the LNG terminal project area include shore pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*) and scattered Port-Orford cedar (*Chamaecyparis lawsoniana*). Shrubs within the forest wetland areas include scotch broom (*Cytisus scoparius*), coyote brush (*Baccharis pilularis*), hairy manzanita (*Arctostaphylos columbiana*), evergreen huckleberry (*Vaccinium ovatum*), salal (*Gaultheria shallon*), wax myrtle (*Myrica californica*) and scattered rhododendron (*Rhododendron macrophyllum*). Herbaceous species include European beachgrass (*Ammophyla arenaria*), silver hairgrass (*Aira caryophyllea*), little hairgrass (*A. praecox*), hairy cat's ear (*Hypochaeris radicata*), bracken fern (*Pteridium aquilinum*), sheep sorrel (*Rumex acetosella*), candy-stick (*Allotropa virgata*), and rattlesnake plantain (*Goodyera oblongifolia*). Forested wetlands occur in the northeast portion of the LNG terminal project area.

Table 4.4.3.1-1 lists all the wetlands identified within Jordan Cove's terminal and related facilities. Approximately 38.0 acres of wetlands would be affected by construction of the proposed LNG terminal and associated facilities (e.g., SORSC, South Dunes Power Plant, and North Point Construction Workers Camp), with approximately 35.6 acres of wetlands being permanently affected during operation of the Project (see table 4.4.3.1-1). The vast majority of impacts are associated with wetlands affected by construction of the access channel (which would impact 29.3 acres of wetlands).

TABLE 4.4.3.1-1

Wetlands Delineated on the LNG Project Site

Wetland Delineation	Wetland Type	Areas Affected By Construction (acres)	Areas Affected By Operation (acres)
Slip and Access Channel			
Eelgrass	Estuarine	2.5	2.5
Intertidal (MHHW)	Estuarine	8.1	8.1
Shallow Subtidal	Estuarine	3.3	3.3
Deep Subtidal a/	Estuarine	15.4 a/	15.4 a/
	Subtotal	**29.3**	**29.3**
Construction Dock			
Intertidal	Estuarine	1.9	1.4
Shallow Subtidal	Estuarine	0.2	<0.1
Eelgrass Habitat a/	Estuarine	0.3 a/	0.0 a/
	Subtotal	**2.4**	**1.5**
LNG Liquefaction Site			
2013-4	Palustrine Scrub-Shrub	0.3	0.3
2013-3	Palustrine Scrub-Shrub	0.1	0.1
	Subtotal	**0.4**	**0.4**
Access /Utility Corridor			
Wetland C	Palustrine Forested	0.2	0.2
Wetland E	Palustrine Aquatic Bed	1.0	0.2
2013-6	Palustrine Emergent	0.3	<0.1
2012-2	Palustrine Scrub-Shrub; Palustrine Emergent	0.2	0.0
2013-1	Palustrine Unconsolidated Bottom; Palustrine Scrub-Shrub; Palustrine Emergent	<0.1	<0.1
2013-2 a/	Palustrine Unconsolidated Bottom; Palustrine Scrub-Shrub; Palustrine Emergent	<0.1 a/	<0.1 a/
	Subtotal	**1.79**	**0.53**
Construction Worker Camp			
Wetland APC-A2	Estuarine	0.2	<0.1
Wetland APC-D	Palustrine Emergent	<0.1	<0.1
Coos Bay, below el. 746´ (MHHW)	Estuarine	<0.1	<0.1
	Subtotal	**0.3**	**<0.1**
South Dunes Power Plant			
Wetland F a/; b/	Palustrine Unconsolidated Bottom	0.9 a/; b/	0.9 a/; b/
Wetland G a/; b/	Palustrine Unconsolidated Bottom	0.9 a/; b/	0.9 a/; b/
Wetland H (East)	Palustrine Emergent	<0.1	<0.1
Wetland H (West)	Palustrine Emergent	<0.1	<0.1
Wetland I (North)	Palustrine Emergent	0.3	0.3
Wetland I (South)	Palustrine Emergent	<0.1	<0.1
Wetland J	Palustrine Emergent	<0.1	<0.1
Wetland L	Palustrine Emergent	0.1	0.1
Wetland M	Estuarine	0.2	0.2
2012-7	Palustrine Emergent	0.2	0.2
Coos Bay, below el. 746´ (MHHW)	Estuarine	0.5	0.5
	Subtotal	**3.2**	**3.2**
Rail Spur Bridge Relocation			
2012-4	Palustrine Emergent	<0.1	<0.1
	Subtotal	**<0.1**	**<0.1**
Southwest Oregon Regional Safety Center			
Wetland A	Palustrine Forested	0.2	0.2
Wetland B	Palustrine Forested	0.4	0.4
	Subtotal	**0.6**	**0.6**
Impact Summaries			
	Total Wetland Impacts	**38.0**	**35.6**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre; values below 0.1 acre are noted as <0.1.

a/ These areas are not included in the mitigation requirements, and no mitigation for these areas has been proposed by Jordan Cove.

b/ These are jurisdictional wetlands but do not require mitigation as these former mill waste treatment areas are under an ODEQ NPDES permit.

Dewatering proposed for excavation of the LNG facilities could have temporary impacts to ground water, surface water, as well as wetlands (see sections 4.4.1 and 4.4.2). Technical memoranda were submitted in Jordan Cove's February 13, 2015, filing that summarize evaluations of the potential for dewatering activities during construction to impact groundwater, surface water, and wetland habitats near the terminal (DEA 2015; GSI Water Solutions Inc. 2015). Based on these assessments, it is expected that groundwater movement and levels would return to pre-disturbance conditions following construction. A monitoring program would be conducted prior to, during, and after construction to monitor potential impacts to ground and surface waters, as well as wetlands.

The spread or establishment of weeds can adversely affect wetlands. Weeds and the measures taken to avoid and minimize their spread or establishment are discussed in detail in section 4.5.

When unavoidable wetland impacts are proposed, the COE, EPA, and ODSL require that all practicable actions be taken to avoid, minimize, and then compensate for those impacts. The specific type and amount of compensatory mitigation that would be required to offset the loss of wetland acreage and functions that cannot be avoided or minimized would be determined by the COE as part of the CWA Section 404 permit process and by the ODSL as part of the state Removal-Fill permit process.

For activities involving CWA Section 404 discharges, a permit will be denied by the COE if the associated discharge does not comply with the EPA's 404(b) (1) Guidelines. The Guidelines are binding regulations and provide substantive environmental standards by which all Section 404 permit applications are evaluated. The Guidelines specifically require that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse effects." The burden of proving no practicable alternative exists is the sole responsibility of the applicant.

The "overall project purpose," as determined by the COE, is used to structure the alternatives analysis. In other words, it determines the scope of alternatives that must be considered. The COE alternatives analysis must consider alternative sites and designs that would accommodate the overall project purpose. If a prospective permittee is not able to overcome the presumption of alternatives to their proposal that would avoid or minimize aquatic resource impacts, compensatory mitigation is required for any and all remaining impacts. The COE decision to issue a permit, issue a permit with conditions, or deny the permit application request is based upon an evaluation of the probable impacts of the project including cumulative impacts of the proposal and the proposal's intended use on the public interest.

Prior to COE authorization, the COE must ensure aquatic resource impact avoidance and minimization have been identified, outlined, and promulgated by an applicant. The COE uses a mitigation sequence to assess the need for aquatic resource impacts. This mitigation sequence contains a primary structure centered on avoidance of aquatic resource impacts, minimization of aquatic resource impacts, and compensation for the loss of aquatic resource impacts that could not be avoided. If, after outlining project aquatic resource avoidance and minimization to the degree practicable, an applicant may mitigate for subsequent aquatic resource impacts. Mitigation for aquatic resource impacts is carried out via the development of a compensatory

mitigation plan. A compensatory mitigation plan must be developed to meet the requirements of the 2008 Compensatory Mitigation Rule as outlined in the Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (73 [70] FR 19594-19705 [April 10, 2008]) and in 33 CFR Part 232.4.

A compensatory mitigation plan must replace lost aquatic functions and values, and must contain the following required components:

- goals and objectives;
- site selection criteria;
- site protection instrument;
- baseline environmental information;
- determination of credit methodology;
- mitigation work plan;
- maintenance plan;
- performance standards;
- monitoring requirements;
- long-term management plan;
- adaptive management plan; and
- financial assurances.

Jordan Cove developed a *Compensatory Wetland Mitigation Plan* to address unavoidable impacts to wetlands.[63] Impacts on freshwater wetland resources would be mitigated via the West Bridge and West Jordan Cove Mitigation Sites for a total of approximately 4.5 acres of mitigation (i.e., area where mitigation would be conducted) with a mitigation credit of approximately 2.9 acres (i.e., offset of impacts; see Part A of Jordan Cove's *Compensatory Wetland Mitigation Plan*). Impacts to estuarine wetland resources would be mitigated via the Eelgrass Mitigation Site and Kentuck Slough Mitigation Site for total of approximately 50.8 acres of mitigation (i.e., area where mitigation would be conducted) with a mitigation credit of approximately 16.9 acres (i.e., offset of impacts; see Part B of Jordan Cove's *Compensatory Wetland Mitigation Plan*). These mitigation plans are still being reviewed by the COE, ODSL, and applicable federal and state agencies. As discussed above, approval of these mitigation plans by these agencies would be required prior to issuance of federal and state wetland permits.

Restoration effort at the Kentuck Slough and West Jordan Cove Wetland Mitigation Sites would result in some short-term impacts; however, they would be limited in scope and would only exist during the actual restoration process. Potential impacts include a temporary reduction in water quality due to an increase in sedimentation (e.g., resulting from grading/excavating at the West Jordan Cove site), temporary disturbances to adjacent wildlife, and a temporary impact on vegetation removed during restoration activities. However, these impacts would not be significant and would be part of an overall long-term enhancement of the wetland habitat. Because they would be limited in scope and temporary in duration, the dredged/excavated and eelgrass revegetation effort at the eelgrass mitigation site could result in temporary short-term impacts. Potential impacts include a temporary reduction in water quality due to an increase in

[63] See *Jordan Cove Energy Project Compensatory Wetland Mitigation Plan* filed with the FERC in April 2014, revising their original filing from the May 2013 application.

sedimentation during dredging activities and a temporary loss of benthic organisms. Benthic organisms could re-establish within the area once eelgrass revegetation was complete (see section 4.6 of this EIS).

The COE and ODSL have not approved the *Compensatory Wetland Mitigation Plan*, and have requested that the applicant provide more details regarding avoidance and minimization of aquatic (including wetland) impacts within the plan. Therefore, **we recommend that:**

- **Prior to construction, Jordan Cove should file with the Secretary its final *Wetland Mitigation Plan*, together with documentation that the plan was developed in consultations with the ODSL, ODEQ, ODFW, and COE.**

4.4.3.2 Pacific Connector Pipeline

Pacific Connector conducted wetland delineations for the pipeline right-of-way, staging areas, temporary extra work areas, and aboveground facilities.[64] On-site delineation was not possible in some areas because landowners denied Pacific Connector survey access. For these areas, Pacific Connector used USGS topographic maps, NRCS soil surveys, FWS NWI maps, and aerial photography to identify the approximate wetland type and boundaries.

The wetland types identified along the proposed route included palustrine unconsolidated bottom, palustrine aquatic bed, palustrine emergent, palustrine scrub-shrub, palustrine forested, riverine, and open water wetlands (e.g., estuarine or lakes). These classifications are based on Cowardin et al. (1979) and are summarized below.

Palustrine Unconsolidated Bottom and Aquatic Bed Wetlands: Unconsolidated bottom wetlands have less than 30 percent vegetation cover and a surface with less than 25 percent of the particles smaller than stones (as described above). The closely related aquatic bed wetland class has less than 30 percent vegetation cover of plants growing on or below the water's surface for most of the growing season.

Palustrine Emergent Wetlands*:* Most of the emergent wetlands identified are disturbed by agricultural activities, primarily grazing or haying. These disturbed emergent communities are dominated by hydrophytic pasture grasses such as meadow foxtail (*Alopecurus pratensis*), rough bluegrass (*Poa trivialis*), and various bentgrasses (*Agrostis* spp.). Soft rush (*Juncus effusus*) and white clover (*Trifolium repens*) are also commonly present in these disturbed wetlands. Within Douglas and Jackson Counties, pennyroyal (*Mentha pulegium*) is also a common dominant species in emergent wetlands. Native emergent wetlands are uncommon, but when they occur (primarily within swales and irrigation canals) they generally contain cattail (*Typha latifolia*), small-fruited bulrush (*Scirpus microcarpus*), hardstem bulrush (*S. acutus*), manna grass (*Glyceria elata*), American sloughgrass (*Beckmannia syzigachne*), and various sedges (*Carex* spp.).

Palustrine Scrub-Shrub Wetlands*:* The delineation identified disturbed scrub-shrub wetlands associated with grazing or development activities. Common species include Oregon ash

[64] The Pacific Connector *Wetland Delineation Report* was included as a stand-alone report in the June 6, 2013 application filed with the FERC. On August 6, 2014, the COE concurred with Pacific Connector's boundaries for the extent of waters of the U.S. as depicted in its wetland delineation report.

(*Fraxinus latifolia*), ponderosa pine (*Pinus ponderosa*), Pacific blackberry (*Rubus ursinus*), and Himalayan blackberry (*Rubus armeniacus*), as well as a mixture of Douglas' spirea, Pacific willow (*Salix lasiandra*), salmonberry (*Rubus spectabilis*), and Pacific ninebark (*Physocarpus capitatus*).

Palustrine Forested Wetlands*:* The majority of delineated forested wetlands contain Oregon ash (*Fraxinus latifolia*). Red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*) are more common along the western part of the pipeline route in Coos and Douglas Counties. Western red-cedar (*Thuja plicata*) and Sitka spruce are common in the coast range forested wetlands. Skunk cabbage (*Lysichiton americanum*), salmonberry (*Rubus spectabilis*), lady fern (*Athyrium filix-femina*), and horsetails (*Equisetum* spp.) are often present in the understory. Forested wetlands are uncommon along the southeastern portions of the pipeline route, but are generally in swales or depressions. They are dominated by Oregon ash with an understory of Himalayan blackberry, slough sedge, and spreading rush.

Riverine Wetlands*:* Riverine wetlands are freshwater wetland habitats contained within a channel. The riverine wetlands along the pipeline construction route include species similar to those found in the palustrine emergent, scrub-shrub, and forested wetlands.

Estuarine and Open Water Wetlands*:* This includes estuaries, lakes, and other open water areas. Estuarine wetlands are discussed in detail within section 4.4.3.1.

The construction of a pipeline could have several effects on wetlands. Removal of vegetation could alter various wetland functions including their ability to provide fish and wildlife habitats, sediment and nutrient trapping, and other water quality functions. Soil disturbance and removal of vegetation could temporarily affect a wetland's capacity to moderate flood flow, control sediment, or facilitate surface water flow. Removal of vegetation could increase water and soil temperatures and alter species composition within forested and shrub wetlands to a more shade intolerant composition. Digging a trench through an impervious layer of soil in a wetland could alter hydrology of a perched water table leading to drier conditions and affect the re-establishment of wetland functions (including to wetlands located outside of the directly impacted area, but which may be hydrological connected to the affected area). Failure to segregate topsoil from the trench could result in altered biological and chemical functions in the wetland soil and could affect the re-establishment of vegetation, recruitment of native vegetation, or success of plantings. Improper operation of equipment or transport of pipe in wetlands could inadvertently rut or compact the soil and affect natural hydrologic patterns of the wetlands, and may lead to inhibited seed germination or increase the potential for siltation. Improper sediment controls could lead to sediment deposition in wetlands (including those wetlands located downslope or outside of the right-of-way or construction disturbance footprint), which could lead to the release of chemical and nutrient pollutants from sediments.

The scope of wetland impacts would vary depending on the type of wetland affected. In general, impacts on herbaceous wetlands would be short term, while impacts on scrub-shrub and forested wetlands would be long term. Also, some wetlands would be permanently affected as a result of maintenance of the of the pipeline's 10-foot-wide operational corridor, which would convert the affected wetland to a different wetland type (e.g., converting a forested wetland to an herbaceous wetland).

The Pacific Connector pipeline route would cross approximately 9.4 miles of wetlands. Construction of the pipeline would initially impact 195.9 acres of wetlands. Approximately 6.0 acres of wetlands would likely have long-term impacts (with about 1.6 acres of this resulting from wetlands that occur in the permeant maintained 10-foot operational corridor), although some of these wetlands would be allowed to restore to preconstruction conditions (i.e., about 4.4 acres of these long-term impacted wetlands would not be located within the permanent operational corridor), it could take many decades for conditions within these wetlands to restore to preconstruction conditions (see further discussion below). Tables N-1a and N-1b in appendix N of this EIS list the wetlands crossed by the pipeline by wetland type, ecoregion, subbasin, and fifth field watershed, and list the acres of impacts that would occur to each of these wetlands. Table 4.4.3.2-1 summarizes the acres of impacts that would occur to the general wetland types found along the pipeline.

TABLE 4.4.3.2-1

Summary of Wetland Impacts along the Pacific Connector Pipeline

Wetland Type	Total Construction Disturbance in Wetland (acres)	Wetland Vegetation Located Within Permanent Operational Corridor, or Requiring Long-Term Restoration a/, b/ (acres)
Palustrine unconsolidated bottom and aquatic beds	1.8	0.0
Palustrine emergent wetlands	97.3	0.0
Palustrine forested wetlands	5.2	5.2 (1.43)
Palustrine scrub-shrub wetlands	0.8	0.8 (0.12)
Riverine wetlands	14.5	0.0
Estuarine	76.3	0.0
Lake	<0.1	0.0
Total Wetland Impact	**195.9**	**6.0 (1.55)**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre; values below 0.1 acre are noted as <0.1.

a/ Includes wetlands that would be allowed to restore to preconstruction conditions (i.e., they would not be filled, nor would they be located within the permanent 10-foot-wide operational corridor); however, it could take many decades for conditions within these wetlands to restore to preconstruction conditions.

b/ The numbers in parentheses represent the permanent conversion of forested wetlands within the 30-foot maintenance corridor and scrub-shrub wetlands within the 10-foot maintenance corridor.

Scrub-shrub wetlands could take several years to reach functionality similar to pre-construction conditions, depending on the age and complexity of the system, indicating that impacts within these areas would be considered long-term impacts.

Within the 30-foot-wide pipeline operational easement subject to selective tree clearing, impacts on forested wetlands would be permanent, because most palustrine forested wetlands within the maintenance corridor would be converted to either scrub-shrub or emergent wetlands. Removing trees from the remaining construction right-of-way would result in a short-term loss in hydrologic and biogeochemical function that would begin to return as soon as the area was revegetated; however, the habitat functions provided by forested wetlands would require several decades to return. Measures to mitigate for impacts to wetlands would be determined during final permitting with the COE and ODSL in addition to the mitigation measures addressed later in the section.

While the pipeline would cross 19 watersheds identified as HUCs,[65] approximately 74 percent of the total wetland crossing length and 84 percent of the pipeline's total wetland impacts would occur in only two HUCs: Coos Bay Frontal and Lake Ewauna Upper Klamath River. Wetland impacts outside of these two HUCs during construction (i.e., about 31.2 acres) would occur primarily to numerous small palustrine emergent wetlands and intermittent drainages (see table N-1b in appendix N).

The majority of wetland impacts would occur within Coos County, in HUC 1710030403 (i.e., Coos Bay-Frontal Pacific Ocean), where approximately 4.6 miles of wetlands would be crossed resulting in 122.1 acres of construction impacts (see table N-1b in appendix N). The wetland crossings lengths within this HUC represents about 49 percent of the amount of wetlands crossed by the total pipeline length, while the acres that would be impacted represent approximately 62 percent of the total acres of wetlands affected by the pipeline.

The pipeline route within Klamath County, in the Lake Ewauna Upper Klamath River fifth field watershed (i.e., HUC 1801020412), would cross approximately 2.3 miles of wetlands, with construction resulting in about 43 acres of impacts to wetlands (see table N-1b in appendix N). The miles of wetland crossings within Lake Ewauna represents about 25 percent of the total wetland crossed by the pipeline, and the acres of wetland impact by construction represent about 22 percent of the total acreage of impacts. The impacts within the Lake Ewauna Upper Klamath River watershed would almost entirely occur to disturbed emergent agricultural pasture and hayfield wetlands, ditches, and canals.

To satisfy COE and state permitting Pacific Connected assessed the function and values of wetlands to determine which affected wetlands were high value wetlands. The criteria used to assess wetlands were their water quality and quantity, the value of their fish and wildlife habitat, their native plant communities and species diversity, and their value for recreation and educational purposes. Table N-2 in appendix N lists the impacts to high-value wetlands and the justification for their classification as high value wetlands. Construction of the pipeline would result in approximately 84.3 acres of impacts to high value wetlands, with the majority of these impacts (about 76.3 acres) occurring to the estuarine wetland located in Coos Bay (Wetland ID NE026). Of the 1.5 acres of permanent wetland impacts discussed above (for all wetland types and values), 0.6 acre would occur to high value wetlands.

Pacific Connector would implement the wetland construction and restoration measures contained in its ECRP. Section VI.A.3 of the FERC's *Procedures* requires that the construction right-of-way width be limited to 75 feet across wetlands, while Section VI.B.1.a requires that TEWAs be located at least 50 feet away from wetland boundaries. However, Pacific Connector has submitted modifications for these requirement associated with 96 areas where the applicant requested a 95-foot-wide construction right-of-way in a wetland or that TEWAs be located less than 50 feet away from a wetland. Their justifications for the modifications at specific locations vary, but include reasons such: necking-down the right-of-way in emergent wetland would require use of TEWAs that would be located 50 feet back from the waterbody, which could result in these work areas being located within forested or shrub wetlands that can have a higher

[65] A USGS classification system used to represent part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature.

function and value than the disturbed emergent wetland. FERC's review of Pacific Connector's proposed modifications to FERC's *Plan* and *Procedures* is provided in appendix P.

Based on our *Procedures* and its ECRP, Pacific Connector would implement the following measures to minimize impacts on wetlands:

- construction efforts would be scheduled for drier seasons;
- hazardous materials, fuels, and oils would not be stored in a wetland or within 150 feet of a wetland;
- the top 1 foot of topsoil would be segregated from the subsoil in the area disturbed by trenching, except where standing water is present or soils are saturated or frozen. Immediately after backfilling, the segregated soil would be restored to its original location;
- vegetation would be cut just above ground level to leave the existing root system in place. Tree stump removal and grading would occur directly over the trenchline. Stumps would not be removed from the rest of the right-of-way unless required for safety reasons;
- construction equipment operating in the wetland would be limited to that needed to clear vegetation, dig trenches, install the pipe, backfill, and restore the right-of-way. Other equipment would use upland access roads to the maximum extent possible. Travel would be restricted across wetlands where topsoil was restored;
- low ground-weight equipment would be used in saturated wetlands or the normal equipment would be operated on prefabricated equipment mats;
- slope breakers and sediment controls would be installed and maintained on slopes greater than 5 percent that are less than 50 feet from a wetland;
- erosion control devices would be installed and maintained as necessary to prevent sedimentation and runoff from entering wetlands;
- trench breakers would be installed, or the bottom of the trench would be sealed as necessary, to maintain the original wetland hydrology;
- appropriate weed-free live seed mixtures would be used for revegetation. No fertilizers would be used in wetlands;
- appropriate native trees and shrubs would be replanted during restoration of wetlands within riparian areas;
- wetlands would be monitored after revegetation for three years after construction or until the revegetation is successful. Revegetation would be considered successful when 80 percent of the type, density, and distribution of species are similar to that of adjacent unaltered wetlands. If revegetation is not successful at the end of three years, Pacific Connector would develop and implement a remedial revegetation plan to actively revegetate the wetland and would continue revegetation efforts until wetland revegetation is successful; and
- vegetation maintenance would not be conducted over the full width of the operational right-of-way within wetlands, but limited to a 10-foot-wide corridor.[66]

Pacific Connector would comply with conditions in the RHA Section 10 and CWA Section 404 permit obtained from the COE; the Removal/Fill permit from ODSL; and the CWA Section 401

[66] Additionally, trees may be selectively removed if they are within 15 feet of the pipeline that could compromise the pipeline coating integrity.

certification obtained from the ODEQ. These agencies would evaluate whether wetlands have been avoided or whether effects on wetlands have been minimized or rectified to the extent practicable.

The COE and ODSL may require additional mitigation (beyond what is required in this EIS) during their permitting process, which could include creating, restoring, or enhancing wetlands to replace the wetland functions and areas connectivity lost due to Project activities, or purchasing credits from a mitigation bank. ODSL administrative rules (OAR 141-085-136) include minimum ratios for acres required for compensation that varies by type of mitigation proposed (e.g., restoration is 1 acre for each acre lost, creation is 1.5 for 1, and enhancement is 3 for 1). Pacific Connector developed a *Compensatory Wetland Mitigation Plan.*[67] The plan proposed that the former Kentuck Golf Course in Coos County, which has been acquired by Jordan Cove, would be used to mitigate for the loss of wetlands associated with the pipeline project.

For approximately 2.4 miles (between MPs 1.7R and 4.1) the Pacific Connector pipeline would cross the Coos Bay estuary at Haynes Inlet, impacting approximately 5 acres of eelgrass beds, 35 acres of mud/sandflat, 1 acre of estuarine wetlands, and 33 acres of shallow subtidal habitats. To compensate for those impacts, Pacific Connector developed an *Estuarine Wetland/Open Water Mitigation Plan*.[68] The goal of the plan is to establish a one-to-one on-site restoration of all wetlands affected along the crossing of Coos Bay. The applicable standard of success is a return of each habitat to pre-construction conditions, or better, in order to ensure that the original functions and values of wetlands affected during the crossing are preserved.

The COE, ODEQ, and ODSL have received Pacific Connector's *Compensatory Wetland Mitigation Plan* and *Estuarine Wetland/Open Water Mitigation Plan*. They are currently reviewing the plan as part of their JPA review process.

4.4.4 Environmental Consequences for Water Resources on Federal Lands

4.4.4.1 Groundwater

Shallow Groundwater

As indicated in section 4.4.1.2, we note that the Pacific Connector Pipeline Project would cross areas where the groundwater is 0-6 feet bgs. Trench dewatering through a well point pumping system with a groundwater treatment plan may be the best option depending on if the groundwater is emanating from a pressurized or non-pressurized source point. We recommended in section 4.4.1.2 that Pacific Connector should file a *Shallow Groundwater Construction Plan* detailing how it would dewater the pipeline trench in areas of shallow groundwater where the push-pull method is not feasible. The plan should indicate dewatering methods and guidelines for discharging groundwater. On federal lands, dewatering activities would be coordinated with the BLM or Forest Service.

[67] Attached as Appendix 2K in Resource Report 2 included with Pacific Connector's June 2013 application to the FERC.
[68] Ellis Ecological Services, December 2013, *Estuarine Wetland/Open Water Mitigation Plan, Pacific Connector Gas Pipeline Project Coos Bay Estuary* was included as Attachment 7 of Pacific Connector's *Compensatory Mitigation Plan* filed with the FERC on April 16, 2014.

Springs, Seeps, and Drains

Pacific Connector surveys have identified a number of springs and seeps, as noted in appendix N of this EIS. Pacific Connector has stated that it would further verify exact locations of springs and seeps during easement negotiations with the land manager. Nearby springs and seeps supplied by deeper pressurized groundwater zones would generally not be affected by the trenching activities or trench plugs. Spring and seeps supplied by shallow groundwater, however, may be effected by the pipeline project, particularly if the pipeline is directly up-gradient of a spring or seep location.

The BLM has disclosed that French drains, similar in function to drain tiles, were installed to stabilize Elk Creek Road, which the proposed route would cross six times between MPs 34.02 and 37.15. These crossings are all within BLM lands. Pacific Connector would ensure that any French drains damaged by the pipeline would be repaired before backfilling. If either damage or repair causes a discharge to waterways under federal jurisdiction, a water quality permit would be required under Section 404 of the CWA. All French drains crossed by the Pacific Connector pipeline would be probed prior to right-of-way restoration to check for damage, and a qualified specialist would test for damage and conduct any necessary repairs. Pacific Connector would restore any damaged drains to the same condition that existed prior to construction. In order to identify, monitor, minimize, and mitigate for potential effects to groundwater, Pacific Connector has developed a *Groundwater Supply Monitoring and Mitigation Plan.* Land managers would be supplied with documentation that explains the pipeline construction Project and outlines the pre-construction field investigation for the identification and monitoring of groundwater supplies. Pre-construction surveys would be conducted to confirm the presence and locations of all groundwater supplies within and adjacent to the pipeline right-of-way.

Soil Compaction

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated (on non-federal lands) within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final cleanup activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts. Pacific Connector would test for soil compaction on federal lands. The EI would be responsible for conducting soil compaction testing and determining corrective measures on non-federal lands, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers. On federal lands, remediation and corrective measures to address compaction would be consistent with specific requirements of the BLM, Forest Service, and Reclamation (see NSR 2015a for details).

Accidental Spills of Hazardous Materials

Pipeline construction necessitates the use of heavy equipment and associated fuels, lubricants, and other potentially hazardous substances that, if spilled, could affect shallow groundwater and/or unconsolidated aquifers. A spill could reach different aquifer layers in these areas. Accidental spills or leaks of hazardous materials associated with vehicle fueling, vehicle

maintenance, and construction materials storage would present the greatest potential contamination threat to groundwater resources. Soil contamination resulting from these spills or leaks could continue to add pollutants to the groundwater long after a spill occurs. Implementation of proper storage, containment, and handling procedures would minimize the chance of such releases.

4.4.4.2 Surface Water

The Pacific Connector pipeline route would cross 19 fifth-field watersheds, and proposed access roads would cross an additional 5 watersheds. Of these, 16 watersheds include either BLM and/or NFS lands subject to the ACS.

Riparian Reserves and the ACS

The 1994 NWFP set forth detailed requirements that describe how land managers should treat the forest lands within the range of the northern spotted owl (through implementation of the Standards and Guidelines – Attachment A to the 1994 NWFP ROD [Forest Service and BLM 1994a]). Some standards and guidelines apply to all lands and others to a specific land allocation. The 1994 NWFP ROD described the ACS, which was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy would protect salmon and steelhead habitat on federal lands managed by the Forest Service within the range of the NSO.

To achieve ACS objectives in the 1994 NWFP ROD, the ACS included areas defined as Riparian Reserves and Key Watersheds, specified analytical procedures for evaluating watersheds, and defined a program for watershed restoration. While the ACS focus was primarily on the conservation of anadromous salmon and steelhead, the nine objectives listed for the ACS include maintaining and restoring aquatic systems, floodplains, wetlands, upslope habitats, and riparian zones in general to support invertebrate and vertebrate species dependent on those habitats.

The existing conditions of the fifth-field watersheds that would be crossed by the Pacific Connector pipeline are provided in the watershed analyses that were prepared by the various federal land management agencies having jurisdiction over the federal lands within the watersheds. Watershed assessments are a necessary component of a monitoring program in order to determine what degraded or impaired areas may exist in the watershed. These watershed analyses also provide a description of the range of natural variability of the important physical and biological components of the watershed. Table 4.4.4.2-1 lists the fifth-field watersheds that would be crossed by the proposed route. The table lists the federal land management agency jurisdiction, the date of completion of the watershed analysis, if available, and the total miles that would be crossed by the pipeline within each fifth-field watershed.

TABLE 4.4.4.2-1

Fifth-Field Watersheds Crossed by the Pacific Connector Pipeline on Federal Lands

Jurisdiction	Watershed (Name)	Approximate Miles Crossed	Watershed Analysis Completed
BLM – Coos Bay District	Coos Bay Frontal	0.3	2010
	Lower Coquille River (Middle Main)	<0.1	1997
	North Fork Coquille River	2.9	2001
	East Fork Coquille River	2.8	2000
	Middle Fork Coquille River	4.8	2007

TABLE 4.4.4.2-1

Fifth-Field Watersheds Crossed by the Pacific Connector Pipeline on Federal Lands

Jurisdiction	Watershed (Name)	Approximate Miles Crossed	Watershed Analysis Completed
BLM – Roseburg District	Middle Fork Coquille River	1.9	2007
	Olalla Creek-Lookingglass Creek	1.2	1999
	Clarks Branch- South Umpqua River	0.7	1999
	Myrtle Creek	2.5	2002
	Days Creek - South Umpqua River	6.7	2001
	Elk Creek	0.1	2004
BLM – Medford District	Trail Creek	4.0	1999
	Shady Cove-Rogue River	4.3	2011
	Big Butte Creek a/	0.8	1999
	Little Butte Creek	6.0	1997
BLM – Lakeview District	Spencer Creek	1.0	1995
	Mills Creek-Lost River	0.3	N/A b/
Forest Service – Umpqua National Forest (NF)	Days Creek-South Umpqua River c/	1.6	2001
	Elk Creek c/	2.7	1995 c/
	Upper Cow Creek c/	4.5	1995 c/
	Trail Creek c/	2.1	1995 c/
Forest Service – Rogue River NF	Little Butte Creek	13.7	1997
Forest Service –Winema NF	Spencer Creek	6.1	1995
Bureau of Reclamation	Lake Ewauna-Upper Klamath River	0.7	N/A b/
	Total Watersheds Crossed on Federal Lands	**71.6**	

Note that mileages may not sum correctly due to rounding. Mileages are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1.
Source: BLM 2006; Forest Service 2006a
a/ The Lower Big Butte Creek Watershed Analysis encompasses the BLM lands within the Big Butte Creek Watershed that are crossed by the pipeline.
b/ Outside the range of the northern spotted owl.
c/ The Elk Creek Watershed Analysis (Forest Service 1996) and the Cow Creek Watershed Analysis (Forest Service 1995a) encompass the Umpqua National Forest lands crossed by the pipeline.

Riparian Reserves and the ACS defined Key Watersheds, the acres of impact that would occur to these areas/land-designations, as well as the mitigation measures that would be implemented to compensate for impacts to these areas are discussed within the following subsection. Riparian Reserves are lands along streams, wetlands, ponds, lakes, reservoirs and unstable and potentially unstable areas where special standards and guidelines direct land use on federally-managed lands.

The ACS includes two designations for Key Watersheds. Tier 1 (Aquatic Conservation Emphasis) Key Watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. They also have a high potential of being restored as part of a watershed restoration program. While Tier 2 (other) Key Watersheds may not contain at-risk fish stocks, they are important sources of high-quality water.

Four watersheds that would be crossed by the Pacific Connector pipeline are designated as Key Watersheds: (1) South Umpqua River (Tier 1); (2) North and South Forks Little Butte Creek (Tier 1); (3) Spencer Creek (Tier 1); and (4) Clover Creek (Tier 2). North and South Forks Little Butte Creek is a Key Watershed within the Little Butte Creek fifth-field watershed. Key Watersheds that would be crossed by the Pacific Connector pipeline are listed in table 4.4.4.2-2. Key Watershed designations on BLM lands are also included in the table to show the ownership and management of the Key Watershed.

TABLE 4.4.4.2-2

Key Watersheds Crossed by the Proposed Pacific Connector Pipeline

Key Watershed	Jurisdiction	Approximate Miles Crossed	Approximate Construction Disturbance (acres) a/	Approximate Operational Easement (acres) b/
South Umpqua River (Tier 1)	BLM Roseburg District	6.6	115	24
MP 82.75-108.97	Umpqua National Forest	3.9	53	15
North and South Forks Little Butte Creek (Tier 1)	BLM Medford District	3.9	69	14
MP 135.0-168.0	Rogue River National Forest	13.7	208	50
Spencer Creek (Tier 1)	Winema National Forest	6.0	80	22
MP 168.01-177.05 and MP 180.51-183.00	BLM Lakeview District	0.9	13	3
Clover Creek (Tier 2)	BLM Lakeview District	0.2	2	<1
MP 177.1-180.5				
	Total	**35.2**	**540**	**128**

Note that values may not sum correctly due to rounding. Mileages are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1. Acreages are rounded to the nearest whole acre; values less than 1 are noted as <1.
a/ Includes uncleared storage areas.
b/ Assumes 50-foot-wide permanent easement.

The pipeline would not cross any roadless areas and would not require any new roads to be constructed within Tier 1 Watersheds. Although the pipeline would cause temporary disturbance within Tier 1 watersheds, all disturbed areas associated with the pipeline would be restored after construction. No adverse, long-term effects are anticipated to the water resources. The 30-foot operational maintenance corridor along the pipeline centerline would create a permanent vegetation type conversion impact within forested vegetation types, but the vegetation conversion is not expected to measurably alter hydrologic functions. Restoration of all areas disturbed by the Pacific Connector pipeline would include shaping to the approximate original contour to restore drainage patterns, scarification to relieve compaction, and revegetation for stabilization and to restore habitats and land use functions. The compensatory mitigation measures outlined for LSRs and Riparian Reserves would benefit Key Watersheds if the mitigation projects such as road decommissioning occur within these watersheds.

On NFS and BLM lands where Riparian Reserves would be affected, up to a 100-foot riparian strip or to the edge of the existing riparian vegetation would be planted to ensure that the "maintain and restore" objectives of the ACS are accomplished for native riparian vegetation.

Impacts on Streams on Federal Lands and Mitigation

Temporary Equipment Crossings

For any temporary equipment crossings on any stream channel (whether intermittent or perennial, wet or dry) on federal lands, equipment crossings must be accomplished using (1) a

bridge, (2) a temporary culvert with temporary road fill to be removed after work is completed, or (3) a low water ford with a rock mat. Although the FERC's *Procedures* allow clearing equipment and equipment necessary for installation of the temporary bridges to cross waterbodies prior to bridge installation, Pacific Connector would not allow clearing equipment to cross waterbodies prior to bridge placement. Furthermore, where feasible, Pacific Connector's contractor would attempt to lift, span, and set the bridges from the streambanks. Where it is not feasible to install or safely set the temporary bridges from the streambanks, only the equipment necessary to install the bridge or temporary support pier would cross the waterbody. Any equipment required to enter a waterbody to set a bridge would be inspected to ensure it is clean and free of dirt or hydrocarbons.

No waterbodies or riparian reserves on federal lands would be affected by temporary or permanent access roads.

Water Use During Pipeline Construction

Water withdrawals on federal lands for dust suppression or hydrostatic testing would require site-specific approval from the agency that manages the specific water resources (federal or state). Water releases on federal lands for dust suppression or hydrostatic testing would require site-specific approval from the agency of jurisdiction. We understand that site-specific approval by the authorized Forest Service officer on NFS lands, and similar authorizations by BLM and Reclamation would be coordinated through the development of the POD to support the Right-of-Way Grant. Withdrawals and releases of hydrostatic test water would be done in accordance with Pacific Connector's *Hydrostatic Test Plan*, included with the POD.

Potential Encounters with Contaminated Sediments

On federal land, hazardous substances, including chemicals, oils, and fuels, would not be stored within 150 feet of a waterbody or wetland boundary. As noted in the ECRP, any variance on federal lands would require prior approval by an authorized agency representative. In instances where it is not possible to maintain the 150-foot distance, the EI would request a variance that would require approval from the authorized agency representative. To reduce impacts from potential encounters with contaminated sediments, Pacific Connector would implement the measures outlined in its *Contaminated Substances Discovery Plan*, which was included as part of its POD.

East Fork Cow Creek Crossing

The Forest Service expressed concerns about the potential for naturally occurring mercury to reach the aquatic environment during construction of the pipeline near the historic Thomason claim group (near MP 109). To address this concern, Pacific Connector conducted a mine hazard evaluation and mercury testing study for the proposed 2007 route on the Umpqua National Forest at the crossing of East Fork Cow Creek, which crossed the Thomason claim group (GeoEngineers 2007c).[69] Soil samples were collected along the proposed alignment in an area believed to be outside the zone of mineralization where mercury deposits occur, in the stream system in the vicinity of the East Fork of Cow Creek, and from mine workings in

[69] GeoEngineers, Inc., 23 August 2007, *Mine Hazards Evaluation and Mercury Testing at the Red Cloud, Mother Lode, Nivinson, and Elkhorn Mining Groups, Jackson and Douglas Counties, Oregon*, prepared by A. Bauer and T. Hoyles, filed as stand-alone report with Pacific Connector's June 2013 application to the FERC.

proximity to the Pacific Connector right-of-way in 2007. The samples did not contain concentrations of mercury that exceeded human health risk screening criteria.

Subsequently, Pacific Connector moved its proposed route to the east to avoid a NSO nest site. GeoEngineers (2009b)[70] conducted an additional assessment of the relocated route, approximately 3,300 feet upstream and east of the original 2007 crossing to address the continued concerns of the Forest Service regarding the potential for naturally-occurring mercury within the East Fork Cow Creek drainage. That study concluded that the soils underlying the current proposed crossing of East Fork Cow Creek are unlikely to have concentrations of naturally occurring mercury exceeding those measured in samples obtained from the previous 2007 crossing location and most likely will have lower levels than those reported in GeoEngineers' (2007c) mine evaluation.

In addition to the GeoEngineers (2009b) report, the Forest Service contracted with a geologist consultant (Broeker 2010b)[71] to collect soil and stream sediment samples for analytical testing and reporting of mercury and other naturally occurring minerals along a 2,000-foot section of the proposed pipeline route between MP 109 and the East Fork Cow Creek. The Broeker study also concluded that construction activities along the revised pipeline route are not likely to encounter soils with elevated mercury concentrations.

In order to prevent this naturally occurring mercury from entering the aquatic environment during and after construction, additional erosion control measures and monitoring would be conducted along the pipeline route in the vicinity of the East Fork Cow Creek. If sediments containing high levels of mercury are encountered in the East Fork Cow Creek drainage during Project construction, Pacific Connector would implement the measures outlined in its *Contaminated Substances Discovery Plan*.[72]

Hyporheic Exchange at South Fork Little Butte Creek

The Forest Service has expressed concern that the crossing of South Fork Little Butte Creek would go through basalt and andesite bedrock, and therefore a site-specific crossing would need to address the potential for groundwater interception and flow at and near the crossing. A site-specific drawing for Little Butte Creek located on NFS land was included in Appendix 2E of Resource Report 2 with Pacific Connector's June 2013 application to the FERC. The crossing would need to address the potential for groundwater interception and flow at and near the crossing since it is a critical coho stream which flows through andesite and basalt. The *Stream Crossing Hyporheic Analysis* (GeoEngineers 2013d) determined that South Fork Little Butte Creek crossing had high hyporheic sensitivity. Therefore, BMPs would be implemented to mitigate for this possible effect.

Given the potential for disruption of hyporheic processes at crossings with a "high" sensitivity ranking, in addition to the pre-construction survey, a qualified geotechnical professional would

[70] GeoEngineers, Inc., 2 October 2009, *Addendum to Mine Hazards Evaluation and Mercury Testing at the Red Cloud, Mother Lode, Nivinson, and Elkhorn Mining Group*, prepared by A. Bauer and T. Hoyles, filed as stand-alone report with Pacific Connector's June 2013 application to the FERC.
[71] Broeker, L., 3 February 2010, *Potential for Natural-Occurring Mercury Mineralization to Enter the Aquatic Environment between MP 109 and East Fork Cow Creek Williams' Pacific Connector Pipeline Project*, filed as a stand-alone report with Pacific Connector's June 2013 application to the FERC.
[72] Appendix E of the POD filed as a stand-alone report in Pacific Connector's June 2013 application to the FERC.

be on-site to observe trenching/excavation associated with pipeline installation to document subsurface conditions, including the presence of fractured bedrock or the low probability of the presence of lava tubes. The geotechnical professional would make recommendations for backfill composition, including the use of trench plugs or other mitigation measures, to ensure that disruption to groundwater pathways are minimized. These recommendations would be pre-approved by an authorized Forest Service representative.

Stream Temperature Assessment

Project-specific temperature modeling was conducted on federal lands stream crossings. Temperature modeling, again using SSTEMP (Bartholow 2002), was conducted at the perennial stream crossings on BLM lands at Middle Creek Deep Creek and Big Creek, and NFS lands at multiple crossing on the East Fork Cow Creek in 2009 and again in 2013 to reflect new pipeline alignment and lower flow conditions (NSR 2009, 2015b,c). During 2013, temperature data recorders were placed at selected locations relative to each crossing during the warmest low-flow summer period to help validate the model. Flows in 2013 represented drought conditions and were about 33 percent of those modeled in 2009 at MP 109.69 in the East Fork Cow Creek. When compared to measured existing conditions, the SSTEMP model overestimated the lower flowing stream's actual existing stream temperature slightly (about 0.2 to 0.4°F) (NSR 2015b,c), indicating the inherent uncertainty in modeling stream temperatures in very small stream channels, and the potential to overestimate temperature changes in small streams.

Model analysis of right-of-way clearing effects predicted slight temperature increases on the BLM channel crossings in Middle Creek and a small tributary to Big Creek (NSR 2014), with these limited temperature changes likely due to relatively higher flows (Middle Creek), cooler air temperatures and relative channel orientations(NSR 2015b). During the drought conditions of 2013, modeled 7-day maximum stream temperature just below in the multiple East Fork Cow Creek crossings showed potential temperature increases of 1.2°F to 4.2°F under the rare drought flow conditions that occurred in 2013 (NSR 2015c). Measured stream volumes ranged from 0.045 cubic feet per second to 0.115 cubic feet per second with modeled total vegetation removal in the whole 75-foot right-of-way for post-construction shade levels ranging from 1.2 to 3.7 percent. Under the drought conditions of 2013 (high temperature and low flow), modeled results suggest temperatures may exceed the TMDL thresholds (0.1°C or 0.18°F at the point of maximum impact) or ODEQ Core Cold-Water Habitat temperature criteria of 16°C (61°F) in small perennial channels in the East Fork Cow Creek. This occurrence likely overestimates temperature changes that would most often occur, because of the drought conditions that occurred in 2013 and potential to overestimate of temperature in low-flow channels from the SSTEMP model as noted above. The 2014 analysis showed larger temperature increases than those reported in NSR (2009) primarily due to much lower flows during 2013.

Although exposure to solar radiation may cause temperature increases, temperatures downstream from limited stream-side forested clearings have often been found to cool rapidly once the stream re-enters forested regions (Zwieniecki and Newton 1999). Other studies have noted downstream cooling below timber harvest areas as well, but the extent of this cooling is not entirely clear and varies by stream (Moore et al. 2005; Poole et al. 2001). Although there is some debate on the magnitude of cooling provided by riparian vegetation and the extent to which stream temperatures return to non-cleared temperature levels after exiting a cleared area, studies emphasize that riparian buffers assist in maintaining water temperatures (Correll 1997; Gomi et

al. 2006). Generally, changes in temperature, especially in small streams, may recover quickly from cooler surrounding conditions downstream (e.g., streambed cooling, evaporation, hyporheic inflows, shade). This was validated by stream temperature data recorded on the Umpqua National Forest in 2013. The updated temperature assessment prepared for the Forest Service at this location (NSR 2014) incorporated field measurements of existing conditions on the Umpqua National Forest that showed decreasing stream temperatures of as much as -7.6°F per 100 feet with an overall average over 2,040 feet of the East Fork Cow Creek of -0.1°F per 100 feet (NSR 2015c). The presence of numerous small wetlands adjacent to the stream channel provide evidence of likely groundwater interactions. Most of this 2,040-foot reach also has substantial shade, suggesting the retention of shading structures, or at least partial shade, may greatly reduce increases in stream temperature. The 2014 assessment also supports the NSR (2009) finding that potential temperature increases are partially offset by cooling from groundwater interactions in the stream channel.

Observations of these streams suggest that LWD and low-growing willows, huckleberries, and other brush species can provide effective shade for small, narrow channels. Blann et al. (2002) noted that riparian grasses and forbs supply as much shade as wooded buffers for streams less than 8 feet (2.5 meters) wide. In many cases during pipeline crossing construction, low-growing brush outside of the immediate crossing construction area could be retained minimizing shade loss. In the mainstem of the East Fork Cow Creek, LWD provides significant shade that helps maintain cooler water temperatures. As described in the ECRP and waterbody crossing requirements for the project, all LWD and boulders removed from the crossing area would be replaced during site restoration and low-growing brush would be retained where possible (NSR 2015). Many of the channels crossed by the Pacific Connector pipeline on federal lands are very small, and could easily be shaded by the placement of LWD and willow plantings. Where site-specific modeling on NFS perennial stream crossings suggests temperature increases over natural pre-project levels, a plan would be prepared to reestablish pre-crossing shade conditions using items such as willows, boulders, and LWD.

With the retention of existing shading brush on small channels, the placement of LWD, and the replanting of willows and other brush species, downstream temperatures are expected to be comparable to the existing condition and to remain below ODEQ thresholds on the East Fork Cow Creek. Additionally, any temperature increases in small streams would likely be masked by the assimilative capacity of larger streams at the stream network scale (NSR 2009).

During the ODEQ CWA Section 401 process, Pacific Connector would develop a source-specific implementation plan in accordance with OAR 340-042-0080 for areas with existing TMDLs and Pacific Connector would be identified as a new nonpoint source. For perennial stream crossings on federal lands, this plan would incorporate the requirements of the site-specific restoration plans (NSR 2015b, c). The source-specific implementation plan would outline mitigation for predicted thermal impacts (GeoEngineers 2013i). This mitigation would have as its goal restoring shade along affected stream channels and nearby channels within the same fourth-field HUCs. Mitigation for construction-related impacts would occur to the extent allowed by landowners on the affected streambanks. This mitigation would incorporate riparian revegetation required by the Forest Service and/or the BLM for impacts to riparian reserves on federal lands. The length of channel banks planted by Pacific Connector would be determined prior to pipeline construction once a clear understanding of landowner wishes regarding

streambank planting are known. Contiguous lengths of streambank planting would be preferred over planting on multiple small parcels, particularly for mitigation of permanent impacts. Mitigation ratios of 1:1 for construction-phase impacts or 2:1 for permanent impacts would be applied as outlined in ODEQ's September 2011 letter. Prior to construction, Pacific Connector would also provide the implementation plan to FERC.

Where TMDL thermal load allocations have not yet been established, ODEQ's 401 Water Quality Certification would require the development of a Water Protection Plan, consistent with the source specific implementation plan, and a mitigation plan to address project impacts on thermal loading.

On NFS lands, the Forest Service has requested that the riparian vegetation strip be extended up to 100 feet on either side of waterbodies in Riparian Reserves. Pacific Connector has agreed to implement this measure on both NFS lands and BLM lands. The riparian strip would generally be replanted with species such as willow cuttings and dogwood to provide a quick cover for shading and streambank stability. Quick cover plantings may be shorter in height than vegetation removed during constructions, thus providing less shade. Plantings/seeding would be done with native vegetation of a local source. The riparian strip would be maintained to allow an herbaceous cover 10 feet in width centered over the pipeline to facilitate corrosion and leak surveys. The remaining area of the construction right-of-way within the riparian strip would be replanted with trees that would provide greater height and stream shading over time.

Restoration

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final clean-up activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts. Pacific Connector would test for soil compaction in agricultural (e.g., active croplands, hayfields, and pastures), residential areas, and on federal lands. The EI would be responsible for conducting soil compaction testing and determining corrective measures on non-federal lands, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers. On federal lands, remediation and corrective measures to address compaction will be consistent with specific requirements of the BLM, Forest Service, and Reclamation (see NSR 2015a for details). In response to a Forest Service request, Pacific Connector would stabilize intermittent stream crossings (whether flowing or not) on NFS lands with temporary sediment barriers and reseed as described for other waterbodies. Streambanks and stream beds would be revegetated with native species and "armored" as needed with LWD and boulders to ensure stability. Channel breakers would be installed on each side of the trench to ensure that subsurface flows are not captured by the pipeline trench.

As discussed in section 4.4.2.2, Pacific Connector has requested a modification to the FERC's *Procedures* requirement that the upper 1 foot of the trench to be backfilled with clean gravel or

native cobbles in all waterbodies that contain cold water fisheries. Pacific Connector has requested that for instances where the existing substrate is not gravel or cobbles, and site access is limited and would require unreasonable efforts to transport clean gravel to the waterbody, that only native materials removed from the stream be used for backfill.

For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans included as a supplement to appendix J (NSR 2014) will be used as directed by BLM and Forest Service monitors in conjunction with FERC's EIs. These restoration plans have been designed to ensure that restoration and revegetation of these crossings are consistent with ACS objectives as described in the relevant BLM and Forest Service land management plans.

All disturbed areas on federal lands would be monitored following construction to verify successful revegetation and to implement corrective action. Pacific Connector would also adhere to its mitigation plan (developed to mitigate for impacts to all riparian and upland habitats), which would be followed in areas with severe to soil erosion potential. Throughout operation of the pipeline, Pacific Connector would continue to monitor and maintain the right-of-way. The Forest Service and BLM, in consultation with Pacific Connector, have prepared a list of mitigation actions to address unavoidable impacts on NFS and BLM lands.

4.4.4.3 Wetlands

The Pacific Connector pipeline would cross approximately 0.2 mile of wetlands on federally managed land, affecting a total of approximately 2.2 acres (see table N-1a in appendix N). Permanent wetland vegetation conversion on federally managed lands would occur in approximately 0.2 acre of wetlands as a result of vegetation management on the operational right-of-way. This 0.2 acre of permanent conversion would occur to three wetlands: palustrine forested wetland CW010 located on lands managed by the BLM Coos Bay District, palustrine forested wetland AW309 located on lands managed by the BLM Medford District, and palustrine scrub-shrub/emergent wetland GW-14/FS-HF-CWWW-111-001 (i.e., a tributary to East Fork Cow Creek) managed by the Forest Service (on the Umpqua National Forest). Compensatory mitigation measures for this long-term wetland impact on federally managed lands would be conducted as described above for the entire pipeline.

There would be no permanent wetland loss or wetland impacts on federally managed land due to the construction of aboveground facilities. Impacts resulting from use of existing roads would be minimized through the implementation of Pacific Connector's ECRP and the mitigation measures described above for the pipeline on all lands.

In order to prevent or limit the spread of invasive species and noxious weeds into wetlands on federally managed lands, Pacific Connector would inspect all construction equipment prior to transporting equipment to the construction right-of-way to ensure that it is clean and free of potential weed seed. Because of the contiguous pattern of NFS lands crossed by the pipeline, equipment would be inspected and cleaned at cleaning stations located at the borders of each National Forest, prior to clearing and grading activities, in addition to being cleaned at cleaning stations associated with any mapped infestation of noxious weed of priority A and T and selected B listed weeds within each National Forest. Because the BLM lands crossed by the pipeline are not contiguous but are instead spread out in a checkerboard pattern, Pacific Connector feels that is not practical to set up inspection and cleaning stations at each entry point. Instead, Pacific Connector proposed that where

BLM lands are contiguous to NFS lands, the cleaning stations would be located to include the adjacent BLM lands. The location of any additional cleaning stations required in areas where BLM- or Reclamation-managed lands are not contiguous with NFS lands would be coordinated with the agency of jurisdiction. Additional measures to prevent the spread of invasive weed and wildlife species into wetlands and waterbodies are addressed within sections 4.5 and 4.6 of this EIS.

Measures to avoid or minimize impacts on wetlands that would be implemented on federally managed lands, in addition to those described above for the entire pipeline, include the following:

- Where straw is to be used on federally managed lands during seeding operations, the authorized officer for the agency of jurisdiction may inspect and approve straw material to verify that the straw is weed-free. Any gravel or rock used on federal lands would be from weed-free sources as well, and approved by the authorized representative for the agency of jurisdiction.
- Hazardous materials, fuels, and oils would not be stored in a wetland or within 150 feet of a wetland. Storage of hazardous materials on NFS lands would be in accordance with SPCCP - AGAR Regulations at Forest Service–approved sites.
- During revegetation efforts, specific mixtures specified by the agency with jurisdiction would be used on federally managed lands. No fertilizers would be used during the revegetation of wetlands.

Based on available information, with the implementation of appropriate plans, the use of additional BMPs, and mitigation, substantial effects to waterbodies on federal lands are not expected.

4.5 UPLAND VEGETATION AND TIMBER

4.5.1 Vegetation

4.5.1.1 Jordan Cove LNG Terminal

Botanical surveys have been conducted at the Jordan Cove LNG terminal site as well as the South Dunes Power Plant site, NPWHC, and the Kentuck Slough mitigation site[73] in order to determine the composition and extent of existing vegetation resources in the area. The Jordan Cove LNG terminal site was initially surveyed in 2005 and 2006 in support of the previous LNG import proposal (Docket No. CP07-444-000). Additional surveys were conducted in 2012 and 2013 to cover new areas identified for the current LNG export proposal.[74] Below we discuss the on-site vegetation associations documented during those botanical surveys, the impacts that construction and operation of the Jordan Cove Project would have on vegetation resources, as well as the measures that would be taken to reduce or mitigate for these impacts.

Vegetation Associations

The vegetation associations that may be affected by the Jordan Cove Project (i.e., the LNG terminal facility, South Dunes Power Plant, and NPWHC) are shown in figure 4.5-1. Vegetation cover within the project area includes forest, woodland, shrubland, and herbaceous plant associations (as described in Christy et al. 1998). In addition, the terminal tract and location for the South Dunes Power Plant contain disturbed areas resulting from former industrial activities (at the Weyerhaeuser linerboard mill site) and the placement of fill from historical dredging operations (at the Ingram Yard). Site-specific information relevant to these vegetation associations are discussed below.

Forested Associations

Forest associations are defined as areas where tree species comprise at least 60 percent of the vegetation cover. Forests on the Jordan Cove site are dominated by coniferous species with scattered hardwoods, generally along ridges and toe slopes, and vary in age and seral stages. The youngest forests are generally located along the perimeter of the site and adjacent to the Trans-Pacific Highway to the north. These young forests are associated with anthropogenic disturbance. More successionally mature forests are located in the interior portions of the site on stabilized dune ridges, troughs, and dry deflation basins.

The forests in this area are typically of dune forest types found on the North Spit of Coos Bay. Five different dune forests have been identified within the Jordan Cove Project site (i.e., Dune Forest A though Dune Forest E). Dune Forest A is located west of Jordan Lake and runs approximately 800 feet down from the utility corridor. Dune Forest B is the largest forest patch and is slated for removal to create the marine slip at the terminal. Dune Forest C is located north of Dune Forest B, immediately south of the Trans-Pacific Parkway. Dune Forest D is located on the northwestern tip of the overall site, immediately south of the Trans-Pacific Parkway. Dune Forest E is located in the western portion of the South Dunes Power Plant site, immediately east of Jordan Cove Road. The location of these dune forests are shown in figure 4.5-1.

[73] The Kentuck mitigation sites are related to wetland and wildlife mitigation efforts.
[74] Copies of the botanical survey reports found in Appendix B3 of Resource Report 3, which was included in Jordan Cove's application to the FERC in Docket No. CP13-483-000.

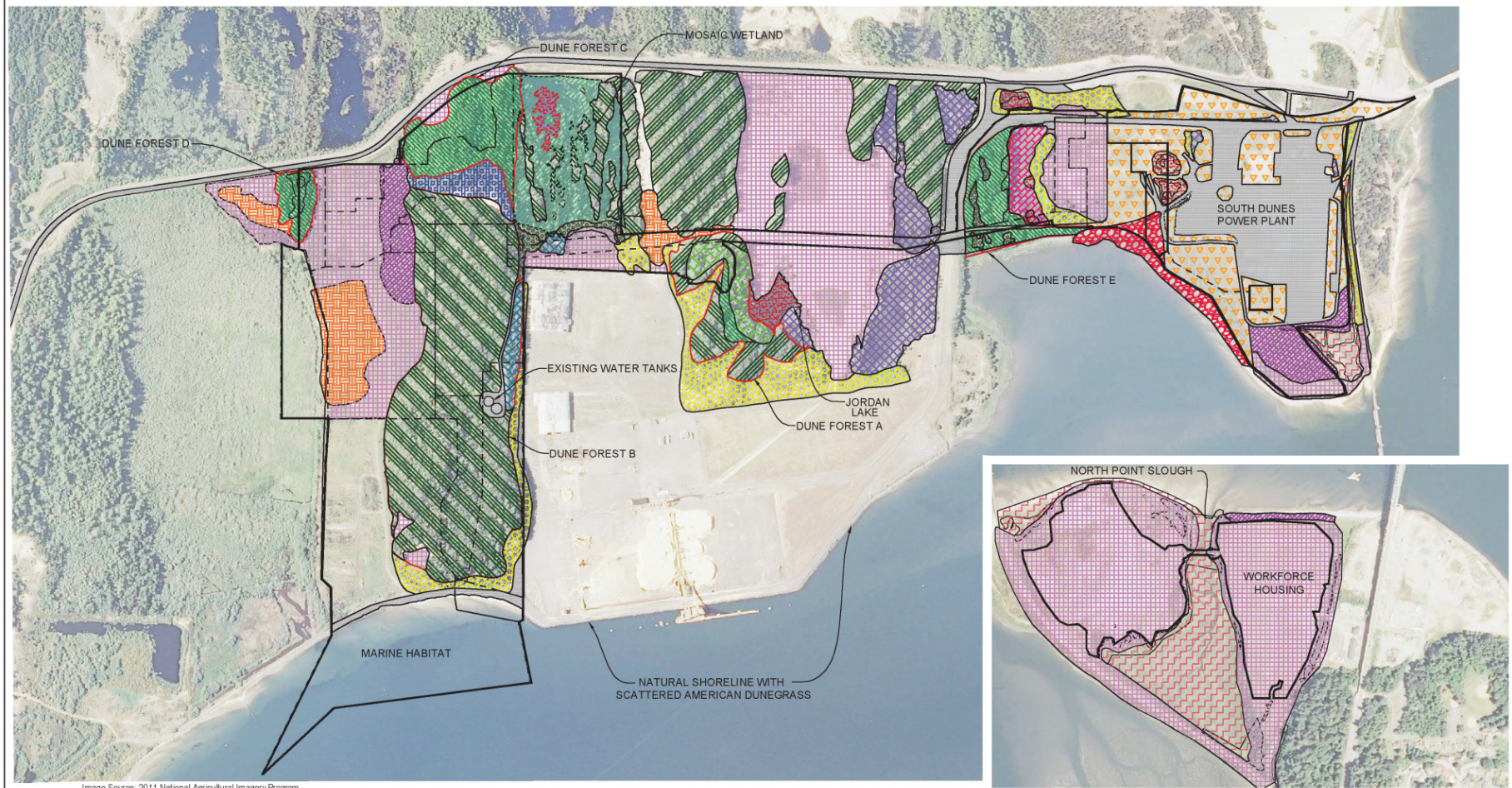


Image Source: 2011 National Agricultural Imagery Program

FOREST ASSOCIATIONS

- SHORE PINE-DOUGLAS FIR/ WAX MYRTLE-EVERGREEN HUCKLEBERRY (EVERGREEN,UPLAND)
- SHORE PINE-SITKA SPRUCE/ EVERGREEN HUCKLEBERRY (EVERGREEN,UPLAND)
- PORT ORFORD CEDAR/ EVERGREEN HUCKLEBERRY (EVERGREEN,UPLAND)
- SHORE PINE/SLOUGH SEDGE (EVERGREEN,SEASONALLY FLOODED)
- RED ALDER/SALMONBERRY/SLOUGH SEDGE-SKUNK CABBAGE (DECIDUOUS, SATURATED)
- SHORE PINE/SCOTCH BROOM/ EUROPEAN BEACHGRASS (EVERGREEN,UPLAND)

WOODLAND ASSOCIATIONS

- SHORE PINE/BEARBERRY (EVERGREEN,UPLAND)
- SHORE PINE/HAIRY MANZANITA (EVERGREEN,UPLAND)

SHRUBLAND ASSOCIATIONS

- HOOKER WILLOW-CRABAPPLE/ SLOUGH SEDGE-SKUNK CABBAGE (DECIDUOUS,SATURATED)

TIDAL HERBACEOUS ASSOCIATIONS

- BALTIC RUSH-PACIFIC SILVERWEED FLOODED TIDAL (TIDALLY FLOODED)
- SALTGRASS-PACIFIC SILVERWEED FLOODED TIDAL (TIDALLY FLOODED)

HERBACEOUS ASSOCIATIONS

- EUROPEAN BEACHGRASS (PERENNIAL,UPLAND)
- RED FESCUE-SALT RUSH (PERENNIAL,UPLAND)
- RED FESCUE (PERENNIAL,UPLAND)
- AMERICAN DUNEGRASS (PERENNIAL,UPLAND)
- POND LILY (PERENNIAL, SEMIPERMANENTLY FLOODED)

OTHER

- HIGHLY DISTURBED W/ SCATTERED HERBACEOUS VEGETATION
- OPEN WATER/ COMMON CATTAIL
- DUNE FOREST BOUNDARY
- VEGETATION TYPE BOUNDARY
- FACILITY AREA BOUNDARY
- PROJECT AREA BOUNDARY

NOTE:
ASSOCIATIONS USED ARE BASED ON USDA PUBLICATION *NATIONAL VEGETATION CLASSIFICATION SYSTEM (NVCS).*

0 800
1:800

Source:
SHN Consulting Engineers & Geologists, Inc.

Figure 4.5-1

Vegetation Associations

Dune Forest A would be affected during construction of both the utility corridor and the control building/plant warehouse/maintenance building. Dune Forest B would be affected by the development of the slip, LNG loading berth, liquefaction process area, LNG storage tank area, refrigerant storage area, flare area, and laydown area. Dune Forest C would be affected by fill generated during construction. Dune Forest D would be affected by construction of the LNG terminal site access as well as the fill area. Dune Forest E would be affected by the construction of the utility corridor and the SORSC located just east of Jordan Cove Road. A total of approximately 90 acres of dune forest habitat would be cleared.

Several forest associations have been classified within the dune forest types found on the Jordan Cove site. These various forest associations are described in the following sub-sections. The location of each of these associations is shown in figure 4.5-1.

Shore Pine–Douglas-Fir/Wax Myrtle-Evergreen Huckleberry (Evergreen, Upland)

This association typically occurs near previously developed areas such as roads, fill sites, or industrial sites. It has been documented to occur most frequently on warm, dry ridges, and slopes on the dunes; primarily with south to west facing aspects (Christy et al. 1998). This association is characteristic of younger forest sites north of Jordan Cove. They occur in areas where dune stabilization has been achieved through rpg ecruitment of vegetation, most notably European beachgrass (*Ammophila arenaria*) and Scotch broom (*Cytisus scoparius*). The dominant tree species are shore-pine (*Pinus contorta*) and Douglas-fir (*Pseudotsuga menziesii*). This association has an open overstory dominated by shore pine with scattered Douglas-fir. The shrub layer is dominated by Scotch broom and coyote bush (*Baccharis pilularis*), with scattered hairy manzanita (*Arctostaphylos columbiana*), wax myrtle (*Myrica californica*), and evergreen huckleberry (*Vaccinium ovatum*). Dominant herbaceous species include European beachgrass, silver hairgrass (*Aira caryophyllea*), little hairgrass (*A. praecox*), hairy cat's ear (*Hypochaeris radicata*), bracken fern (*Pteridium aquilinum*), and sheep sorrel (*Rumex acetosella*). This association can be found in portions of Dune Forests A, B, and C where adjacent landscapes have been altered by human or natural influences.

Shore Pine-Sitka Spruce/Evergreen-Huckleberry (Evergreen, Upland)

This association is common in successionally mature forests. Stands are generally dominated by shore pine and Douglas-fir, but also include Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), and scattered Port-Orford-cedar (*Chamaecyparis lawsoniana*). The shrub understory layer ranges from dense to nearly impenetrable, and is dominated by evergreen huckleberry, salal (*Gaultheria shallon*), and wax myrtle, with scattered Pacific rhododendron (*Rhododendron macrophyllum*) also present. The shore pine–Douglas-fir association is differentiated from the shore pine-Sitka spruce association by the presence of western hemlock, which is more widespread in the shore pine–Douglas-fir/wax myrtle-evergreen huckleberry association. The herbaceous layer varies from being depauperate (diminished) to moderately covered with candy-stick (*Allotropa virgata*), rattlesnake plantain (*Goodyera oblongifolia*), and bracken fern along edges or gaps in the overstory. This association can be can be found in portions of Dune Forest B.

Port-Orford-Cedar/Evergreen-Huckleberry (Evergreen, Upland)

This association occurs in all aspects and slopes on narrow, dry stabilized dune ridges, troughs, and seasonally dry deflation basins at the southern end of the ODNRA immediately north of the Jordan Cove terminal site. The Port-Orford-cedar and evergreen huckleberry association is described by

Christy et al. (1998) as unique. The dominant tree species is Port-Orford-cedar. This forest association is unique because it is being decimated throughout its limited range by the Port-Orford-cedar root rot disease which is caused by the fungal root rot *Phytopthora lateralis* (Christy et al. 1998). A small component of a well-developed Port-Orford-cedar/evergreen huckleberry association is located upslope from the southwestern shore of Jordan Lake. Port-Orford-cedar observed at this location includes two trees upslope from the existing access trail that travels from the Roseburg Forest Products facility to Jordan Lake. Additionally, 23 Port-Orford-cedars were observed at sites located adjacent to Jordan Lake, in areas that would be preserved as part of the Jordan Cove Project. This association can be found in portions of Dune Forest A.

Shore Pine/Slough Sedge (Evergreen, Seasonally Flooded)

This wetland forest association occurs in depressions on deflation plains and on ancient marine terraces. The dominant tree species is shore pine. The understory is dominated by shrub species, including wax myrtle, salal, and evergreen huckleberry. Slough sedge is the single dominant herbaceous species, and was observed growing in depressions and open water habitats throughout the North Spit. This association has been detected in the north central wetland mosaic north of the Roseburg Forest Products property (along Dune Forest A).

Red Alder/Salmonberry/Slough Sedge-Skunk Cabbage (Deciduous, Saturated)

The red alder/salmonberry/skunk cabbage forest association occurs in wetland habitats adjacent to upland forested habitats, and in low flat areas adjacent to inundated wetlands. In this association, the overstory consists entirely of red alder (*Alnus rubra*) located around wet areas, but transitions to shore pine in adjacent areas. Canopy cover varies from moderate to closed (i.e., more than 50 percent canopy cover). Scattered clusters of dense shrubs that include salmonberry (*Rubus spectabilis*) and Hooker willow (*Salix hookeriana*) are located in the understory. Herbaceous coverage is generally found in wet areas and consists almost entirely of slough sedge, with scattered skunk cabbage (*Lysichiton americanus*). This association has been documented in low spots in forests east of Jordan Cove Road (in Dune Forest E) and along the southern edge of the wetland mosaic located in the northwest part of the LNG terminal site (adjacent to Dune Forest B).

Shore Pine/Scotch Broom/European Beachgrass (Evergreen, Upland)

Although this association contains shore pine, it is sometimes described as a shrubland due to the high density of shrubby species, including Scotch broom, with only a limited distribution of shore pine. This association is relatively widespread throughout the LNG terminal site and is associated with roads and other disturbed areas. The overstory within this association is generally open, averaging less than 50 percent cover of shore pine in most areas. Scotch broom cover varies from moderately dense to very dense in areas that lack a substantial canopy cover. Dominant herbaceous species include European beachgrass, red fescue (*Festuca rubra*), tall fescue (*Festuca arundinaceae*), silver hairgrass, hairy cat's ear, and sheep sorrel. This association is early to mid-seral and is typically the first forest association to develop and replace European beachgrass dominated areas (Christy et al. 1998). This association occurs west of the South Dunes Power Plant, north of the Roseburg Forest Products property, along previous road cuts for the Trans-Pacific Parkway, and at the NPWHC.

Woodland Associations

Woodland associations are defined as open stands with tree cover varying from 25 percent to 60 percent. They occur on all aspects of dry, well drained, partially stabilized dune ridges, slopes, and flats between the sand and the forest edge (Christy et al. 1998). Two woodland associations occur within the Jordan Cove Project site, but neither is well represented (see figure 4.5-1).

Shore Pine/Bearberry Woodland Association

The shore pine/bearberry woodland association's overstory consists entirely of shore pine. The shrub layer is dominated by the low growing shrub bearberry (*Arctostaphylos uva-ursi*) with hairy manzanita in scattered patches. The understory is comprised almost entirely of moss and lichen species except for scattered little hairgrass, hairy cat's ear, and shrub starts. This association is unique due to its limited distribution, which is restricted to a thin band adjacent to the coastline, and the fact that it is easily damaged by human disturbances. The shore pine/bearberry association is scattered throughout the Jordan Cove terminal site, with the most substantial occurrence on the stabilized dune ridge northwest of the Roseburg Forest Products property between Dune Forests B and C.

Shore Pine/Hairy Manzanita Woodland Association

The shore pine/hairy manzanita woodland association's overstory is moderately open and is dominated by shore pine with scattered Douglas-fir trees. The shrub layer varies from moderately dense to dense in areas where the canopy is patchy. Hairy manzanita is the dominant shrub species with scattered evergreen huckleberry and bearberry along edges. The herbaceous layer varies from depauperate to moderately covered, with nonvascular plants and non-native herbs. The shore pine/hairy manzanita association successionally replaces the shore pine/bearberry association. A small area of this association can be found along the eastern boundary of Dune Forest B.

Shrubland Associations

Communities that consist of shrubs greater than 0.5 meter tall with generally greater than 25 percent cover and generally less than 25 percent tree cover are classified as shrubland associations. The density and distribution of the shrubland association is correlated to hydrology and topography. One of the major characteristics of the shrubland association is minor variation in topography, which affects the distribution of herbs and shrubs. The lowest lying areas are frequently inundated with water and, depending on the frequency and duration of inundation, they may be dominated with emergent hydrophyte species that generally grow partly or totally submerged in water. A single shrubland association was identified within the Jordan Cove project area (see figure 4.5-1).

Hooker Willow-Crabapple/Slough Sedge-Skunk Cabbage (Deciduous, Saturated)

The overstory within this association varies from patchy to dense, and is dominated by Hooker willow, Sitka willow, and Douglas spiraea, with scattered twinberry (*Lonicera involucrata*). Evergreen trees are mostly absent in this shrubland community, but may include scattered shore pine and Sitka spruce. Slough sedge is the most abundant herbaceous species. Other species include spreading rush (*Juncus effuses*), dagger-leaved rush (*Juncus ensifolius*), toad rush (*J. bufonius*), western bent-grass (*Agrostis exarata*), creeping bent-grass (*A. stolonifera*), reed canary grass (*Phalaris arundinacea)*, northern willowherb (*Epilobium ciliatum*), tall mannagrass (*Glyceria elata*), and lowland cudweed (*Gnaphalium palustre*). This association has been

observed extensively throughout the wetland areas west of Jordan Cove Road, southwest of Jordan Lake, and at the southern tip of the South Dunes Power Plant.

Herbaceous Associations

Herbaceous associations and sand dunes are defined as communities with less than 25 percent shrub cover. Herbaceous associations are the most variable of all the vegetation associations located in the Jordan Cove project area. They range from being dominated by plants that are adapted for sand burial and desiccating winds, to species that are emergent or submergent hydrophytes. They are widespread throughout the site, including areas that have some active sand movement and/or anthropogenic disturbance. Five herbaceous associations have been identified within the site (see figure 4.5-1).

European Beachgrass Herbaceous Association

Dominant species within this association include European beachgrass, red fescue, silver burweed (*Ambrosia chamissonis*), sand pea (*Lathyrus japonicus*), seashore lupine (*Lupinus littoralis*), beach silvertop (*Glehnia littoralis*), and beach evening primrose (*Camissonia cheiranthifolia*). This association was observed in the western part of the LNG project area (also known as Ingram Yard) where the slip would be located, and at the NPWHC. It was also observed in patchy distribution throughout open dune lands located north of Jordan Lake where the access/utility corridor is proposed.

Red Fescue Herbaceous Association

The red fescue herbaceous association is generally located within sandy areas that are not dominated by European beachgrass and have limited sand movement. Red fescue (*Festuca rubra*) is the dominant grass; associate species are similar to the species found in the European beachgrass association, but also include bracken fern. European beachgrass is scattered in this association, but is not a dominant species because sand is partially stable. Scattered red fescue was observed west of the South Dunes Power Plant site (on fill) and north of the Roseburg Forest Products facility (on sand).

Red Fescue-Salt Rush Herbaceous Association

This association is similar to the red fescue association described above, except that it is dominated by salt rush (*Juncus lesuerii*) as well as red fescue. Red fescue-salt rush was also observed at sites where sand burial by wind driven forces limits species diversity, including in the Ingram Yard east of Henderson Marsh (western part of the LNG terminal site).

American Dunegrass Herbaceous Association

This association includes dune lands with the single dominant species: American dunegrass (*Leymus mollis*). It can be found on beaches and in foredunes, and to a lesser extent on open deflation plains and in upper estuaries. Continual sand burial and inputs of salt spray seem necessary for American dunegrass to thrive. Stands in most locations have been overrun by European beachgrass, but American dunegrass often persists in patches among the European beachgrass. Scattered American dunegrass was observed west of Dune Forest B, in the Ingram Yard grassland habitat east of Henderson Marsh on previous fill deposits.

Pond Lily (Perennial, Semi-permanently Flooded)

Dominant species in this association include yellow pond lily (*Nuphar lutea* ssp. *polysepala),* floating water-pennywort *(Hydrocotyle ranunculoides),* floating-leaved pondweed (*Potamogeton*

natans), parrotfeather (*Myriophyllum aquaticum*), water shield (*Brasenia schreberi*), and common bladderwort (*Utricularia macrorhiza*). Pond lily habitat has been observed in deep freshwater wetlands located in the Jordan Cove Project site. This includes wetlands immediately west of Jordan Cove Road where the access/utility corridor is proposed (Wetlands 2012-2 and 2013-6) and in the southern portion of Wetland E.

Saltgrass-Pacific Silverweed Tidal Herbaceous Association

Dominant species found within this association include saltgrass (*Distichlis spicata*) and pickleweed (*Salicornia Virginia*). Himalayan blackberry (*Rubus discolor*) is the single dominant species along the upper shoreline above the ordinary high tide line and upper channel banks of this association, tapering to subdominant further inland. In the inland portion of the channel where freshwater prevails, common cattail (*Typha latifolia*) is the single dominant species. Subdominant species in this association include Hooker willow (*Salix hookeriana*) and giant horsetail (*Equisetum telmateia*) along the channel bank, reed canary grass (*Phalaris arundinaxxea*) and common rush (*Juncus effusus)* on the inland portions, and Lyngby sedge (*Carex lyngbeii*) above the high tide line on each side of the channel.

The saltgrass-Pacific silverweed tidal herbaceous association is one of the most salt-tolerant associations present on the North Spit, and also one of the most limited in distribution. It occurs at the South Dunes Power Plant site, adjacent to and including Wetland H (which includes a small freshwater channel to the shoreline of Coos Bay). The association occurs on sand or mud, usually cut with channels of tidal creeks. Occasional storm surges flood these areas with seawater, reworking sediments and importing large drift logs from beaches, as is the case with the Wetland H site.

Baltic Rush-Pacific Silverweed Tidal Herbaceous Association

Pickleweed and Lyngby sedge are the dominant species in this association, covering the majority of low marsh areas where this association is found. Subdominant species found include sea lavender (*Limonium californicum*), gumweed (*Grindelia squarrosa*), seaside arrowgrass (*Triglochin maritimum*), and salt rush (*Juncus lesueurii*).

This association is a component of "salt meadow" vegetation just above the intertidal zone in brackish marshes where limited freshwater is present. At the South Dunes Power Plant site, this association was found at the tip of Jordan Point where Wetland J occurs. Although there is a berm along the point, a culvert drains the inner marsh and opens up the area for tidal influence.

Other Vegetation Associations

Multiple disturbed areas are located within the LNG terminal site. Species composition within these disturbed areas consists of both native and non-native weedy herbaceous species with scattered shrubs. Forbs are more prevalent in areas that are heavily disturbed and compacted; grasses are widespread in areas that are moderately disturbed and are located along forest edges. Dominant species within the disturbed association include sweet vernal grass (*Anthoxanthum odoratum*), Queen Ann's lace (*Daucus carota*), hedgehog dogtail grass (*Cynosurus echinatus*), bird's foot trefoil (*Lotus corniculatus*), little hairgrass, silver hairgrass, hairy cat's ear, velvet grass (*Holcus lanatus*), English plantain (*Plantago lanceolata*), yarrow (*Achillea millefolium*), pearly everlasting (*Anaphalis margaritacea*), black mustard (*Brassica nigra*), small-head clover (*Trifolium microcephalum*), hop clover (*T. dubium*), white clover (*T. repens*), yellow

parentucellia (*Parentucellia viscosa*), and wild radish (*Raphanus sativus*). In areas where this association has 50 percent cover or more of grasses, dominant species include tall fescue, wild oats (*Avena* spp.), orchard grass (*Dactylis glomerata*), bent grasses (*Agrostis stolonifera* and *A. exarata*), and brome grasses (*Bromus* spp.) with scattered Pacific reed grass (*Calamagrostis nutkaensis*) and a variety of herbs listed above.

Open water and areas dominated by common cattails can be found surrounding the existing sludge ponds at the South Dunes Power Plant site as well as around wetlands observed south of the Trans-Pacific Parkway in the eastern portion of the Jordan Cove terminal site. Species diversity in these areas is limited due to competition from the common cattail, which displaces other emergent vegetation.

General Impacts on Vegetation Associations

Table 4.5.1.1-1 lists the impacts on vegetation that would result from construction and operation of the LNG terminal and associated infrastructure (e.g., South Dunes Power Plant, temporary workers camp, SORSC). The areas affected by operation (as listed in table 4.5.1.1-1) would be considered a permanent impact, as these areas would remain cleared of vegetation for the life of the Jordan Cove Project. Areas that would be restored to pre-construction conditions following completion of construction would be considered temporary impacts (i.e., the difference between the values reported for construction impacts and the values reported for operation).

TABLE 4.5.1.1-1

Impact on Vegetation Type from the Proposed Jordan Cove Facilities

Vegetation Type	Land Cleared during Construction (acres) a/	Land Permanently Cleared due to Operations (acres) a/
FERC-Jurisdictional Project Facilities		
Forested Associations		
Port Orford Cedar/Evergreen Huckleberry	2	2
Red Alder/Salmonberry/Slough Sedge-Skunk Cabbage	<1	<1
Shore Pine- Sitka Spruce/Evergreen Huckleberry	2	2
Shore Pine/Scotch Broom/Evergreen Beachgrass	5	5
Shore Pine-Douglas Fir/Wax Myrtle-Evergreen Huckleberry	8	8
Shore Pine-Sitka Spruce/Evergreen Huckleberry	42	42
Woodland Associations		
Shore Pine/Hairy Manzanita	2	2
Shrubland Associations		
Hooker Willow-Crabapple/Slough Sedge-Skunk Cabbage	<1	<1
Herbaceous, Disturbed, or Other Associations		
American Dunegrass	8	8
Baltic Rush-Pacific Silverweed Flooded Tidal (Tidally Flooded)	<1	<1
Disturbed	19	9
Estuarine Habitat	31	31
European Beachgrass	51	51
Open Water/Common Cattail	<1	<1
Pond Lily	<1	<1
Red Fescue	10	10
Red Fescue-Salt Rush	10	10
Saltgrass-Pacific Silverweed Flooded Tidal (Tidally Flooded)	2	2
Total Impacts from Jurisdictional Project Facilities	***195***	***185***
Non-Jurisdictional Project Facilities		
Forested Associations		
Red Alder/Salmonberry/Slough Sedge-Skunk Cabbage	<1	<1
Shore Pine/Scotch Broom/European Beachgrass	<1	<1
Shore Pine-Douglas Fir/Wax Myrtle-Evergreen Huckleberry	5	5
Shrubland Associations		

TABLE 4.5.1.1-1

Impact on Vegetation Type from the Proposed Jordan Cove Facilities

Vegetation Type	Land Cleared during Construction (acres) a/	Land Permanently Cleared due to Operations (acres) a/
Hooker Willow-Crabapple/Slough Sedge-Skunk Cabbage	<1	<1
Herbaceous, Disturbed, or Other Associations		
American Dunegrass	1	1
Disturbed	***33***	***33***
European Beachgrass	<1	<1
Open Water/Common Cattail	1	1
Red Fescue	24	24
Total Impacts from Non-Jurisdictional Project Facilities	***66***	***66***
Temporary Construction Areas b/		
Forested Associations		
Shore Pine/Scotch Broom/European Beachgrass	3	0
Shore Pine-Douglas Fir/Wax Myrtle-Evergreen Huckleberry	12	0
Shore Pine-Sitka Spruce/Evergreen Huckleberry	13	0
Woodland Associations		
Shore Pine/Bearberry	4	0
Shore Pine/Hairy Manzanita	<1	0
Herbaceous, Disturbed, or Other Associations		
American Dunegrass	3	0
Disturbed	43	0
European Beachgrass	57	0
Total Impacts from Temporary Construction Areas	***136***	***0***
Grand Total for All Impacts		
Impact Grand Total	**397**	**251**

See table 2.3.1-1 in chapter 2 for the acreage of each individual Project component.

a/ Values may not sum exactly due to rounding of significant digits. Acreages are rounded to the nearest whole acre; acreages less than 1 acre are reported as <1.

b/ The values reported for Temporary Construction Area impacts exclude areas that overlap with permanent facility impacts.

Construction of the Jordan Cove facilities would result in a total of approximately 397 acres of clearing (about 195 acres of this would result from construction of FERC jurisdictional facilities). A total of approximately 251 acres of this impact would consist of permanent vegetation removal (i.e., areas that would remain affected throughout the life of the Jordan Cove Project and would occur under or within the footprint of Project-related facilities), with about 185 acres of this permanent impact resulting from FERC jurisdictional facilities. European beachgrass (with 109 acres of construction impacts or 27.4 percent of the total impact), currently disturbed habitats (with 95 acres of construction impacts or 23.0 percent), shore pine-Sitka spruce/evergreen huckleberry (with 55 acres of construction impact or 13.8 percent), and red fescue associations (with 34 acres of construction impacts or 8.6 percent) would be the most affected vegetation types.

The clearing of a dune forest habitat during construction would indirectly impact the vegetation at the newly exposed edge of the coniferous forest by changing the micro-climate factors (wind, light, salt spray, organisms that prefer edges). The vegetation found within the forest interior would be exposed to the environmental elements experienced by a forest edge, which could lead to a change in species composition.

After creation of the marine slip, all disturbed areas would be stabilized immediately with a dunegrass seed mixture compatible with applicable agency criteria as being capable of surviving in highly permeable substrates in order to withstand seasonal soil moisture changes, loose sand, and burial and deflation from aeolian (wind) processes.

To reduce the effects on vegetation within the construction area and improve the potential for revegetation, Jordan Cove would implement measures from its *Plan* and *Procedures* during construction and restoration. Areas that are disturbed by construction activities but are not affected by a facility component would be revegetated with native species of a local seed source, to achieve stabilization and prevent erosion of the disturbed areas. Restoration of areas disturbed by permanent facility components would be stabilized to prevent erosion by the planting of non-invasive species. Native species would be used if practical and, if any non-native species are required for specific problem areas, the species would be selected to ensure that it would not become a nuisance species to the surrounding areas. Environmental monitoring would be conducted in all of the areas disturbed, and would focus upon stabilization and prevention of erosion; monitoring would be an ongoing activity within the Jordan Cove facilities for the life of the Jordan Cove Project.

Noxious Weeds

For the purpose of this analysis, noxious weeds and invasive plant species are defined as non-native, undesirable native, or introduced species that are able to exclude and out-compete desirable native species, and thereby decrease overall species diversity. Noxious weeds often invade and persist in areas after the vegetation and ground has been disturbed and can hinder restoration. The ODA Noxious Weed Control Program and the OSWB maintain the State Noxious Weed List. There are three classes of listed noxious weeds under the ODA Noxious Weed Control Classification System (i.e., Class A, Class B, and Class T weeds[75]). Species listed in the Noxious Weed Policy and Classification System and in the Oregon Aquatic Nuisance Species Management Plan that could potentially occur within the LNG terminal area are summarized in table 4.5.1.1-2.

TABLE 4.5.1.1-2

Potential for Species on the Coos County Noxious Weed List 2011-2012 to Occur at the Jordan Cove Project Site

Common Name	Scientific Name	LNG Export Terminal Facility	South Dunes Power Plant	Worker Camp
"A" Designated Weeds (i.e., weeds that occur in small enough infestations to make eradication or containment possible or is not known to occur in Oregon, but is present in neighboring states making occurrence in Oregon seem imminent)				
Dalmatian toadflax	*Linaria dalmatica*			
Diffuse knapweed	*Centaurea diffusa*			
False brome	*Brachypodium sylvaticum*			
Garlic mustard	*Alliaria petiolata*			
Giant hogweed	*Heracleum mantegazzianum*			
Portuguese broom	*Cytisus striatus*			
Spanish heath	*Erica lusitanica*			
Spotted knapweed	*Centaurea stoebe*			
Wooly distaff thistle	*Carthamus lanatus*			
Yellow Star thistle	*Centaurea solstitialis*			
"B" Designated Weeds (i.e., weeds that are regionally abundant, but may have limited distribution in some counties)				
Acacia	*Acacia* spp.			

[75] Class A – Weeds of known economic importance which occur in small enough infestations to make control or containment possible; or are not known to occur in Oregon, but are present in neighboring states making future occurrence in Oregon seem imminent.
Class B – Weeds of economic importance which are regionally abundant, but which may have limited distribution in some counties.
Class T – Priority noxious weeds designated as target species for which the ODA will develop and implement statewide management plans. Species selected from either the class "A" or "B" list.

TABLE 4.5.1.1-2

Potential for Species on the Coos County Noxious Weed List 2011-2012 to Occur at the Jordan Cove Project Site

Common Name	Scientific Name	LNG Export Terminal Facility	South Dunes Power Plant	Worker Camp
Biddy biddy	*Acaena novae-zelandiae*			
Bohemian knotweed	*Polygonum bohemica*			
Brazilian waterweed	*Egeria densa*			
Bull thistle	*Cirsium vulgare*	L	L	X
Butterfly bush	*Buddleia davidii*			
Canada thistle	*Cirsium arvense*	X	X	L
Cotoneaster	*Cotoneaster frigidus*			
English holly	*Ilex aquifolium*			
English ivy	*Hedera helix*	L	X	L
European beachgrass	*Ammophila arenaria*	X	X	X
Field bindweed (morning glory)	*Convolvulus arvensis*	L	L	L
French broom	*Cytisus monspessulanas*	X	L	L
Giant knotweed	*Polygonum sachalinesis*			
Gorse	*Ulex europaeus*	X	X	X
Herb robert	*Geranium robertianum*			
Himalayan blackberry	*Rubus discolor (R. armeniacus, R. procerus, R. fruticosa)*	X	X	X
Himalayan knotweed	*Polygonum olystachyum*			
Italian thistle	*Carduus pycnocephalus*	L	X	L
Japanese knotweed	*Polygonum cuspidatum*			
Meadow knapweed	*Centaurea moncktonii*			
Milk thistle	*Silybum marianum*			
Old man's beard	*Clematis vitalba*			
Pampas grass	*Cortaderia jubata*	L	X	X
Parrotfeather	*Myriophyllum aquaticum*	X	X	
Pennyroyal	*Mentha pulegium*	X	L	
Poison hemlock	*Conium maculatum*	X	X	
Purple loosestrife	*Lythrum salicaria*			
Scotch broom	*Cytisus scoparius*	X	X	X
Smooth cordgrass	*Spartina alterniflora*	L	L	
Sweet fennel	*Foeniculum vulgare*	X		
Tansy ragwort	*Senecio jacobaea*			
Yellow flag iris	*Iris psuedacorus*			
Yellow glandweed	*Parentucellia viscosa*	X	L	L
"T" Designated Weeds (i.e., weeds that are selected from the A or B lists and are designated as a target species)				
Bohemian knotweed	*Polygonum bohemica*			
Butterfly bush	*Buddleia davidii*			
Giant knotweed	*Polygonum sachalinesis*			
Gorse	*Ulex europaeus*	X	X	X
Himalayan knotweed	*Polygonum polystachyum*			
Japanese knotweed	*Polygonum cuspidatum*			
Meadow knapweed	*Centaurea moncktonii*			
Old man's beard	*Clematis vitalba*			
Parrotfeather	*Myriophyllum aquaticum*	X	X	
Purple loosestrife	*Lythrum salicaria*			
Yellow flag iris	*Iris psuedacorus*			

County list provided by the Oregon State University Extension Service.
"X" – indicates species has been documented at the project site
"L" – indicates species is likely to occur at the project area

Of the species listed in table 4.5.1.1-2, the following were encountered during field surveys conducted for the Jordan Cove Project: gorse (*Ulex europaeus*), parrotfeather (*Myriophyllum aquaticum*), Canada thistle (*Cirsium arvense*), English ivy (*Hedera helix*), European beachgrass, Himalayan blackberry (*Rubus armeniacus*), Italian thistle (*Carduus pycnocephalus*), Pennyroyal (*Mentha pulegium*), poison hemlock (*Conium maculatum*), scotch broom (*Cytisus scoparius*), sweet fennel (*Foeniculum vulgare*), and yellow glandweed (*Parentucellia viscosa*). Of these

species, gorse and parrotfeather are classified as Class "T" weeds (i.e., weeds selected from the A or B lists that are targeted for eradication). The basic traits of these two Class "T" weeds are summarized below:

- Gorse readily invades areas of recent disturbance, such as pastures, agricultural lands, harvested timberlands, roadsides, trails, state parks and vacant lots, and can increase the risk of fire within affected areas due to an increase in flammable fuel loads. Gorse is intermixed within the forest and shrub associations in the project area, primarily near disturbed areas.
- Parrotfeather is a dominant species within yellow pond lily wetlands within the project area. Once parrotfeather becomes established in a natural waterbody, it can quickly grow into dense mats that shade out native plants and algae, while reducing fish habitat and recreational use.

Although botanical surveys were conducted at an appropriate time of year to identify weed species, the fact that only a subset of the weed species that could potentially occur in the area were actually identified in the areas does not mean that the other possible weed species (or any other invasive species) are not also present in the area (for example, additional weeds species may be present in the seedbank, and simply did not germinate during the survey window). Surveys were conducted to create a list of known infestations that could be mapped and controlled. If additional infestations or other invasive weed species are found, then these would be controlled and monitored as well. Measures aimed at preventing the spread of invasive weeds were designed to prevent the spread of all weeds species, not just those that were identified during surveys.

Construction of the LNG terminal has the potential to increase the risk of aquatic and terrestrial invasive plant species within and adjacent to the project area due to the amount of ground disturbance, heavy equipment use, and potential off-site vectors (i.e., equipment used in other locations). To avoid introducing or spreading invasive species, Jordan Cove would follow the recommendations outlined in the Oregon Aquatic Species Management Plan, the Oregon Noxious Weed Strategic Plan, BLM's multi-state EIS Northwest Area Noxious Weed Control Program (BLM 1985) and its supplements, and the BLM's *Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report* (2007). These documents focus on detection, containment, and/or reduction of invasive plant infestations with an integrated pest management approach (e.g., chemical, mechanical, manual, and/or biological) as well as implementation of measures to avoid the introduction and spread of noxious weeds.

Jordan Cove would conduct a pre-construction survey of the site to identify noxious species listed by the ODA that persist despite recent and previous control efforts. Following the survey, Jordan Cove would employ standard removal practices (BLM 1985) for the weed species identified on the site. Methods for removal that would not aid in the dispersal of these species would be used and would include the use of integrated BMPs such as fire, mechanical or manual removal, and herbicide application, as appropriate. Treated areas would be restored by spreading native seeds and planting native plants.

Construction equipment used off the site would be cleaned to prevent the export and spread of noxious weed species and seeds. Jordan Cove would also use herbaceous and native dune seed mixes to limit germination of noxious weeds during the stabilization and restoration of the site

during and following construction. Once the site is stabilized and in operation, Jordan Cove would check the site for noxious weed infestations and control measures would be implemented that are consistent with ODA, OISC, and BLM noxious weed control plans and policies, as applicable.

Vegetative Pathogens

Port-Orford-cedar root rot disease is caused by the fungus *Phytophthora lateralis*. The disease was first discovered in Port-Orford-cedar's natural range in 1952 and since has spread throughout the host's range. The fungus invades the roots of Port-Orford-cedar and eventually colonizes the entire root system until the tree eventually dies from girdling. Port-Orford-cedar root rot disease affects both seedlings and mature trees. Evidence of infected trees includes lighter colored foliage that eventually turns red to brown and dies and discolored inner bark. The spores live in the soil and are spread through contact with contaminated soil or via free water. The disease is primarily spread through soil disturbance and moving water. Spread of the disease over long distances occurs from contaminated equipment and livestock.

Surveys for Port-Orford-cedar root rot disease were not conducted at the Jordan Cove project area; however, based on what is known about the disease, it is likely to be present in the Coos Bay area, regardless of whether infected trees have been identified. Jordan Cove would take precautions during the construction to minimize the introduction or spread of Port-Orford-cedar root rot disease from contaminated earth moving equipment. Jordan Cove would conduct surveys prior to construction to identify whether the disease occurs on site, and if found, it would implement measures to decontaminate equipment before leaving the site and to prevent cross contamination between soil and water. In addition, all equipment would be decontaminated before beginning work on the site. If the disease is found during pre-construction surveys, maps with precise locations would be provided to all contractors and site construction personnel to help prevent the spread of the disease to off-site locations. To ensure adequate conservation measures to address Port-Orford-cedar root rot disease are in place and implemented, Jordan Cove would follow the measures and recommendations found in the Forest Service and BLM's Final Supplemental EIS regarding the management of Port-Orford-cedar in southwest Oregon (Forest Service and BLM 2004).

4.5.1.2 Pacific Connector Pipeline

The Pacific Connector pipeline route would cross ecologically diverse areas from Coos Bay to the Klamath Basin. It would pass through the wet, marine-influenced evergreen forests in the coastal region, coniferous forests of the Klamath Mountains and Cascades, and sagebrush steppe typical of the Basin and Range sub-ecoregions.

The pipeline lies within four ecoregions (see figure 4.5-2): (1) the Coast Range, which consists mainly of Douglas-fir plantations; (2) the Klamath Mountains, which supports a mosaic of northern California and Pacific Northwest conifers and hardwoods characteristic of areas with lengthy summer droughts; (3) the Cascades, which has a moist, temperate climate and contain an extensive and highly productive coniferous forest; and (4) the Eastern Cascades Slopes and Foothills, which supports shrub/grassland areas as well as open forests of ponderosa pine (*Pinus ponderosa*) and some shore pine (also known as lodgepole pine; *Pinus contorta*) that are adapted to the prevailing dry, continental climate and frequent fires found in this area (Bryce et al. 2003). Each ecoregion within Oregon has been divided into sub-ecoregions.

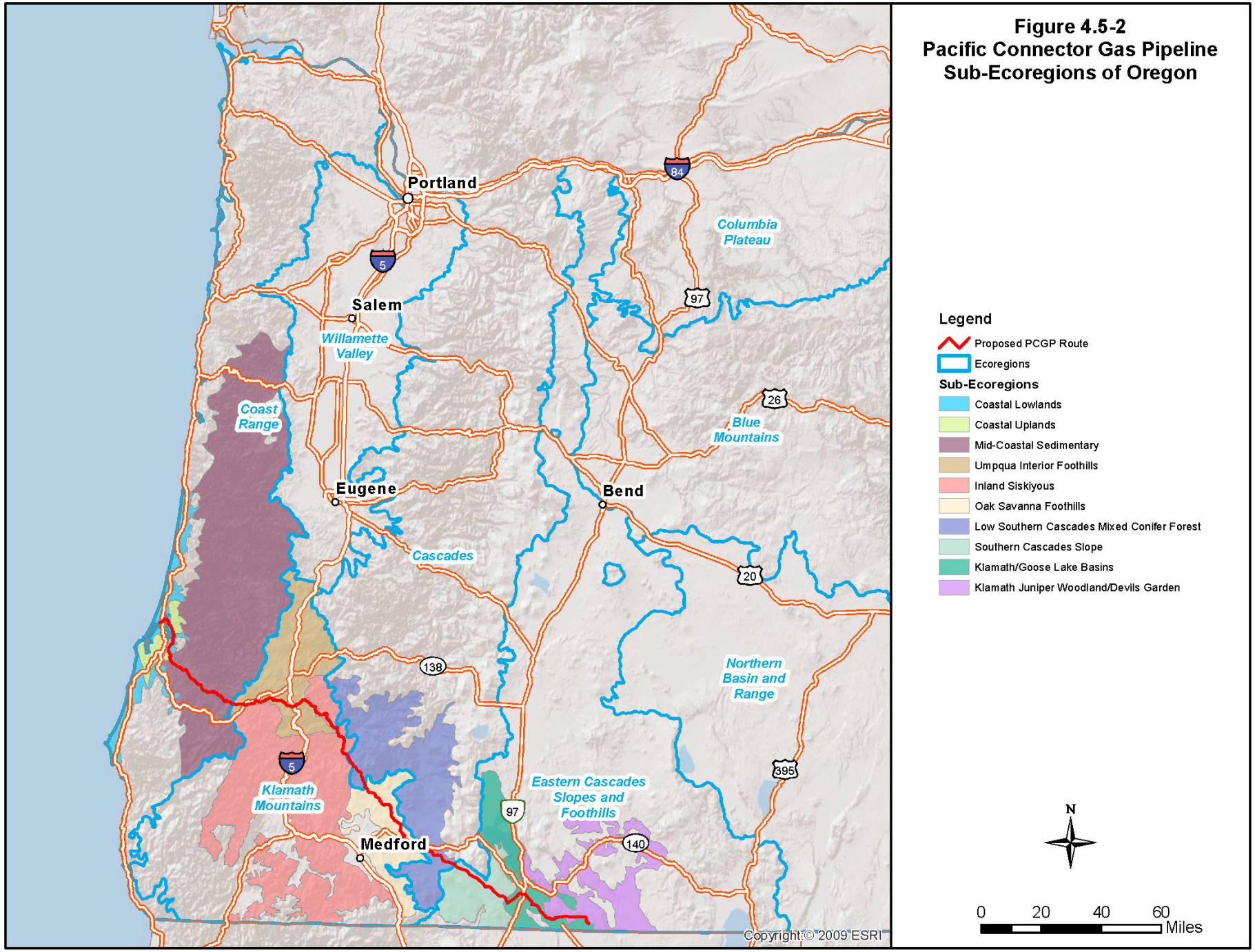


Figure 4.5-2
Pacific Connector Gas Pipeline
Sub-Ecoregions of Oregon

Within the Coast Range ecoregion there are three sub-ecoregions: the Coastal Lowlands, Coastal Uplands, and Mid-Coastal Sedimentary sub-ecoregions (Bryce et al. 2003). The Coastal Lowlands sub-ecoregion consists of beaches, dunes, and marine terraces (less than 400 feet) with wet forests, lakes, estuarine marshes, and tannic streams. Within this sub-ecoregion, many wetlands have been drained and converted to pastures. Residential, commercial, and recreational developments are currently expanding within this sub-ecoregion. The Coastal Uplands sub-ecoregion consists of headlands and low mountains. The Mid-Coastal Sedimentary sub-ecoregion consists of Douglas-fir forests, which lie outside the coastal fog zone and are intensively managed for timber production. Because this area is typically underlain by sandstone and siltstone, slope can become unstable when disturbed.

Within the Klamath Mountains ecoregion there are three sub-ecoregions, the Umpqua Interior Foothills, Inland Siskiyous, and Oak Savanna Foothills sub-ecoregions (Bryce et al. 2003). The Umpqua Interior Foothills sub-ecoregion consists of a complex of foothills and narrow valleys containing fluvial terraces, floodplains, and a xeric moisture regime. Dominant species present include Oregon white oak woodland, Douglas-fir, ponderosa pine, and Pacific madrone (*Arbutus menziesii)*, intermixed with pastureland, vineyards, orchards, and row crops. Within the Inland Siskiyous sub-ecoregion, forest cover is diverse, with a multi-layered mix of conifers, broadleaf evergreens, and deciduous trees. This area experiences a higher fire frequency with less annual precipitation and longer summer droughts than the coastal areas. It is more mountainous and at higher elevations than neighboring ecoregions. The Oak Savanna Foothills has two distinct components: (1) the driest area east of Medford that is dominated by oak woodlands, grassland-savanna, ponderosa pine, and Douglas-fir; and (2) the wetter foothills in the Illinois Valley that support Douglas-fir, Pacific madrone, and incense cedar (*Libocedrus decurrens*).

Only one sub-ecoregion (Southern Cascades) is crossed by the pipeline within the Cascades ecoregion (Bryce et al. 2003). Tree species present within the Southern Cascades sub-ecoregion are western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), and Sierra Nevada species, such as incense cedar, white fir (*Abies concolor*), and Shasta red fir (*Abies magnifica* var. *shastensis*) that can tolerate prolonged summer drought. The Southern Cascades are low in elevation and lack steep slopes, which means river and stream discharge is low.

Within the Eastern Cascades Slopes and Foothills ecoregion there are three sub-ecoregions, the Southern Cascade Slope, Klamath/Goose Lake Basins, and Klamath Juniper Woodland sub-ecoregions (Bryce et al. 2003). The Southern Cascade Slope sub-ecoregion is considered a transition zone between the Cascades and the drier Eastern Cascades, this sub-ecoregion has a mix of forest types, including ponderosa pine, white fir, incense cedar, Shasta red fir, and Douglas-fir (at higher elevations). Historically, the Klamath/Goose Lake Basins consists of a variety of wildrye, bluegrass, and wheatgrass species; however, most of the wet meadows and wetlands have been drained and converted for agriculture. This sub-ecoregion consists of river floodplains, terraces, and lake basins. The Klamath Juniper Woodland is composed of hills, benches, and escarpments that are covered with a mosaic of rangeland and woodland, providing important habitat for wildlife. Western juniper (*Juniperus occidentalis*) grows on shallow, rocky soils with an understory of low sagebrush (*Artemisia arbuscula*), big sagebrush (*Artemisia tridentate*), bitterbrush (*Purshia tridentate*), and bunchgrasses. Other shrubland/grasslands include species uncommon in eastern Oregon, such as woolly wyethia (*Wyethia mollis*), Klamath

plum (*Prunus subcordata*), and birchleaf mountain mahogany (*Cercocarpus montanus* var. *glaber*).

Existing vegetative resources within the pipeline's project area were determined and classified based on (1) botanical surveys conducted between 2007 and 2012 by Siskiyou BioSurvey LLC (SBS); (2) wetland delineation surveys conducted between 2006 and 2008 by Jones & Stokes Associates; (3) consultation with BLM and Forest Service experts; (4) aerial photography of the pipeline alignment; (5) BLM Forest Cover Operations Inventory digital GIS coverage; (6) digital GIS data coverage and vegetation categories described by the Oregon Gap Analysis Project (Oregon GAP; Kagan et al. 1999); and (7) current wildlife-habitat types described and delineated by the Northwest Habitat Institute in 1999 (Kiilsgaard and Garrett 1999). Additional details regarding the botanical and wetland surveys can be found in the botanical and wetland survey reports, which were included in Pacific Connector's June 2013 application to the FERC in Docket No. CP13-492-000.

Vegetation Associations

The following subsections describe the various vegetation associations found along the pipeline route. In general, these descriptions follow the categories developed by the Oregon GAP (Kagan et al. 1999); however, there are a few cover types present along the Pacific Connector pipeline route that were not described by the Oregon GAP. Therefore, descriptions found in the USGS Land Use and Land Cover Classification System, as well as Anderson et al. (1976), Johnson and O'Neil (2001), and Franklin and Dyrness (1988) were used for vegetation types delineated within the Pacific Connector pipeline area that were not included in the Oregon GAP.

Forest and Woodland Vegetation Types

Forests associations found along the Pacific Connector pipeline route were assigned an age class using available GIS data. Age class was also reviewed by BLM and Forest Service biologists on their respective lands with specific focus on verifying/classifying late seral forest stands, as well as by SBS. Age classes were categorized within five age ranges: clearcut (0-5 years), regenerating (5-40 years), mid-seral (40-80 years), late successional (80-175 years), and old growth (175+ years), based on Moeur et al. (2006).

- Clearcut includes areas that were recently harvested within the past five years but presently are non-stocked. This age class generally has a canopy cover of less than 10 percent.
- Regenerating forest or younger forest includes stands with average age of tree from 5 to 40 years. This age class generally includes seedlings and saplings with canopy cover greater than 10 percent and tree size less than 10 inches diameter at breast height (dbh). This category was further refined to identify early regenerating forest (harvested within the last 10 to 15 years) and regenerating forest for interior forest analyses described later in this section.
- Mid-seral forest includes stands within the current harvest rotation in Oregon, generally 40 to 80 years. This age class generally includes small single- and multi-storied trees with canopy cover greater than 10 percent and tree size between 10 and 20 inches dbh.
- Late successional forest includes forest stands between 80 and 175 years old. This age range is consistent with definitions used in the NWFP and as described in Moeur et al.

(2006). This age class generally includes medium and large single- or multi-storied trees with canopy cover greater than 10 percent and average tree size between 20 and 30 inches dbh.

- Old-growth forest includes forest stands greater than 175 years and dominated by coniferous forest. This correlates well with Moeur et al. (2006), Franklin et al. (1981, 1986), and Franklin and Spies (1991) descriptions that consider primary size and canopy structure characteristics of old-growth Douglas fir to develop between 175 and 250. This age class generally includes large, multi-storied stands with canopy cover greater than 10 percent and average tree dbh greater than 30 inches.

Douglas-fir–Western Hemlock–Western Redcedar Forest

Douglas-fir dominates multi-storied canopy, with western hemlock, western redcedar, and grand fir (*Abies grandis*) as co-dominants. In addition, Pacific yew (*Taxus brevifolia*) may be present in the subcanopy (Kagan et al. 1999). Port-Orford-cedar can also be a dominant tree species within Douglas-fir–Western hemlock–Western redcedar forest types within the pipeline project area (Johnson and O'Neil 2001). Within riparian areas, and non-conifer dominated stands, bigleaf maple (*Acer macrophyllum*) and red alder (*Alnus rubra*) are common. Large stature shrubs are frequently present, such as vine maple (*Acer circinatum*), Pacific rhododendron, and evergreen and red huckleberry (*Vaccinium ovatum* and *V. parvifolium*). Ferns dominate the rich and diverse herbaceous layer. This forest type is found low to mid elevations (Kagan et al. 1999). It is located in Coos and Douglas Counties along the pipeline route.

Douglas-Fir–Mixed Deciduous Forest

This forest type is a low to mid-elevation conifer and mixed deciduous forest found primarily in southwestern Oregon. The upper tree layer always contains Douglas-fir, with the sub-canopy consisting of a mix of shade tolerant conifers and deciduous trees including: tanoak, Pacific madrone, golden chinquapin, and Pacific dogwood. Indicative shrubs of this cover type include dwarf Oregon-grape, pacific blackberry, oceanspray, California hazelnut, and others (Kagan et al. 1999). This forest type is found within Douglas, Jackson, and Klamath Counties along the pipeline route.

Alder–Cottonwood

This forest type is found along the margin of flowing streams in the foothills and mountains throughout much of Oregon. It is prevalent along high gradient stream systems that flood frequently and deposit bed-load sand and gravel. Black cottonwood is always present in the overstory. West of the Cascade crest, other dominant species in the overstory include red alder and big leaf maple, and conifers could include Douglas-fir, western hemlock, Western redcedar, and Port-Orford-cedar. East of the Cascade crest, the other dominant species include white alder, with other deciduous trees present including mountain alder, Pacific willow, non-native black locust, and quaking aspen. Conifers associated east of the Cascades include ponderosa pine, Douglas-fir, Engelmann spruce, and lodgepole pine (Kagan et al. 1999). This forest type is found within all counties crossed by the pipeline route.

Mixed Conifer/Mixed Deciduous Forest

This forest type contains early successional (old clear-cut) generally composed of co-dominant conifer (Douglas-fir) and deciduous (red alder and/or bigleaf maple) trees in a single-layered canopy forest (Kagan et al. 1999). Port-Orford-cedar may also be the dominant tree species

within this forest type (Johnson and O'Neil 2001). This forest type is found in low- to mid-elevations (Kagan et al. 1999). It is located in Coos County along the pipeline route.

Shasta Red Fir–Mountain Hemlock Forest

This mid-to-upper elevation conifer forest is mostly found above 4,000 feet. Overstory species generally include Shasta red fir, mountain hemlock, white fir, and lodgepole pine. It often is a closed, multi-story canopy with dense understory of shrubs, forbs, and ferns, including dwarf bramble, Oregon boxwood, pinemat manzanita, and saddler oak (Kagan et al. 1999). Along the pipeline route, this forest type is located in Jackson and Klamath Counties.

Douglas-fir–White Fir/Tanoak–Madrone Mixed Forest

Multi-layered forest of mixed conifer and mixed deciduous species make up this forest type. It always contains Douglas-fir, with other co-dominants (i.e., white fir, incense cedar, sugar pine [*Pinus lambertiana*] and western white pine). Subcanopy layers contain shade-tolerant trees, including tanoak (*Lithocarpus densiflorus*), Pacific madrone, chinquapin (*Chrysolepis hjelmquist*), Pacific dogwood (*Cornus nuttallii*), and California laurel (*Umbellularia californica*). Shrub and herb layers are generally well represented. This forest type is found at low to mid elevations (Kagan et al. 1999). It is located in Jackson County along the pipeline route.

Douglas-fir Dominant-Mixed Conifer Forest

Single-layer forest canopy is typical within this forest type, although stand structure can be diverse in undisturbed late seral stands. There is a wide range of canopy closure based on management practice, disturbance history, and microsite. Douglas-fir is dominant, with a variety of coniferous trees including, white fir, incense cedar, western white pine, ponderosa pine, and sugar pine. Understory vegetation is usually diverse and rich in species. This forest type is found at mid elevations (Kagan et al. 1999). It is located in Coos, Douglas, Jackson, and Klamath Counties along the pipeline route.

Ponderosa Pine/White Oak Forest and Woodland

Ponderosa pine is exclusively the overstory tree at low elevations within this forest type. White fir, grand fir, western larch (*Larix occidentalis*), incense cedar, Douglas-fir, subalpine fir, and Engelmann spruce (*Picea engelmannii*) dominate at higher elevations. Understory and regeneration layers reflect similar composition as overstory. Lower elevations have fewer shrubs, increasing in diversity and abundance with elevation and improved soil moisture conditions. This forest type is found at low to middle elevations (Kagan et al. 1999). It is found in Jackson and Klamath Counties along the pipeline route.

Ponderosa Pine Forest and Woodland

Ponderosa pine is exclusively the overstory tree at low elevations within this forest type. White fir, grand fir, western larch, incense cedar, Douglas-fir, subalpine fir, and Engelmann spruce are dominant at higher elevations. Understory and regeneration layers reflect similar composition as overstory. Lower elevations have fewer shrubs, increasing in diversity and abundance with elevation and improved soil moisture conditions. This forest type is found at low to middle elevations (Kagan et al. 1999). It is found in Jackson and Klamath Counties along the pipeline route.

Oregon White Oak Forest

This forest type contains deciduous woodland/forest dominated by Oregon white oak (*Quercus garryana*). Other canopy trees can be Douglas-fir and ponderosa pine in upland settings, and Oregon ash (*Fraxinus latifolia*), cottonwood (*Populus* spp.), and bigleaf maple on valley floors. The subcanopy often consists of California black oak (*Quercus velutina*). Understory typically contains tall deciduous shrubs and smaller stature deciduous trees. This forest type is a highly desirable wildlife habitat that has been decreasing as a result of fire suppression. It is found at low elevations (Kagan et al. 1999). This forest type can require more than 100 years to reach full productivity and function as wildlife habitat, and these types of habitats are limited within the region (see section 4.6). It can be found in Douglas and Jackson Counties along the pipeline route.

Western Juniper Woodland

This woodland type is dominated by western juniper and has an open canopy (less than 30 percent crown closure) and single story, short stature (6 to 20 feet tall) trees. Understory vegetation is dominated by sagebrush species, such as big sagebrush, rigid sagebrush (*Artemisia rigida*), and low sagebrush, as well as mountain mahogany, bitterbrush, and rabbitbrush (*Chrysothamnus* spp.). Grasses characterize the herbaceous layer. This woodland type is found at a wide range of elevations (Kagan et al. 1999). It can be found in Klamath County along the pipeline route.

Ponderosa Pine/Western Juniper and Woodland

This woodland type is typically found in the foothill margins bordering upland conifer types and sagebrush dominant lowlands. This forest type has a two-story canopy with widely spaced overstory ponderosa pine and a subcanopy of western juniper. Canopy cover is generally between 10 and 50 percent. The understory is dominated by a shrub layer, including big sagebrush, low sagebrush, rabbitbrush, mountain mahogany, and bitterbrush, and is interspersed with annual bunch grasses (Kagan et al. 1999). This woodland type is in Klamath County along the pipeline route.

Grass-shrub-sapling or Regenerating Young Forest

This forest type is characteristic of successional conditions following timber harvest, which can include ground scarification and slash/large woody debris, a variety of shrubs and forbs typical of the area, and then conifer saplings which form a continuous canopy above the shrub layer (Kagan et al. 1999). This forest type is located within all counties crossed by the pipeline route.

Grassland and Shrubland Vegetation Types

Sagebrush Steppe

This vegetation type is a mosaic of grasses (mostly introduced) and shrubs that include big sagebrush subspecies, such as Wyoming, basin, and mountain. Other shrubs include low, silver, and three-tip sage brush, and rabbitbrush. A variety of bunchgrasses are scattered with the shrubs, although overgrazing has limited their presence (Kagan et al. 1999). This vegetation type is found in Klamath County along the pipeline route.

Shrublands

This vegetation type consists of a mosaic of grasses and shrubs. It may include sagebrush, but is not dominated by this species. It typically occurs within revegetated utility corridors and

transitional areas, such as reclaimed industrial sites. This vegetation type is within all counties crossed by the pipeline route.

Grasslands (west of Cascades)

This habitat contains less than 30 percent tree or shrub cover and is generally used for livestock grazing. Bunchgrasses dominate native-dominated sites, with mosses, lichens, and native forbs occurring throughout. It is found at lower elevations (Johnson and O'Neil 2001). It can be found in Coos, Douglas, and Jackson Counties along the pipeline route.

Grasslands (east of Cascades)/Forest-Grassland Mosaic

This vegetation type is a mosaic of bunchgrass grasses and conifer forest in the east Cascades. Ponderosa pine, Douglas-fir, white fir, and incense cedar are common conifers, with Idaho fescue generally the dominant grass. Other grasses that can form co-dominances include bluebunch wheatgrass (*Pseudoroegneria spicata*), junegrass (*Koeleria* spp.), Sandberg bluegrass (*Poa secunda*), and western needlegrass (*Achnatherum occidentale*). In heavily grazed stands, cheatgrass (*Bromus tectorum*) and bottlebrush squirreltail (*Elymus elymoides* ssp. *elymoides*) can be dominant. This vegetation type is found at low to middle elevations (Kagan et al. 1999). It is found in Klamath County along the pipeline route.

Riparian and Wetland Vegetation Types

Palustrine Forest

This vegetation type typically has a multi-storied canopy (trees greater than 18 feet tall). Deciduous trees generally dominate in eastern Oregon, including black cottonwood, white alder (*Alnus rhombifolia*), quaking aspen (*Populus tremuloides*), and peachleaf willow (*Salix amygdaloides*). In western Oregon, conifer trees tend to dominate the canopy: western redcedar, western hemlock, Douglas-fir, and grand fir. This vegetation type is located in narrow strips along riparian zones (Kagan et al. 1999). It is found within all counties crossed by the pipeline route.

Palustrine Shrubland

This vegetation type is dominated by dense, tall shrubs, typically willow species. Other shrubs found could include chokecherry (*Prunus virginiana*), bog birch (*Betula pumila*), bog blueberry (*Vaccinium uliginosum*), snowberry (*Symphoricarpos albus*), wax currant (*Ribes cereum*), and *Douglas spiraea*. This vegetation type is most prominent along low gradient streams in broad valleys and pluvial basins of eastern Oregon (Kagan et al. 1999). It can be found in Coos, Jackson, and Klamath Counties along the pipeline route.

Estuarine Emergent

This vegetation type consists of herbaceous wetlands that border coastal river mouths, bays, and estuaries. Vegetation composition consists of three plant communities: salt marsh, intermarsh, and transition zone (Kagan et al. 1999). Within the pipeline project area, this category is found in Coos County.

Palustrine Emergent

This vegetation type is made up of freshwater herbaceous wetlands that contain medium tall (2 to 4 feet) to tall (greater than 4 feet) grass or grass-like plants. Common herbaceous plants include cattails (*Typha* spp.), bulrush species, and burreed (*Sparganium* spp.). Grasses associated with this category are blue wildrye (*Elymus glaucus*), tufted hair grass (*Deschampsia cespitosa*), bluejoint weedgrass (*Calamagrostis canadensis*), reed canarygrass, American sloughgrass

(*Beckmannia syzigachne*), and northern mannagrass (*Glyceria borealis*) (Kagan et al. 1999). This vegetation type can be found within all counties crossed by the pipeline route.

Agricultural Areas

Agricultural areas include crop land, orchards, hay fields, and managed pastures. These areas consist of lands that have been cleared of native vegetation and modified for growing crops and/or animal husbandry (Kagan et al. 1999). Agricultural lands are found within all counties crossed by the pipeline route.

Non-Vegetated Areas

There are multiple non-vegetated areas crossed by the pipeline route, including developed lands (including roads), industrial lands, urban lands, residential lands, barren land, and open water (e.g., rivers, streams, ditches, canals, ponds, bays, and estuaries). These areas are not assessed in detail within this section of the EIS as they are not vegetated; however, they are included in impact tables as well as brief summary discussions to maintain consistency with total impact values presented in other sections of this EIS.

General Impacts on Vegetation Associations

The pipeline would cross approximately 231.8 miles, of which 211.5 miles would occur in areas considered to be vegetated (i.e., excluding developed, barren, and open water areas; see table 4.5.1.2-1). Construction of the pipeline would impact approximately 5,565 acres, of which 4,523 acres would occur in areas considered to be vegetated (see table 4.5.1.2-2). Operation of the pipeline project would impact approximately 877 acres, of which 802 acres would occur in areas considered to be vegetated (see table 4.5.1.2-3). The primary effects of pipeline construction would be the cutting, clearing, and/or removal of existing vegetation within the work areas. All areas except the UCSAs and portions of the hydrostatic test discharge sites would be cleared of vegetation during construction.

Impacts on areas where no permanent structures, aboveground facilities, or roads would occur are considered temporary, because these areas would be restored and revegetated. However, the duration of these impacts could be either short-term or long-term, depending on pre-disturbance vegetation cover. For example, the clearing and restoration of forested areas would be a long-term impact because of the extended length of time it takes trees to grow to maturity from seedlings or saplings planted as part of the revegetation process. However, the 30-foot-wide maintenance corridor within the operational pipeline easement that is kept clear of trees in formerly forested area would be considered a permanent impact.

TABLE 4.5.1.2-1

Vegetation Cover Types Crossed by the Pacific Connector Pipeline Project

General Vegetation Type	Mapped Vegetation Category	Late Successional or Old-Growth Forest Crossed a/ (miles)	Percent of Total Late Successional or Old-Growth Forest a/	Mid-Seral Forest Crossed b/ (miles)	Percent of Mid-Seral Forest b/	Clearcut/ Regenerating Forest Crossed c/ (miles)	Percent of Clearcut/ Regenerating Forest c/	Total Miles d/	Percent of Total Vegetation Type
Forest-Woodland	Douglas-fir-W. Hemlock-W. Red-Cedar Forest	2.2	1.5	5.4	3.7	12.0	8.2	19.5	8.4
	Douglas-Fir-Mixed Deciduous Forest	6.4	4.4	12.9	8.8	7.8	5.3	27.1	11.7
	Alder-Cottonwood	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
	Mixed Conifer/Mixed Deciduous Forest	0.6	0.4	3.0	2.1	13.1	9.0	16.8	7.2
	Shasta Red Fir – Mountain Hemlock Forest	1.6	1.1	0.9	0.6	4.0	2.7	6.4	2.8
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	0.8	0.5	1.1	0.8	0.4	0.3	2.2	0.9
	Douglas-fir Dominant-Mixed Conifer Forest	23.6	16.2	8.6	5.9	13.9	9.5	46.1	19.9
	Ponderosa Pine/White Oak Forest and Woodland	2.7	1.9	2.0	1.4	2.5	1.7	7.3	3.1
	Ponderosa Pine Forest and Woodland	1.0	0.7	2.7	1.9	3.4	2.3	7.1	3.1
	Oregon White Oak Forest	2.5	1.7	2.4	1.6	0.0	0.0	4.9	2.1
	Western Juniper Woodland	0.0	0.0	3.3	2.3	0.0	0.0	3.3	1.4
	Ponderosa Pine/Western Juniper Woodland	0.0	0.0	1.0	0.7	3.8	2.6	4.8	2.1
	Subtotal	**41.3**	**28.3**	**43.6**	**29.9**	**60.9**	**41.7**	**145.9**	**62.9**
Grasslands-Shrubland	Sagebrush Steppe	0.0	0.0	0.0	0.0	0.0	0.0	4.9	2.1
	Shrublands	0.0	0.0	0.0	0.0	0.0	0.0	10.6	4.6
	Grasslands (West of Cascades)	0.0	0.0	0.0	0.0	0.0	0.0	10.2	4.4
	Grasslands (East of Cascades)/Forest-Grassland Mosaic	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.8
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**27.6**	**11.9**
Wetland / Riparian e/	Palustrine Shrub	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Palustrine Emergent	0.0	0.0	0.0	0.0	0.0	0.0	5.6	2.4
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**5.7**	**2.5**
Agriculture	Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	32.1	13.8
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**32.1**	**13.8**
Developed / Barren	Urban	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.6
	Industrial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Beaches	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
	Roads	0.0	0.0	0.0	0.0	0.0	0.0	15.0	6.5
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**16.5**	**7.1**
Open Water	Rivers and Streams	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4
	Ditches and Canals	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
	Palustrine Unconsolidated Bottom	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
	Bays and Estuaries	0.0	0.0	0.0	0.0	0.0	0.0	2.5	1.1
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3.8**	**1.6**
	Project Total	**41.3**	**0.0**	**43.6**	**0.0**	**60.9**	**0.0**	**231.8**	**100.0**
	Percent of Project Total	**17.8**	**0.0**	**18.8**	**0.0**	**26.3**	**0.0**	**100.0**	

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).
d/ Total miles crossed include the 0.9 mile of pipeline that would not disturb vegetation because of the HDD method and direct pipe method used to install pipeline below four waterbodies: Coos River, South Umpqua River, Rogue River, and Klamath River.
e/ Following wetland regulation protocols, the length of wetlands crossed is approximately 11.6 miles total for all Project elements. See section 4.4 for results of jurisdictional wetland delineation and discussion of project impacts to wetlands.
General: Mileages may not sum correctly due to rounding. Mileages are rounded to nearest tenth of a mile; values less than 0.1 are shown as "<0.1".).

TABLE 4.5.1.2-2

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project (acres)

			Pipeline Facilities								Subtotals					
General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Construction Right-of-Way	Hydrostatic Discharge Sites d/	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements) e/	Pipe Yards	Aboveground Facilities - Klamath Compressor Station	Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	25	0	1	5		<1	0	0	32	99	245	376	*13.0*	*6.8*
		M-S	66	0	22	9	<1	<1	0	0						
		C-R	138	0	78	23	5	<1	0	0						
	Douglas-fir – Mixed Deciduous Forest	L-O	73	0	20	102		<1	0	0	194	303	255	753	*26.1*	*13.5*
		M-S	152	0	34	105	3	2	7	0						
		C-R	92	<1	43	119		<1	<1	0						
	Alder-Cottonwood	L-O	0	0	0	0	0	0	0	0	0	<1	33	34	*1.2*	*0.6*
		M-S	<1	0	<1	0	0	<1	0	0						
		C-R	0	0	0	0	0	0	33	0						
	Mixed Conifer/Mixed Deciduous Forest	L-O	7	0	2	0	0	0	0	0	9	48	216	273	*9.5*	*4.9*
		M-S	37	0	10	1	0	0	0	0						
		C-R	155	0	56	5	0	<1	0	0						
	Shasta Red Fir – Mountain Hemlock Forest	L-O	18	0	1	7	0	0	0	0	26	14	78	119	*4.1*	*2.1*
		M-S	9	0	<1	4	0	0	0	0						
		C-R	45	0	17	16	0	<1	0	0						
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	9	0	3	6	0	0	0	0	17	23	6	46	*1.6*	*0.8*
		M-S	13	0	3	6	0	2	0	0						
		C-R	4	0	<1	1	0	<1	0	0						
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	273	0	50	112	2	1	0	0	438	171	265	873	*30.3*	*15.7*
		M-S	100	0	29	41	0	<1	0	0						
		C-R	157	0	45	61	<1	<1	0	0						
	Ponderosa Pine/White Oak Forest and Woodland	L-O	31	0	13	3	0	0	0	0	47	33	43	123	*4.3*	*2.2*
		M-S	24	<1	7	<1	0	0	0	0						
		C-R	29	0	8	7	0	0	0	0						
	Ponderosa Pine Forest and Woodland	L-O	11	0	2	0	0	0	0	0	13	35	50	99	*3.4*	*1.8*
		M-S	33	0	2	0	0	<1	0	0						
		C-R	39	0	9	0	<1	<1	0	0						
	Oregon White Oak Forest	L-O	30	0	10	5	0	<1	0	0	45	39	0	84	*2.9*	*1.5*
		M-S	28	0	8	3	0	<1	0	0						
		C-R	0	0	0	0	0	0	0	0						
	Western Juniper Woodland	L-O	0	0	0	0	0	0	0	0	0	42	0	42	*1.5*	*0.8*
		M-S	34	0	7	0	<1	<1	0	0						
		C-R	0	0	0	0	0	0	0	0						
	Ponderosa Pine/Western Juniper Woodland	L-O	0	0	0	0	0	0	0	0	0	13	48	61	*2.1*	*1.1*
		M-S	12	0	1	0	0	0	0	0						
		C-R	44	0	4	0	0	<1	0	0						

TABLE 4.5.1.2-2

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project (acres)

			Pipeline Facilities								Subtotals					
General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Construction Right-of-Way	Hydrostatic Discharge Sites d/	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements) e/	Pipe Yards	Aboveground Facilities - Klamath Compressor Station	Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*
Subtotal Forest-Woodland by Age Class		*L-O*	*477*	*<1*	*101*	*240*	*2*	*2*	*0*	*0*	*821*	*821*	*1,239*	*2,882*	*28.5*	*51.8*
		M-S	*508*	*<1*	*126*	*170*	*4*	*6*	*7*	*0*					*28.5*	
		C-R	*705*	*<1*	*260*	*233*	*6*	*2*	*33*	*0*					*43.0*	
	Subtotal Forest-Woodland		1,689	0	487	643	11	10	41	0	821	821	1,240	2,882	*100.0*	
	Percent of All Forest-Woodland		*58.6*	*0.0*	*16.9*	*22.3*	*0.4*	*0.3*	*1.4*	*0.0*	*28.5*	*28.5*	*43.0*	*100.0*		
Grasslands-Shrubland	Sagebrush Steppe	n/a	62	0	14	0	7	<1	0	31	n/a	n/a	n/a	115	*21.3*	*2.1*
	Shrublands	n/a	120	<1	38	8	0	2	0	0	n/a	n/a	n/a	169	*25.1*	*3.0*
	Grasslands (West of Cascades)	n/a	116	<1	94	6	<1	2	21	0	n/a	n/a	n/a	239	*35.8*	*4.3*
	Grasslands (East of Cascades)	n/a	22	0	4	<1	1	<1	92	0	n/a	n/a	n/a	120	*17.8*	*2.2*
	Subtotal Grasslands-Shrubland		320	<1	151	13	10	5	113	31	n/a	n/a	n/a	643	100.0	11.6
Wetland / Riparian	Palustrine Forest	L-O	0	0	0	0	0	0	0	0	0	2	3	4	*4.0*	*0.1*
		M-S	<1	0	<1	0	0	0	0	0						
		C-R	2	0	<1	<1	0	0	0	0						
	Palustrine Shrub	n/a	<1	0	<1	0	0	0	0	0	n/a	n/a	n/a	<1	*0.9*	*0.0*
	Palustrine Emergent	n/a	65	0	34	<1	0	<1	0	0	n/a	n/a	n/a	98	*95.1*	*1.8*
	Subtotal Wetland / Riparian		69	0	35	<1	0	<1	0	0	0	2	3	103	*100.0*	*1.9*
Agriculture	Agriculture	n/a	364	<1	195	1	3	5	325	0	n/a	n/a	n/a	896	*100.0*	*16.1*
	Subtotal Agriculture		364	<1	195	1	3	5	325	0	n/a	n/a	n/a	896	*100.0*	*16.1*
Developed / Barren	Urban	n/a	17	0	34	<1	0	<1	11	<1	n/a	n/a	n/a	63	*6.7*	*1.1*
	Industrial	n/a	4	0	46	<1	61	<1	522	0	n/a	n/a	n/a	633	*66.8*	*11.4*
	Beaches	n/a	0	0	7	0	0	0	0	0	n/a	n/a	n/a	7	*0.7*	*0.1*
	Roads	n/a	144	0	68	17	2	<1	12	0	n/a	n/a	n/a	244	*25.8*	*4.4*
	Subtotal Developed / Barren		166	0	155	17	63	<1	545	<1	n/a	n/a	n/a	947	*100.0*	*17.0*
Open Water	Rivers and Streams	n/a	7	0	1	<1	<1	<1	0	0	n/a	n/a	n/a	9	*9.1*	*0.2*
	Ditches and Canals	n/a	4	0	3	0	0	<1	<1	0	n/a	n/a	n/a	7	*7.3*	*0.1*
	Palustrine Unconsolidated Bottom	n/a	<1	0	2	1	0	0	0	0	n/a	n/a	n/a	3	*3.3*	*0.1*
	Bays and Estuaries	n/a	74	0	2	0	0	0	0	0	n/a	n/a	n/a	76	*80.3*	*1.4*
	Subtotal Open Water		86	0	7	2	<1	<1	<1	0	n/a	n/a	n/a	95	*100.0*	*1.7*
	Subtotal Non-Forest		1,005	<1	543	33	76	11	983	32	0	2	3	2,683		*48.2*
	Percent of All Non-Forest		*37.5*	*0.0*	*20.2*	*1.2*	*2.8*	*0.4*	*36.6*	*1.2*	*0.0*	*0.1*	*0.1*	*100.0*		
Project Total		n/a	2,694	1	1,030	676	87	21	1,024	32	821	822	1,242	5,565		
Percent of Pipeline Facilities		n/a	*48.4*	*0.0*	*18.5*	*12.1*	*1.6*	*0.4*	*18.4*	*0.6*	*14.8*	*14.8*	*22.3*	*100.0*		

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

TABLE 4.5.1.2-2

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project (acres)

			Pipeline Facilities											Subtotals		
General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Construction Right-of-Way	Hydrostatic Discharge Sites d/	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements) e/	Pipe Yards	Aboveground Facilities - Klamath Compressor Station	Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*

c/ The "Clearcut or Regenerating" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

d/ Small brush or trees may be cleared by a rubber-tired rotary or flail motor (brush hog) or by hand with machetes/chainsaws. Minimal soil disturbance would occur. A rubber-tired hoe would be utilized to lay the discharge line and to remove the saturated hay bales or filter bags upon completion of hydrostatic discharge.

e/ Portions of some of the PARs are located within the construction right-of-way and there is some duplication in the acreage calculations. Impacts associated with existing access roads that would be improved (e.g., widening) would affect an additional 14 acres. Vegetation types affected by existing road improvement activity identify the vegetation type adjacent to the access road, although the majority of the 14 acres is assumed to be road surface or immediate roadside that has been previously disturbed.

TABLE 4.5.1.2-3

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project

			Pipeline Facilities (acres a/)								Aboveground Facilities (acres a/)																		
Mapped Vegetation Category	Type	Forest Stand by Age b/,c/,d/	*30-foot Maintenance Corridor*	Permanent Access Roads	Subtotal LSOG	Subtotal Mid-Seral Forest	Subtotal Clearcut / Regenerating Forest	Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Road Improvements	Jordan Cove MS & BVA #1 e/	BVA #2	BVA #3	BVA #4	BVA #5	BVA #6, Clarks Branch Meter Station	BVA #7	BVA #8	BVA #9	BVA #10	BVA #11	BVA #12	BVA #13	BVA #14	BVA #15	BVA #16	Klamath CS, BVA #17, MS	Subtotal Aboveground Facilities	Total Operation Impacts by Vegetation Type f/
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	8	0	8	17	43	68	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72
		M-S	17	0					29	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R	43	0					72	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Douglas-fir – Mixed Deciduous Forest	L-O	23	<1	23	47	29	99	39	<1	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	<1	99
		M-S	47	<1					79	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R/	29	0					49	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Alder-Cottonwood	L-O	0	0	0	<1	0	<1	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		M-S	<1	0					<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Mixed Conifer/Mixed Deciduous Forest	L-O	11	0	11	11	42	64	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	61
		M-S	11	0					19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R	42	<1					70	<1	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Shasta Red Fir – Mountain Hemlock Forest	L-O	6	0	6	3	15	24	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	24
		M-S	3	0					5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R	14	<1					24	<1	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0		
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	3	0	3	4	1	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
		M-S	4	0					7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R	1	0					2	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	86	0	86	31	50	167	143	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	167
		M-S	31	0					52	<1	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0		
		C-R	50	<1					84	<1	0	0	0	<1	0	0	0	0	<1	0	0	0	0	0	0	0	0		
	Ponderosa Pine/White Oak Forest and Woodland	L-O	10	0	10	7	9	26	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
		M-S	7	0					12	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R	9	0					15	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Ponderosa Pine Forest and Woodland	L-O	4	0	4	10	12	26	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
		M-S	10	0					17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R	12	0					20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Oregon White Oak Forest	L-O	9	0	9	9	0	18	15	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
		M-S	9	0					15	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		C-R	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

TABLE 4.5.1.2-3

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project

Mapped Vegetation Category	Type	Forest Stand by Age b/,c/,d/	Pipeline Facilities (acres a/)								Aboveground Facilities (acres a/)																		
			30-foot Maintenance Corridor	Permanent Access Roads	Subtotal LSOG	Subtotal Mid-Seral Forest	Subtotal Clearcut / Regenerating Forest	Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Road Improvements	Jordan Cove MS & BVA #1 e/	BVA #2	BVA #3	BVA #4	BVA #5	BVA #6, Clarks Branch Meter Station	BVA #7	BVA #8	BVA #9	BVA #10	BVA #11	BVA #12	BVA #13	BVA #14	BVA #15	BVA #16	Klamath CS, BVA #17, MS	Subtotal Aboveground Facilities	Total Operation Impacts by Vegetation Type f/
	Western Juniper Woodland	L-O	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	11	0	0	11	0	11	19	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
		C-R	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Ponderosa Pine/Western Juniper Woodland	L-O	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	4	0	0	4	14	18	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	18
		C-R	14	<1					23	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0		
Subtotal Forest-Woodland by Age Class		*L-O*	158	<1					265	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*<1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*<1*	*150*
		M-S	156	<1	158	156	215	530	260	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*<1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*<1*	*158*
		C-R	215	<1					360	*2*	*0*	*<1*	*0*	*<1*	*0*	*0*	*0*	*0*	*<1*	*0*	*0*	*0*	*<1*	*<1*	*0*	*0*	*0*	*<1*	*222*
Subtotal Forest-Woodland			530	<1	158	156	215	530	885	9	0	<1	0	<1	0	0	<1	0	<1	0	0	0.0	<1	<1	0	0	0	<1	530
Grassland-Shrubland	Sagebrush Steppe	n/a	19	<1	n/a	n/a	n/a	19	31	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	31	49
	Shrublands	n/a	38		n/a	n/a	n/a	39	64	2	0	0	0	0	0	0	0	0	0	0	0	<1	0	<1	0	0	0	<1	39
	Grasslands (West of the Cascades)	n/a	37	<1	n/a	n/a	n/a	38	62	1	0	0	0	0	0	<1	0	<1	0	<1	0	0	0	0	0	0	0	<1	38
	Grasslands (East of the Cascades)	n/a	7	<1	n/a	n/a	n/a	7	12	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Subtotal Grasslands-Shrubland			101	<1	n/a	n/a	n/a	102	*169*	4	0	0	0	0	0	<1	0	<1	0	<1	0	<1	0	<1	0	0	31	31	132
Wetland/ Riparian	Palustrine Forest	L-O	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	<1	0	0	<1	<1	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		C-R	<1	0					<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Palustrine Shrubland	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Palustrine Emergent	n/a	18	<1	n/a	n/a	n/a	18	30	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
Subtotal Wetland/Riparian			19	<1	n/a	n/a	n/a	19	*32*	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
Agriculture	Agriculture	n/a	116	<1	n/a	n/a	n/a	117	193	<1	0	0	<1	0	<1	<1	0	0	0	0	<1	0	0	0	<1	<1	0	1	117
Subtotal Agriculture			116	<1	n/a	n/a	n/a	117	*193*	<1	0	0	<1	0	<1	<1	0	0	0	0	<1	0	0	0	<1	<1	0	1	117
Developed / Barren	Urban	n/a	5	<1	n/a	n/a	n/a	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1	6
	Industrial	n/a	1	0	n/a	n/a	n/a	1	2	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Beaches	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Roads	n/a	56	<1	n/a	n/a	n/a	56	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54
Subtotal Developed / Barren			62	<1	n/a	n/a	n/a	63	*101*	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1	61

TABLE 4.5.1.2-3

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project

Mapped Vegetation Category	Type	Forest Stand by Age b/,c/,d/	Pipeline Facilities (acres a/)								Aboveground Facilities (acres a/)																		Total Operation Impacts by Vegetation Type f/
			30-foot Maintenance Corridor	Permanent Access Roads	Subtotal LSOG	Subtotal Mid-Seral Forest	Subtotal Clearcut / Regenerating Forest	Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Road Improvements	Jordan Cove MS & BVA #1 e/	BVA #2	BVA #3	BVA #4	BVA #5	BVA #6, Clarks Branch Meter Station	BVA #7	BVA #8	BVA #9	BVA #10	BVA #11	BVA #12	BVA #13	BVA #14	BVA #15	BVA #16	Klamath CS, BVA #17, MS	Subtotal Aboveground Facilities	
Open Water	Rivers and Streams	n/a	3	<1	n/a	n/a	n/a	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
	Ditches and Canals	n/a	1	<1	n/a	n/a	n/a	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Palustrine Unconsolidated Bottom	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bays and Estuaries	n/a	9	0	n/a	n/a	n/a	9	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
	Subtotal Open Water		13	<1	n/a	n/a	n/a	13	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
	Subtotal Non-Forest		313	2	n/a	n/a	n/a	315	518	5	0	0	<1	0	<1	<1	<1	<1	0	<1	<1	<1	0	<1	<1	<1	31	33	347
	Project Total		843	2	158	156	215	845	1,404	14	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	31	34	877

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, 50-foot permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.

b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

d/ The "Clearcut or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years).

e/- CT = Communications tower

f/ Total by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves are located within the 30-foot maintenance corridor).

Columns and rows do not necessarily sum correctly due to rounding.

Acres of impacts to non-vegetated areas are included within this table for consistency in values reported within this EIS.

Shaded cells identify acres of vegetation type within the defined area but are not included in the overall Project total because: 1) only the 30-foot Maintenance Corridor included within the 50-foot Permanent Easement is expected to be affected during operations and maintenance activities, and 2) no additional maintenance would occur on access roads improved for construction of the Project.

Short-Term Impacts

Impacts are considered short term if, after three growing seasons, the revegetated disturbed areas resemble adjacent undisturbed lands. Vegetated areas that have the potential for revegetation within three growing seasons include agricultural lands and areas dominated by grass and shrubs. For example, short-term revegetation in shrublands is possible because riparian shrubs removed during construction would be replaced by cuttings and sprigs of locally available shrub species during restoration/reclamation. Approximately 896 acres of agricultural lands and 643 acres of grassland-shrubland areas would experience short-term temporary impacts (see table 4.5.1.2-2).

Short-term impacts would also include areas within the UCSAs. UCSAs are work areas that would not be cleared of vegetation during construction. The UCSAs would be used to store forest slash, stumps, as well as dead and downed log materials that would be scattered across the right-way after construction. These areas may also be used to store spoil and park construction equipment and other vehicles. UCSAs would be located in mature forests and areas where the slopes of the soils would preclude the areas from being cleared (i.e., in order to minimize erosion risks) or along narrow ridgelines. In forests, these areas are characterized by trees that are sufficiently spaced to allow for storage of cleared right-of-way vegetation. EIs would rope off stands of mature trees and operators would be required to place and retrieve materials in such a manner as to minimize impacts such as soil compaction and bark damage. There would be approximately 676 acres of short-term impacts related to UCSAs (note that this value double counts some of the short-term impacts listed above, and includes impacts in forested and non-forested UCSA).

Within UCSAs located in forests and woodlands, some damage to understory vegetation and minor damage to trees would be expected. Trees that are damaged at the time of construction could die over time (in these cases, the impact would be long term; i.e., the death of a tree would be considered a long-term and permanent impact. See the discussion below for more details). Vegetation disturbance would generally depend on the site-specific vegetation characteristics, with younger revegetating forests being potentially more susceptible to damage such as limb breakage. UCSAs would impact approximately 643 acres of forest and woodland communities (see table 4.5.1.2-2). Of this, approximately 240 acres would occur to LSOG forests (i.e., forests areas where the majority of trees are over 80 years of age), 170 acres to mid-seral forests (i.e., forests where the majority of trees are over 40 years in age but under 80 years), and 233 acres of clearcut/grass-shrub-sapling or regenerating forests (i.e., clearcut consists of trees age 0 to 5 years in age while regeneration forest contain trees 5 to 40 years in age).

To protect trees within UCSAs, Pacific Connector would implement the measures outlined in its *Leave Tree Protection Plan*.[76] After construction, Pacific Connector would assess potential tree damage within the UCSAs and would appropriately compensate the landowner for damage. Appropriate restoration measures in areas were disturbance occurred would be applied as described in Pacific Connector's ECRP (e.g., scarification prior to seeding grasses and forbs; subsoiling prior to the replanting of deep-rooted trees and shrubs especially in areas where water infiltration is of prime importance, such as within riparian areas; etc.). Compacted soils would be scarified or subsoiled, depending on the vegetation to be restored, after use and prior to the

[76] This plan was included as Appendix P to Pacific Connector's POD, and filed as a stand-alone document with the June application to the FERC, as Appendix P (see table 2.1.4-1 in this EIS).

rainy season to promote revegetation and ensure that soil disturbance caused by pipeline construction would not permanently impact long-term site productivity. UCSAs and their utility to the Pacific Connector pipeline are discussed in more detail within section 2.3.2.1.

Short-term impacts would also include affected areas around hydrostatic test discharge sites. Pacific Connector has stated that portions of these sites may be cleared of small brush or trees either by mechanical means or by hand in order to position hay bales or filter bags. The six hydrostatic discharge sites, located outside of the construction right-of-way, would impact approximately 1 acre (less than a quarter acre of which would occur in forested areas) and would be revegetated as necessary following construction.

Long-Term Impacts (e.g., permanent impacts)

Long-term impacts would last longer than three growing seasons within the disturbed area and in some cases they would not resemble adjacent undisturbed lands for the life of the pipeline project (e.g., some long-term impacts would be permanent). For example, areas with trees and shrubs removed from coniferous, deciduous, and mixed forests would have long-term impacts. Particularly, mature trees would not regenerate during the life of the project, so their removal would be a long-term loss. The pipeline route would cross a total of about 145.9 miles of forest-woodlands areas (table 4.5.1.2-1). Construction of the Project would result in approximately 821 acres of impact to LSOG forests, 821 acres of impact to mid-seral forests, and 1,240 acres of impact to clearcut/regenerating forests (table 4.5.1.2-2); however, as discussed above, some of these impacts would occur as a result of UCSAs (which would not be cleared of vegetation, and would only result in long-term impacts if trees were damaged, resulting in loss of vigor or death of trees over time). Impacts to forested-woodlands areas, excluding UCSAs, would consist of 581 acres of LSOG, 651 acres of mid-seral forests, and 1,007 acres of clearcut/regenerating forests (table 4.5.1.2-2).

In addition, a portion of this initial construction impact would remain for the life of the Pacific Connector pipeline (i.e., would be a permanent impact), due to the permanent right-of-way maintenance, access roads, and aboveground facilities. Permanent impacts would occur at all aboveground facilities, within the operational footprint. At those locations, vegetation would be removed during construction, but not revegetated during restoration. Instead, structures would be installed at the aboveground facilities locations, and their yards would be covered by gravel during restoration. Permanent impacts to forested habitats would include approximately 150 acres LSOG forests, 158 acres of mid-seral forests, and 222 acres of clearcut/regenerating forests (table 4.5.1.2-3).

Operational right-of-way maintenance, access roads, and aboveground facilities would affect non-forested/woodland habitats as well. Permanent disturbance features (such as right-of-way maintenance, access roads, and aboveground facilities) would encompass approximately 347 acres of non-forested/woodland habitats, including 132 acres of grasslands/shrublands, 22 acres of wetlands, 117 acres of agricultural areas, 61 acres of barren/developed areas, and 14 acres of open water (table 4.5.1.2-3).

Additional long-term impacts would include the cutting of danger trees, which are defined as trees located outside approved construction areas that are at risk of falling on workers or vehicles and thus would need to be removed. The removal of these trees would result in an additional

long-term impact to adjacent vegetation that cannot be quantified prior to construction. Landowners would be compensated for the removal of danger trees. Danger trees are discussed further in section 4.5.2.2.

Comments were received on the DEIS questioning how the cleared pipeline right-of-way may increase the chance for wind blowdowns. Wind is the major natural disturbance agent that affects forest dynamics. Trees can be blown down during high wind events (i.e., "windthrow"), resulting in the loss of some trees. The severity and frequency of wind disturbance is determined by many interrelated factors, including tree size and vitality, slope aspect, soil characteristics, stand composition, canopy structure, as well as the characteristics of the surrounding topography (i.e., as it affects wind flow). The Project's proposed vegetation clearing in forested habitats has the potential to exacerbate the rate of windthrow in adjacent forest stands. Long-term forest stand degradation due to windthrow could potentially occur in local areas along the proposed right-of-way where the route is exposed to strong winds, especially where it runs perpendicular to the direction of the prevailing wind.

General Measures to be Implemented to Reduce or Mitigate Impacts on Vegetation

During construction and restoration, Pacific Connector would implement measures to minimize impacts on vegetation and ensure successful revegetation of disturbed areas. These measures include those found in the ECRP, *Leave Tree Protection Plan*, *Integrated Pest Management Plan*, and the SPCCP. These measures would be applied to all lands crossed by the pipeline route; however, federal land-managing agencies may impose additional measures on federal lands. Measures specific to federally managed lands are addressed below in section 4.5.1.3. General measures that would be implemented to minimize impacts on vegetation and ensure successful revegetation of disturbed areas include:

- UCSAs would be used in some places instead of TEWAs, with trees left in place.
  - No materials would be stored in aquatic areas such as streams or wetlands.
- In areas where the UCSAs may be used to store spoil, slash, stumps, logs, or to temporarily park equipment between the mature trees, these activities would not occur immediately adjacent to the tree to minimize impacts.
- The construction right-of-way would be limited to 75 feet based at stream and wetland crossings.
- TEWAs would be located 50 feet back from streams and wetlands, except where site-specific conditions would not allow (see table P-1 in appendix P).
- Topsoil would be segregated in agricultural and residential area, or where requested by landowners.
- The construction right-of-way would be graded to restore pre-construction contours and leave the soil in proper condition for seeding or planting.
- Damage to drain tiles or irrigation systems resulting from construction in active agricultural areas would be corrected and monitored until restoration is successful.
- Landscaped areas would be restored in accordance with the landowner's request, or the landowner would be compensated (e.g., where mature trees are removed and can't be replaced in kind).

- Restoration plans would include measures for re-establishing herbaceous or woody vegetation, controlling the establishment or spread of invasive species, weed control, and monitoring.
- Disturbed areas would be seeded in accordance with written recommendations for seed mixes, rates, and dates obtained from the local conservation authority or as requested by the landowner. Seed stock mixtures would be native seeds that are genetically and geographically adapted to local site conditions.
- Manufactured wood fiber mulch would be applied as hydromulch at 2,000 pounds per acre during hydroseeding. A tackifier or bonding agent recommended by the manufacturer would be used to bond the wood fiber mulch to the soil surface.
- Disturbed areas would be seeded within 6 working days of final grading, weather and soil conditions permitting.
- Fencing or other measures would be used to exclude cattle from entering sensitive reclamation areas in order to protect/enhance areas.
- A standard fertilization rate of 200 pounds per acre bulk triple-16 fertilizer (16:16:16 - nitrogen, potassium, and phosphorus) would be used on all disturbed areas to be reseeded.
- Seedbed preparation would be conducted, where necessary, immediately prior to seeding to prepare a firm seedbed conducive to proper seed placement and moisture retention. Seedbed preparation would also be performed to break up surface crusts and to eliminate weeds which may have developed between initial reclamation and seeding.
- Pacific Connector would use certified weed-free straw for any mulch used during seeding. In addition, certified weed-free straw would be used for mulch and sediment barriers, dewatering structures, or other uses along the right-of-way. The EI or Pacific Connector's authorized representative would be responsible for ensuring that all straw hauled to the construction yards would be certified weed-free.
- All disturbed areas would be monitored each growing season until revegetation is considered successful, as compared to nearby undisturbed site vegetation of the same plant association. Any new locations of noxious weed infestations would be recorded and treated.
- Slash from timber clearing would be scattered across the right-of-way in order to return organic material to the soil and serve as erosion control.
- Revegetation in non-agricultural areas would be considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands (not including landscaped areas). In agricultural areas, revegetation would be considered successful if crop yields are similar to adjacent undisturbed portions of the same field.
- All disturbed forests outside of the 30-foot maintenance corridor would be replanted. Approximately 1,800 acres would be replanted with native conifer species of the local seed source in forested areas outside of the 30-foot maintenance right-of-way, and 30 acres of hardwoods of the local seed source would be replanted within forested, shrub and riverine wetlands.

- In riparian areas on private lands, shrubs and trees would be replanted across the right-of-way for a width based on ODF's Riparian Management Area widths.
- Vegetation within the upland portion of the 30-foot maintenance corridor, centered over the pipeline, would be maintained in an herbaceous/shrub state of less than 6 feet in height. The remainder of the operational easement outside of 15 feet on each side of the pipeline centerline would be fully restored and revegetated in accordance with the ECRP, using native species.
  - The 30-foot maintenance corridor would be periodically maintained using mowing, cutting, and trimming either through mechanical methods or by hand. Maintenance activities are expected to occur approximately every three to five years depending on the vegetation's growth rate.
  - Routine vegetation maintenance clearing would not occur more frequently than every three years, except as necessary for the 10-foot-wide corridor centered over the pipeline that could be maintained annually if necessary.
  - Routine vegetation maintenance clearing would not occur during the principal portion of the growing season from April 15 to August 1.
  - Ground-based mechanized vegetation clearing/maintenance work would only be performed between August and October (outside of the principal rainy season).
  - Compaction of soils would be prevented through the implementation of the ECRP.
  - Outside of the 30-foot maintenance corridor, the permanent easement would not be maintained in order to allow mature trees to re-establish.
- Prior to construction or disturbance, areas of known noxious weeds may be pretreated with herbicides.
  - Mostly hand and mechanical methods (pulling, mowing, disking) would be used to remove weeds, with some spot use of herbicides. Herbicides would not be used within 100 feet of a waterbody or wetland. Boulders and other large rocks generated by construction activities would be used to block OHV access to the right-of-way.

Noxious Weeds

As discussed above for the LNG terminal site, noxious weeds and other invasive plant species are non-native species that are able to exclude and out-compete desirable native species, and thereby decrease overall species diversity. Noxious weeds often invade and persist in areas after the vegetation and ground has been disturbed, and their presence can hinder restoration.

The ODA Noxious Weed Control Program and the OSWB maintain the State Noxious Weed List for the State of Oregon. Noxious weeds listed as Class "T" (i.e., target species) that have the potential of occurring in the area of the pipeline are listed in table 4.5.1.2-4.

TABLE 4.5.1.2-4

Oregon Target Weeds (Class T) (a/) Suspected within or Near the Proposed Pacific Connector Pipeline Work Area

Noxious Weed Common and Scientific Name	Known or Suspected Occurrences			Oregon DOA Class e/
	County b/	Forest Service Region 6 d/	BLM Districts d/	
Garlic mustard *Alliaria petiolata*	Jackson (L)			B
Plumeless thistle *Carduus acanthoides*	Klamath (L)			A
Woolly distaff thistle *Carthamus lanatus*	Douglas (L) Jackson c/		MD	A
Spotted knapweed *Centaurea stoebe*	Coos (L) Douglas (L) Jackson (L) Klamath (L)	Yes UMP	MD KF	B
Squarrose knapweed *Centaurea virgata*	Klamath c/		MD KF	A
Rush skeletonweed *Chondrilla juncea*	Douglas (W) Jackson (W)	UMP	MD KF	B
Field bindweed *Convolvulus arvensis*	Coos (W) Douglas (W) Jackson (W) Klamath (W)			B
Portuguese broom *Cytisus striatus*	Douglas (W)			B
Paterson's curse *Echium plantagineum*	Douglas (L)			A
Leafy spurge *Euphorbia esula*	Douglas (H) Jackson (W)		MD	B
Orange hawkweed *Hieracium aurantiacum*	Klamath (L)			A
Perennial pepperweed *Lepidium latifolium*	Klamath (W)			B
Dalmatian Toadflax *Linaria dalmatica* (*L. genista*)	Jackson (L) Klamath (W)	Yes	KF	B
Matgrass *Nardus stricta*	Klamath (L)			A
Taurian thistle *Onopordum tauricum*	Klamath (L)			A
Tansy ragwort *Senecio jacobaea*	Coos (W) Douglas (W) Jackson (L) Klamath (H)	Yes UMP	CB MD KF	B
Smooth cordgrass *Spartina alterniflora*	Coos (L)			A
Saltcedar *Tamarix ramosissima*	Klamath (L)			B
Gorse *Ulex europaeus*	Coos (W) Douglas (L) Jackson		CB	B

a/ Source: ODA 2012a; Forest Service 2005b

b/ Letter in parenthesis indicates distribution within the county, if provided (ODA 2012a). L = Limited, W = Widespread, and H = Historic. No letter indicates county not listed on the ODA (2012a) species fact sheet

c/ Medford BLM District indicated that this species is found in the listed county.

d/ Forest Service and BLM District Codes: UPM–Umpqua NF, CB–Coos Bay BLM, MD–Medford BLM, KF–Klamath Falls BLM, "Yes" indicates that it is document or suspected to occur in Forest Service Region 6 but not necessarily within forests crossed by the Pacific Connector pipeline.

e/ Oregon Noxious Weed List: Class "A" weeds occur in small enough infestations to make eradication or containment possible or is not known to occur in Oregon, but is present in neighboring states making occurrence in Oregon seem imminent. Class "B" weeds are regionally abundant, but may have limited distribution in some counties. Class "T" weeds are selected from the "A" or "B" lists and are designated as a target species

Note that table 4.5.1.2-4 only lists Class T weeds that have the potential to occur along the pipeline route; however, there are other weed species (e.g., non-Class T species) that are also of concern and could occur along the pipeline project. For example, land-managing agencies are concerned with the management of Medusahead rye (*Taeniatherum caput-medusae*), which is a Class B weed-species (with no Class T status) that has the potential to occur along the pipeline

route. All Oregon State noxious weeds that could potentially occur along the pipeline project (including Class A and B species) are listed in Table 3C-4 of Appendix C in Resource Report 3, which was included in Pacific Connector's application to the FERC.

Multiple noxious weeds were documented along the pipeline route during botanical surveys (table 4.5.1.2-5). Occurrences of these weed species would increase the potential for new or expanded growth of noxious weeds as a direct consequence of pipeline construction. Of the weeds documented within the pipeline project area during surveys, only rush skeletonweed, Dalmatian toadflax, and tansy ragwort were Class T weeds (see table 4.5.1.2-4 and 4.5.1.2-5). The basic traits of these three Class T weeds are summarized below:

- Rush skeletonweed readily invades areas of recent disturbance, such as rangelands and pastures. It occurs in Douglas and Jackson Counties in the area of the pipeline, and was found at the following mileposts along the pipeline route: 63.5-63.8, 64.1-64.2, 67.1-67.3, 67.9, 69.0, 69.1, 70.2-70.3, 76.3, 94.7, and 98.3-98.4.
- Dalmatian toadflax thrives in arid rangelands and pastures, and can out-compete desirable forage plants in these areas. It occurs in Jackson and Klamath Counties in the area of the pipeline. It was found at the City of Klamath Falls Pipe Yard, at MP 160.3.
- Tansy ragwort is often found in pastures, clearcuts, and disturbed roadsides. The seeds can remain viable in the soil for many years. The plant is toxic to cattle and horses. It occurs in Coos, Douglas, Jackson, and Klamath Counties in the area of the pipeline, and was found at the following mileposts along the pipeline route: 47.7-47.7, 48.2-48.4, 51.5-51.5, 75.4, 90.3, 91.5-91.7, 93.0, 93.4-93.5, 97.1-97.7, 98.6-99.3, 105.7-105.8, 108.13, 109.8, and 110.2.

TABLE 4.5.1.2-5

Summary of Noxious Weeds found Along the Pacific Connector Pipeline Route during Surveys a/

Common Name *Scientific Name*	Oregon DOA Class	Oregon DOA Target "T" Weed	Number of Incidences on Right-of-Way
Meadow knapweed *Centaurea pratensis*	B	No	7
Yellow starthistle *Centaurea solstitialis*	B	No	18
Rush skeletonweed *Chondrilla juncea*	B	Yes	10
Canada thistle *Cirsium arvense*	B	No	11
Scotch broom *Cytisus scoparius*	B	No	10
English ivy *Hedera helix*	B	No	1
St. Johnswort *Hypericum perforatum*	B	No	2
Dalmation toadflax *Linaria dalmatica (L. genista)*	B	Yes	1
Purple loosestrife *Lythrum salicaria*	B	No	1
Japanese knotweed *Polygonum cuspidatum*	B	No	1
Himalayan blackberry *Rubus discolor*	B	No	40
Tansy ragwort *Senecio jacobaea*	B	Yes	14

a/ Although it was not discovered during surveys (which is why it is not listed in the table), the Forest Service has indicated that at least two populations of Medusahead rye (a Class B weed) are located along the pipeline route.

Although surveys were conducted at an appropriate time of year to identify weed species, the discovery of these weed species during surveys does not indicate that other noxious weeds are not also present within the pipeline right-of-way (for example, additional weeds species may be present in the seedbank). If additional infestations or other invasive/noxious weed species are found, then these would be controlled and monitored as well. Measures aimed at preventing the

spread of invasive species and noxious weeds were designed to prevent the spread of all weeds species, not just those that were identified during surveys.

Short- or long-term impacts on any vegetation community could result from establishment and spread of noxious weeds following construction. Noxious weeds can adversely affect an area either when invasive plants become established or when an existing species' population size increases. Invasive or noxious plants can negatively affect habitat by competing for resources such as water and light, changing the community composition, eliminating or reducing native plants, or changing the vegetation structure. The changes in community composition or vegetation structure can reduce native plant populations and can also negatively affect habitat for wildlife. Soil disturbance and/or removal of existing vegetation for pipeline or road construction can provide openings for invasive or noxious plants to establish or spread. Movement of equipment can also provide opportunities for seed transport into new areas. Direct effects of invasions can include the establishment or spread of invasive or noxious plants through the use of new roads after construction, maintenance activities, or by providing a corridor for the establishment and spread of invasive or noxious plants to adjoining lands. In general, habitats with more bare ground, such as grasslands, riparian areas, and relatively dry or open forests, are more susceptible to invasion than are dense, moist forests, high montane areas, and serpentine areas that have relatively closed canopy cover or have extreme climate or soils that are tolerated by fewer invasive plant species. Due to the connectivity of lands by roads and their use, the potential effects of invasive or noxious plants are not limited to the area of initial Project-related disturbance.

Pacific Connector's ECRP includes measures to control noxious weeds, soil pests, and forest pathogens. In addition, Pacific Connector developed an *Integrated Pest Management Plan,*[77] in consultation with the ODA (Butler 2006), BLM, and the Forest Service, to minimize the potential spread and infestation of weeds along the construction right-of-way. This plan can be found in Appendix N to the POD, which was included in Pacific Connector's application to the FERC. This plan includes requirements for surveys conducted prior to construction to determine the presence of noxious weeds; cleaning of construction equipment (in areas where weeds have been identified or when leaving these areas) to prevent the import and spread of weeds; and vegetation clearing and grading requirements in areas of noxious weeds. Additionally, disturbed areas would be replanted with appropriate seed mixes to prevent noxious weed germination. After construction, the right-of-way would be monitored and any noxious weed infestations would be controlled. Pacific Connector would also investigate noxious weed issues raised by landowners during operation of the pipeline.

Construction equipment would be power washed, if necessary, as determined by the EI. In addition, initial inspections of all company and construction contractor vehicles would be performed prior to being allowed on the construction right-of-way. The EI or Pacific Connector's authorized representative would be responsible for performing inspections and registering or tagging the equipment prior to being transported or moved to the right-of-way. Any equipment used within areas where noxious weeds are present (specifically those that are classified as priority A and T as well as selected B listed weeds) would be cleaned by hand, blown down with air, or pressure washed prior to leaving the site. Equipment cleaning on the

[77] See Appendix N to the POD, which was included in Pacific Connector's application to the FERC in June 2013.

right-of-way would occur in a cleaning station approved by the EI. Infested areas and cleaning stations would be mapped to ensure that these areas are monitored during construction and to ensure that weeds at these areas are controlled and not spread.

After construction, Pacific Connector would monitor the right-of-way for infestations of noxious weeds, in compliance with their *Integrated Pest Management Plan*. Targeted weed monitoring would occur in the areas where noxious weeds were identified prior to construction and were previously mapped to ensure that potential infestations do not reestablish and/or spread. Monitoring would also occur in areas along the right-of-way where equipment cleaning stations, hydrostatic dewatering sites, and other temporary project disturbances were located to ensure that infestation at these locations do not occur. Pacific Connector's operational staff or their contractors (limited to personal qualified in noxious weed identification) would be responsible for these monitoring efforts. If infestations occur along the right-of-way, Pacific Connector would make an assessment of the source of the infestation, the potential for the infestation to spread, and develop a treatment plan to control the infestation. The treatment plan would be developed using integrated weed management principles, and if herbicides are used, all applicable approvals would be obtained prior to their use including landowner approvals. Only herbicides that are approved for use on the affected lands (private, state, or federal) would be used. Herbicide treatments would not be conducted during precipitation events or when precipitation is expected within 24 hours to minimize the risk of these chemicals moving beyond the treated areas or into waterbodies. If weeds targeted for herbicide treatments are in the vicinity of sensitive sites, proper buffers would be used in order to prevent the spread of herbicides to these areas. Pacific Connector would consult with the ODA Noxious Weed Control Program or local County Weed Programs for additional support regarding noxious weed control issues that may occur during the pipeline operations. Pacific Connector would conduct follow-up inspections of all disturbed areas until revegetation is successful.

Vegetation Pathogens

In Oregon, the Forest Service and ODF conduct annual aerial surveys of all forested land to determine insect and disease activity status. The surveys indicated the following insect and/or disease activity within 0.5 mile of the pipeline route: Douglas-fir beetle, fir engraver, flatheaded borer, mountain pine beetle (ponderosa and sugar pine), western pine beetle, lodgepole pine needle cast, and Port-Orford-cedar root disease. Table 3C-3 in the applicant's Resource Report 3 lists the location (by MP when known) of each identified pathogen near the pipeline route. Within the pipeline project area, the western pine beetle and fir engraver are most prevalent. Other diseases that may occur or have potential to occur within the pipeline project area are annosus root rot, laminated root rot, dwarf mistletoe, sudden oak death, and the black stain root disease. Below are general descriptions of each disease and insect infestation known along the pipeline route.

Douglas-fir Beetle (ODF 2007)

The Douglas-fir beetle is a medium-sized, brown to black colored beetle that exclusively infects Douglas-fir (standing or down trees with diameter at breast height greater than 8 inches). Douglas-fir beetle can be found almost anywhere its host occurs; however, it rarely kills its host tree in the lower elevation of interior southwest Oregon, where the flat-headed borer is usually the cause of Douglas-fir mortality. Two attacks generally occur throughout the year, with an initial attack from April through June, producing piles of reddish or yellowish dust, and then a

secondary attack from July through August. The pipeline is adjacent to or intersects documented Douglas-fir beetle infestations on private lands, BLM lands, and lands managed by the Forest Service.

Fir Engraver Beetle (ODF 2005a; Forest Service 2006b)

Fir engraver beetle occurs in mature and pole-sized true fir (grand, white, red, noble), Douglas-fir, Engelmann spruce, and occasionally hemlocks. An attack from fir engraver beetles generally occurs from June through September and can result in dead branches, top kill, or tree mortality. Although outbreaks are often associated with drought events, fir engravers are opportunistic and will invade trees that are stressed during wetter years (i.e., affected by root disease or wounded). The pipeline is adjacent to or intersects documented fir engraver infestations on private lands, BLM lands, as well as lands managed by the Forest Service.

Flatheaded Borer (ODF 2002; Forest Service 2006b; Nelson et al. 2004)

Trees that typically serve as the host for this beetle include Douglas-fir, true firs, western larch, spruce, and western hemlock. The flatheaded borer typically attacks weakened, dead, and recently felled trees in the upper crown resulting in topkill; however, it can infest an entire tree. Outbreaks are usually associated with dead or severely damaged trees, especially after disturbance events such as drought, storm damage, or fire. Within southwest Oregon, this beetle is aggressive, often attacking trees on the edge of stands or adjacent to newly created corridors. In 2003, a greater than 50 percent increase of flatheaded borer infestation was observed in southwestern Oregon. The pipeline route would cross through known occurrences of the flatheaded borer.

Mountain Pine Beetle (ODF 2005b; Forest Service 2006b; Nelson et al. 2006)

This destructive beetle can cause landscape-level tree mortality. Attacks occur most often in dense stands of lodgepole, sugar, western white, and ponderosa pine. Thinning stands of pine is recommended to reduce the severity of mountain pine beetle outbreaks. Within Oregon, mountain pine beetle infestations have increased significantly in the last five years. The current outbreak is expected to continue at least another decade. The pipeline is adjacent to or intersects documented mountain pine beetle infestations.

Western Pine Beetle (Forest Service 2006b)

The host for this beetle is ponderosa pine in southwest Oregon. Successful attacks will kill the host tree. Characterized by dying old-growth trees scattered within a stand or groups of trees in overstocked stands of second growth. Trees weakened by drought or fire damage are especially susceptible. Thinning overstocked ponderosa pine stands and removing infested trees would help reduce the hazard of western pine beetle attacks. The pipeline is adjacent to or intersects documented western pine beetle infestations.

Lodgepole Pine Needle Cast (Hunt 1995; Forest Service 2006b)

This disease results in a severe and sudden loss of needles in coniferous trees. Although it can be caused by insects, drought, excessive shading, or poor soil, needle loss in lodgepole is usually a result of the fungal disease, *Lophodermella* ssp. Spores released from previously infected year-old needles in early summer affect the current year's new needle growth. Trees infected for several years become more susceptible to other diseases. Other than avoiding plantings with

offsite stock, no management is usually warranted. Infected sites are unknown; however, Lodgepole Pine Needle Cast most likely exists within the project area.

Port-Orford-Cedar Root Disease (Roth et al. 1987; Forest Service and BLM 2004; Nelson et al. 2006)

This disease is caused by the fungus *Phytophthora lateralis* that infects approximately 9 to 15 percent of federally administered Port-Orford-cedar acreage. The pathogen enters through roots and is usually fatal to old growth or sapling trees it infects. The fungus is spread from soil movement associated with construction and road maintenance, off-road traffic, movement of surface water from infected to uninfected areas, off-road traffic (both walking and motorized), and transfer by hooves of cattle and game animals (Roth et al. 1987; Forest Service and BLM 2004; Nelson et al. 2006). Port-Orford-cedar is geographically limited to southwest Oregon and northwest California and is an ecologically and economically important tree. The root disease is known to occur in Coos and Douglas Counties. The root disease is documented within 0.1 mile of the pipeline route and is known to occur in Coos Bay, Roseburg, and Medford BLM Districts. Appendix R-7 provides additional information on this topic.

Annosus Root and Butt Rot (Schmitt et al. 2000; Hadfield et al. 2006; Forest Service 2006b)

This disease is caused by the pathogen *Fomes annosus*, which can infect all conifers. The most susceptible tree species in the Pacific Northwest are western hemlock, mountain hemlock, grand fir, white fir, and Pacific silver fir. Infected trees suffer root and butt decay and root mortality, which result in reduced vigor, windthrow, predisposition to bark beetles, and eventual mortality. It can spread by windblown spores that germinate on freshly exposed wood (i.e., stumps or wounded trees) or underground transfer from diseased roots to uninfected roots. On the west side of the Cascades, stump infection can occur any time of the year, whereas on the east side of the Cascades, stump infection occurs in the spring and autumn. Infected sites are unknown within the pipeline project area; however, annosus root rot is known to be increasing in Oregon. *F. annosus* may occur within the pipeline project area because western and mountain pine beetles and fir engraver infestations exist and they are known to attack trees infected with *F. annosus*.

Laminated Root Rot (Forest Service 2006b; Nelson et al. 1981)

This disease is caused by a native fungus, *Phellinus weirii*, and infects all conifers, but the most susceptible trees are Douglas-fir, mountain hemlock, grand fir, and white fir, which are often killed. The infected trees usually show evidence of slow crown decline, including thinning and foliage chlorosis, and in the final stages the tree produces numerous small cones or distressed cones before death. Often the trees are wind-thrown and exhibit root balls where most of the roots have rotted off just below the root crown. The decay of the wood looks reddish-brown to brown in the butts and main roots and in later stages will begin to separate along annual rings (i.e., laminate). The fungus spreads through underground root contact and readily penetrates bark of roots of living susceptible trees that have been recently cut (within 12 months). Infected sites are unknown; however, host species are present in the project area.

Dwarf Mistletoe (Hennon et al. 2001; Hadfield et al. 2000)

Dwarf mistletoe (*Arceuthobium* M. Bieb.) is a damaging parasitic plant that affects conifers including Douglas-fir, grand fir, and mountain hemlock. The first symptom of dwarf mistletoe

infection is slight swelling at the infection site, which becomes visible one to two years after infection occurs. The variously shaped masses of abnormal branch and twig growth associated with the disease are indications of old infections and are called "witches' brooms", and can vary in size from small, palm-like structures in young infections to large masses of branches weighing several hundred pounds. Dwarf mistletoe can occur in the main stem of trees creating large burl-like structures on the trunk. The dwarf mistletoe alters tree form, reduces vigor and growth rates, reduces seed production, increases susceptibility to other damaging agents, and results in top-killing and tree death; however, the deformation of trees can provide nesting sites and cover for wildlife. This parasite is spread from tree-to-tree by seed. Infected sites are unknown; however, dwarf mistletoe most likely exists within the project area.

Sudden Oak Death (Forest Service 2006b; Nelson et al. 2006)

This disease is caused by a recently introduced water mold, *Phytophthora ramorum*. It has killed large numbers of myrtle and tanoak trees and can also infect many other tree and shrub species, including Douglas-fir. It affects the aboveground plant parts forming sporangia on infected leaves and twigs. In forests, the sporangia spread from tree-to-tree by wind and rain and usually infect the upper crown first. Infected leaves drop on the ground allowing the sporangia to be transported through a variety of other methods, including boots, vehicles, animals, and streams. Within Oregon, *P. ramorum* has caused bore cankers and death to tanoaks, shoot dieback in Pacific rhododendron and evergreen huckleberry, and leaf blight in cascara and Oregon myrtlewood. Since 2001, state and federal agencies have been trying to eradicate sudden oak death in Oregon by cutting and burning infected host plants and uninfected adjacent plants. It has already killed extensive areas of myrtle and tanoak trees in California and hundreds of acres in Curry County, Oregon, which lies adjacent to two counties (Coos and Douglas) that would be crossed by the pipeline. Infected areas in Curry County are approximately 80 miles from the pipeline's location. ODF and the Forest Service conduct *P. ramorum* detection surveys in at-risk forests and systematic surveys in tanoak forested areas throughout southwest Oregon. To date, no accounts of sudden oak death have been documented within the project area.

Black Stain Root Disease (Hessburg et al. 1995)

This disease is caused by the fungus *Leptographium wageneri*, and affects several western conifer species. Species affected include Douglas-fir, ponderosa pine, Jeffery pine (*Pinus jeffreyi*), pinyon pine (*pinus edulis*), and singleleaf pinyon (*Pinus monophylla*). This fungus blocks the movement of water to foliage by attacking the tree's water conducting tissues. Tree growth is stunted and needles are permanently shed; in addition, infected trees become more susceptible to attacks from bark beetles. This fungus is likely transmitted by soil disturbance and insects. Although this disease is not widespread, the Forest Service has indicated that this disease could affect Douglas-fir trees of 30 years or less in age, as well as ponderosa and Jeffery pines of any age, and is found within the project area (personal communication Paula Trudeau; Forest Service Silviculturist).

Potential Effects of Pathogens and Proposed Avoidance/Minimization Measures

Insects and diseases can adversely affect a forest if pipeline associated activities introduce new or spread existing infestations. Trees may be more susceptible to infestation that are damaged during clearing activities and/or have soil compacted over their roots, including those within UCSAs. Equipment can transport insects or disease in or out of an area; as a result, the

pipeline's right-of-way and the use of roads can spread or introduce insects or disease to new areas. Diseases could also be transferred from one area to another via hydrostatic test water. The spread of insects or disease along the pipeline would result in both short- and long-term effects, such as reduced species diversity due to invasion or infestation, and a loss of habitat function for wildlife.

Multiple infestations of insect parasites and tree pathogens already exist along the Pacific Connector pipeline route (table 4.5.1.2-6). Those occurrences increase the potential for new or expanded infestations or infections as direct result of pipeline construction.

TABLE 4.5.1.2-6

Summary of Known Infestations of Insect Parasites and Tree Diseases Along the Pacific Connector Pipeline Route a/

Tree Insect or Disease	Land Ownership	Number of Incidences Along Pipeline Route	Approximate Length (miles) of Route Affected
Douglas-fir Beetle	BLM/Forest Service	5	0.3
Fir Engraver	BLM/Private/Forest Service	13	3.3
Flatheaded Borer	BLM/Private/Forest Service	16	1.7
Mountain Pine Beetle	Forest Service	2	0.7
Pine Engraver	Private	1	N/A – TEWA
Port-Orford-Cedar Root Disease	Private	2	0.1
Western Pine Beetle	BLM/Private/Forest Service	10	0.9

Mileages rounded to nearest tenth of a mile.
a/ Summarized from Table 3C-3 in Appendix 3C of Pacific Connector's Resource Report 3.
Source Data: ODF 2004 through 2011 aerial GIS data [Online: http://egov.oregon.gov/ODF/PRIVATE_FORESTS/fh.shtml#Survey_Maps___Data].

Pacific Connector's *Integrated Pest Management Plan* identifies BMPs and conservation measures that would be implemented to minimize the spread of forest pathogens and insects along the pipeline route. Pacific Connector would identify/verify areas infested with forest pathogens during timber cruises prior to construction and implement minimization measures, including but not limited to cleaning equipment and vehicles upon entering/departing infested areas, applying sporax/borax on freshly cut stumps and wounds to reduce spread of root rot, and utilizing standard logging practices that minimize or prevent damage to standing trees adjacent to the Pacific Connector pipeline. Listed below are some measures for specific insect or diseases that would be implemented within infected areas.

- Douglas-fir beetle – Within areas where Douglas-fir beetle infestations have been documented, methylcychexenone capsules (a natural beetle repellent) would be applied to trees along the edge of the construction right-of-way. This treatment would occur before beetle flight in April to protect remaining stands of Douglas-fir and to prevent the spread of Douglas-fir beetle.
- Fir engraver – When clearing the construction right-of-way within true fir stands, Pacific Connector would utilize logging practices that directionally fall timber into the right-of-way, as well as store logs away from trees adjacent to the right-of-way to minimize or prevent damage to standing trees. Additionally, fresh slash greater than 4 inches provides breeding material for the beetles and can contribute to outbreaks. Slash greater than 4 inches would be treated.

- Flatheaded borer – Pacific Connector would minimize damage to adjacent trees when clearing and maintaining the right-of-way, including felling trees within the right-of-way away from adjacent, standing trees.
- Western pine beetle – In overstocked, infested stands, Pacific Connector would remove infested trees before beetle emergence in early June to reduce potential for infestation, if feasible. Also, if a mature ponderosa pine tree is identified with western pine beetle infestation within, but on the immediate edge of the construction right-of-way and would not pose a safety or construction hazards, it would be retained for future snag recruitment to benefit wildlife. Thinning overstocked ponderosa pine stands and removing trees infested with western pine beetles would help reduce the hazard of additional attacks.
- Port-Orford-cedar root disease – The BLM and Forest Service conducted a risk assessment to determine if there was a need for the Project to implement additional management practices to control *P. lateralis*, and determined that no special mitigation is required along the pipeline's right-of-way or haul routes (see appendix R). However, Pacific Connector has proposed additional measures as part of their Plan of Development. To minimize or prevent the spread of *P. lateralis* along the pipeline, Pacific Connector would implement the following in areas with Port-Orford-cedar, whether stands are infested or not (adapted from BLM 1994a): (1) pressure wash equipment and vehicles prior to entering uninfected areas and prior to departure of infested areas; (2) limit ground-disturbing construction and maintenance activities to the dry season, if feasible; and (3) prevent use of right-of-way in Port-Orford-cedar areas from off-road recreationists by blocking access. Pacific Connector would revegetate Port-Orford-cedar areas using disease-resistant strains of seedlings.
- Laminated root rot – Infected stands would be documented and revegetated with resistant species (native cedars, pines, spruces, and hardwoods).
- Dwarf mistletoe – In the event that dwarf mistletoe is found within the pipeline right-of-way, Pacific Connector would consult with the agencies to determine the appropriate plan to minimize its spread.
- Black stain root disease – As was discussed for dwarf mistletoe, in the event that black stain root disease is found within the pipeline right-of-way, Pacific Connector would consult with the agencies to determine the appropriate plan to minimize its spread.
- Annosus root and butt rot – During timber cruises that would occur prior to vegetation clearing, sites infected with annosus root and butt rot would be documented. Management to reduce tree loss from *F. annosus* varies depending on tree species affected. To reduce the spread of annosus root rot along the pipeline, dry borax would be applied to freshly cut stumps and wounds inflicted on trees adjacent to the construction right-of-way in areas identified with infestations of annosus root rot, especially when true firs and pine are the tree species present. In general, dry borax would be applied within 1 to 2 hours following cutting or working within these areas, and would not exceed more than 24 hours. Unless the specific strain of annosus root disease is known (p-type strain or s-type strain), cut surfaces of all susceptible species would be treated in areas where the disease may be occurring to prevent spread. P-type strain occurs mainly on pines and incense cedar, but also on hardwoods and brush; the s-type strain infects spruces, firs, Douglas-fir, western redcedar, and hemlocks.

Habitat Fragmentation

Fragmentation, or breaking up of contiguous areas of vegetation into smaller patches that become progressively smaller and isolated over time, has occurred and continues to occur within areas crossed by the pipeline route. Fragmentation has occurred within the area as a result of natural causes (e.g., landslides and windthrow) as well as previous and ongoing land use activities, including timber harvesting, as well as the development of agriculture areas, urban growth, roads, and utility corridors. The conditions within these fragments are affected by the reduced patch size as well as habitat alterations resulting from edge effects. Forest edges play a crucial role in ecosystem interactions and landscape function, including the distribution of plants and animals, fire spread, vegetation structure, and wildlife habitat. Creation of forest edge adjacent to dense canopy would impact microclimate factors such as wind, humidity, and light, and can lead to a change in species composition within the adjacent forest or increase invasion by invasive species. Compared to the forest interior, areas near edges receive more direct solar radiation during the day, lose more long-wave radiation at night, have lower humidity, and receive less short-wave radiation. Increased solar radiation and wind can desiccate vegetation by increasing evapotranspiration, can affect which species survive along the edge (typically favoring shade intolerant species), and can impact soil characteristics. Fragmentation and a loss of habitat connectivity can also impact wildlife (see section 4.6).

Although any habitat type can be fragmented, of the habitat types crossed by the pipeline, forested habitats and their associated species are likely the most sensitive to fragmentation. Existing patch size, patch isolation, and edge characteristic (i.e., the contrast or the relative difference among adjacent patches) of coniferous and/or mixed forest patches of different age classes (old growth, late successional, mid-seral, regenerative, and clearcut) were evaluated along the pipeline's centerline. During this assessment, (1) the distance of the pipeline's centerline with individual patches was assumed to be indicative of patch size; (2) the distance separating patches of the same age class along the centerline was assumed to be indicative of patch isolation; and (3) the contrast between one forest age category and another forest age category and/or with a non-forested vegetation type (e.g., pasture or agriculture, road or altered vegetation, waterbodies) was used to specify whether an edge was "hard" (i.e., high contrast as an edge between mid-seral and clearcut forest types) or "soft" (i.e., low contrast as between late successional and mid-seral or regenerating forest types). Patches of old-growth forest that were adjacent to late successional forest patches were combined as LSOG. Table 4.5.1.2-7 summarizes the existing patch characteristic of forest age classes crossed by the pipeline's centerline.

TABLE 4.5.1.2-7

Existing Patch Characteristics of Different Coniferous and Mixed Forest Seral Age Classes Crossed by the Pipeline

		Forest Seral Age Class			
Measurement	**Statistic**	**LSOG**	**Mid-Seral**	**Regenerating**	**Clearcut-Early Regeneration b/**
	Number of Patches	370	579	544	141
Patch Size (Centerline intercept distance, feet)	Mean	581.8	397.7	476.7	425.6
	Median	288.0	187.2	294.0	267.6
	Maximum	6,566.2	4,384.4	4,679.7	3,915.4
	Minimum	0.3	0.3	1.5	0.5

TABLE 4.5.1.2-7

Existing Patch Characteristics of Different Coniferous and Mixed Forest Seral Age Classes Crossed by the Pipeline

Measurement	Statistic	Forest Seral Age Class			
		LSOG	Mid-Seral	Regenerating	Clearcut-Early Regeneration b/
Patch Isolation (Centerline distance between adjacent patches, feet)	Mean	1,803.0	1,622.2	1,294.2	5,824.6
	Median	159.3	207.5	117.4	171.7
	Maximum	50,777.9	126,093.3	56,413.37	102,016.9
	Minimum	1.4	1.0	1.0	1.0
Patch Edge Contrast (Percent of Patches with Edge Type) a/	1 Hard Edge	38.4%	35.2%	41.7%	36.2%
	2 Hard Edges	50.8%	46.5%	34.4%	30.5%
	1 Soft Edge	16,8%	21.9%	15.1%	2.8%
	2 Soft Edges	2.7%	6.9%	5.3%	0.7%

a/ If an edge of younger age class patch is adjacent to a similar age class patch, the edge contrast is neither "Hard" nor "Soft".
b/ Early regeneration includes areas that were recently cut in the past 10 years, but greater than five years since harvest.

The orientation of a fragment's edge can affect the extent and magnitude of edge effects because the amount of solar radiation that falls on the newly created edge would depend on the direction it faces, its latitude, time of year and time of day (solar azimuth and solar altitude), and height of trees in the area that would cast shadows on the new edge (Chen et al. 1995). Because these values constantly change temporally and spatially, the edge effects would also constantly change along the pipeline, as tree shadows would extend different distances across the right-of-way depending on the time of year or aspect of the edge. This would result as some areas would be in shade at one point in the year (reducing edge effects) and in sunlight during another portion of the year (increasing edge effects).[78] As a result, the changing amounts of solar radiation, due to tree shadows, would occur along the entire route although the shortest shadows (and most solar radiation) would always occur on the summer solstice when the solar altitude is at its maximum. Harper et al. (2005) estimated that edge effects to vegetation communities in forests could occur up to 300 feet (91.4 meters) from the edge (note that edge effects can be greater for specific wildlife species; see section 4.6).

Table 4.5.1.2-8 lists the acreage of interior forests that would be affected, both directly and indirectly, by the pipeline's contribution to edge effects. As shown in this table, approximately 944 acres of interior forest would be directly affected by construction of the pipeline, while approximately 4,561 acres would be indirectly affected (i.e., would be within 100 meters of newly created edges).

To minimize the effects of the pipeline project on fragmentation and edge effects, Pacific Connector would replant native shrubs and trees within the temporary construction right-of-way outside of the 30-foot-wide operational pipeline maintenance corridor right-of-way, per the requirements found in its ECRP (e.g., by revegetating the area, the hard edge along the fragment would be reduced, thereby minimizing the effects of fragmentation and edge effects).

[78] For example, assume the 95-foot-wide pipeline construction corridor is oriented northwest to southeast at 135 degrees from north. At a location in the vicinity of the pipeline (longitude=123.0 degrees West, latitude=42.5 degrees North) on June 21, the sun would be shining from the east (azimuth ≈91.5 degrees) at 0815 (Pacific Standard Time [PST]) with solar altitude of ≈ 37.6 degrees. A tree 100 feet tall on the southwest-facing edge of the right-of-way would cast a shadow 130 feet which, given the angle and width of the right-of-way, would fall short of reaching the opposite side (northeast-facing edge) by about 5 feet. On May 21, however, the sun in the same position would have cast a shadow of about 170 feet at 0745 (PST) and on July 21 at 0800 (PST) the shadow would extend about 160 feet. In both instances, the edge opposite the eastern sun would be in shadow.

TABLE 4.5.1.2-8

Direct and Indirect Effects to Interior Forests from Construction of the Pacific Connector Pipeline Project

			Direct Effects to Interior Forest (acres)						Indirect Effects to Interior Forest (acres)	
Landowner	**Land Use Allocation**	**Age Classes a/, b/, c/**	**Construction Right-of-Way**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/ Disposal / Pipe Yards**	**Total by Age Class**	**Total Direct Effects**	***100-meter Buffer from Vegetation Removal***	**Total Indirect Effects**
BLM - Coos Bay	LSR - RO 261	L-O	<1	<1	0	0	<1	6	16	46
		M-S	2	<1	0	0	2		14	
		Regen	1	<1	<1	2	4		15	
	Unmapped LSR d/	L-O	15	<1	4	0	19	21	137	141
		M-S	<1	<1	<1	0	1		3	
		Regen	<1	<1	0	0	1		<1	
	Other	L-O	<1	<1	<1	0	<1	34	3	212
		M-S	13	5	1	0	20		125	
		Regen	8	4	<1	0	13		84	
	Subtotal - Coos Bay	*L-O*	15	1	4	0	20	**61**	157	**399**
		M-S	16	6	2	0	23		142	
		Regen	10	5	1	2	18		100	
		TOTAL	**41**	**11**	**6**	**2**	**61**		**399**	
BLM - Roseburg	LSR - RO 261	L-O	2	<1	<1	0	2	5	15	48
		M-S	1	0	0	0	1		15	
		Regen	<1	<1	0	<1	2		18	
	LSR - RO 223	L-O	17	3	14	0	34	43	175	221
		M-S	2	<1	2	0	5		15	
		Regen	2	<1	1	0	5		32	
	Unmapped LSR d/	L-O	15	4	12	0	30	30	116	123
		M-S	<1	<1	<1	0	<1		<1	
		Regen	<1	<1	<1	0	<1		6	
	Other	L-O	17	4	33	0	54	90	166	322
		M-S	3	3	1	0	7		46	
		Regen	10	5	14	0	29		110	
	Subtotal - Roseburg	L-O	51	11	58	0	120	**169**	472	**714**
		M-S	7	3	3	0	13		76	
		Regen	13	6	15	1	36		166	
		TOTAL	**71**	**21**	**77**	**1**	**169**		**714**	
BLM - Medford	Other	L-O	36	12	13	0	61	**83**	230	**327**
		M-S	11	1	4	0	17		72	
		Regen	3	<1	<1	0	4		25	
	Subtotal - Medford	**TOTAL**	**50**	**15**	**18**	**0**	**83**		**327**	

TABLE 4.5.1.2-8

Direct and Indirect Effects to Interior Forests from Construction of the Pacific Connector Pipeline Project

			Direct Effects to Interior Forest (acres)						Indirect Effects to Interior Forest (acres)	
Landowner	**Land Use Allocation**	**Age Classes a/, b/, c/**	**Construction Right-of-Way**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/ Disposal / Pipe Yards**	**Total by Age Class**	**Total Direct Effects**	***100-meter Buffer from Vegetation Removal***	**Total Indirect Effects**
BLM - Lakeview	Other	L-O	0	0	0	0	0	0	7	**13**
		M-S	0	0	0	0	0		6	
		Regen	0	0	0	0	0		0	
Subtotal - Lakeview		**TOTAL**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	
Umpqua N.F.	LSR - RO 223	L-O	27	3	16	0	45	52	162	244
		M-S	2	<1	0	0	2		55	
		Regen	2	1	1	0	5		27	
Umpqua N.F. (continued)	Other	L-O	21	3	9	0	33	57	122	263
		M-S	11	2	7	0	20		112	
		Regen	3	<1	0	0	4		30	
	Subtotal Umpqua National Forest	L-O	47	6	25	0	78	**109**	284	**507**
		M-S	13	2	7	0	22		167	
		Regen	6	2	1	0	9		57	
		TOTAL	**66**	**10**	**33**	**0**	**109**		**507**	
Rogue River N.F.	LSR - RO 227	L-O	34	3	18	0	55	**105**	234	**527**
		M-S	3	<1	1	0	5		48	
		Regen	28	3	15	0	46		245	
Subtotal - Rogue River National Forest		**TOTAL**	**65**	**5**	**35**	**0**	**105**		**527**	
Winema N.F.	Other	L-O	6	<1	3	0	9	20	42	140
		M-S	1	<1	<1	0	2		24	
		Regen	6	<1	3	0	9		74	
Subtotal Winema National Forest		**TOTAL**	**13**	**1**	**6**	**0**	**20**		**140**	
Other Landowners	None	L-O	41	12	24	0	78	**398**	179	**1,934**
		M-S	84	20	71	<1	176		830	
		Regen	80	24	40	0	144		925	
Subtotal - Other Landowners		**TOTAL**	**206**	**56**	**136**	**<1**	**398**		**1,934**	
Total Indirect/Direct Effects to Interior Forest	LSR - RO 261	L-O	2	0	<1	<1	2	11	31	94
		M-S	3	0	<1	0	3		30	
		Regen	2	0	<1	<1	6		33	
	LSR - RO 223	L-O	44	0	5	30	79	95	337	466
		M-S	4	0	<1	2	6		70	
		Regen	5	0	2	3	9		59	
	LSR - RO 227	L-O	34	0	3	18	55	105	234	527
		M-S	3	0	<1	1	5		48	
		Regen	28	0	3	15	46		245	

TABLE 4.5.1.2-8

Direct and Indirect Effects to Interior Forests from Construction of the Pacific Connector Pipeline Project

			Direct Effects to Interior Forest (acres)						Indirect Effects to Interior Forest (acres)	
Landowner	**Land Use Allocation**	**Age Classes a/, b/, c/**	**Construction Right-of-Way**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/ Disposal / Pipe Yards**	**Total by Age Class**	**Total Direct Effects**	***100-meter Buffer from Vegetation Removal***	**Total Indirect Effects**
Total Indirect/Direct Effects to Interior Forest (continued)	Unmapped LSR d/	L-O	29	4	15	0	49	52	254	264
		M-S	<1	<1	<1	0	1		3	
	Unmapped LSR d/	Regen	<1	<1	<1	0	1		7	
	Subtotal LSR	***TOTAL***	**156**	**19**	**85**	**3**	**263**	***263***	***1,351***	
	Other	L-O	81	21	57	0	159	***283***	569	**1,276**
		M-S	40	12	14	0	66		384	
		Regen	30	11	18	0	58		323	
	Subtotal Other	***TOTAL***	**357**	**43**	**89**	**0**	**283**		***1,276***	
	None	L-O	41	12	24	0	78	***398***	179	**1,934**
		M-S	84	20	71	<1	176		830	
		Regen	80	24	40	0	144		925	
	Subtotal - Other Landowners	***TOTAL***	**206**	**56**	**136**	**<1**	**398**		**1,934**	
Total Indirect/Direct Effects to Interior Forest		***L-O***	231	45	146	0	422	**944**	1,604	**4,561**
		M-S	136	33	88	<1	257		1,365	
		Regen	145	40	76	3	265		1,592	
		TOTAL	**513**	**118**	**310**	**3**	**944**		**4,561**	

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

c/ The "Regenerating" category (Regen) describes those forest areas that are regenerating (tree age 5 to 40 years), but do not include recently harvested but regenerating forest (approximately 5 to 10 years – or early regenerating forest).

d/ Unmapped LSRs include occupied marbled murrelet stands and known owl activity centers that occur on NWFP Matrix lands. Areas identified as Unmapped LSRs include those provided by BLM (NSR 2012), as well as occupied marbled murrelet stands (delineated by BLM) that were not identified as unmapped LSRs (LSR3) by BLM but occur on Matrix lands.

Fire Regimes

Fires play a substantial role in shaping the composition and structure of vegetative communities found in southern Oregon. The Pacific Connector pipeline would pass through diverse areas, from Coos Bay to the Klamath Basin, each with a distinct fire regime. Table 4.5.1.2-9 lists the mean fire return interval (i.e., mean fire frequency in the area) as well as the total acres that have burned between 2002 and 2011 (based on existing fire data) for the fifth field watersheds crossed by the pipeline.

TABLE 4.5.1.2-9

Historic Average Fire Frequency and Extent of Acreage Burned in Watersheds Crossed by the Proposed Pacific Connector Pipeline

Ecoregion	HUC – Fifth-Field Watershed	Mean Fire Return Interval a/	Total Acres Burned (2002–2011) b/
Coast Range	Coos Bay-Frontal Pacific Ocean	126-150 Years	0
	Coquille River	81-90 Years	0
	North Fork Coquille River	151-200 Years	0
	East Fork Coquille River	126-150 Years	0
	Middle Fork Coquille River	61-70 Years	0
Klamath Mountains	Olalla Creek-Lookingglass Creek	21-25 Years	0
	Clark Branch-South Umpqua River	26-30 Years	0
	Myrtle Creek	61-70 Years	0
	Days Creek-South Umpqua River	46-50 Years	4,697
	Upper Cow Creek	41-45 Years	942
Cascades	Elk Creek	36-40 Years	17
	Trail Creek	26-30 Years	315
Klamath Mountains	Shady Cove-Rogue River	21-25 Years	27
Cascades	Big Butte Creek	26-30 Years	959
Klamath Mountains	Little Butte Creek	26-30 Years	3,552
Eastern Cascades Slopes and Foothills	Spencer Creek	31-35 Years	0
	John C Boyle Reservoir-Klamath River	26-30 Years	11
	Lake Ewauna-Klamath River	61-70 Years	24
	Mills Creek-Lost River	91-100 Years	3

a/ Data from LANDFIRE (2007).
b/ Data from BLM_Fire_History shapefile (BLM 2013). Acres rounded to nearest whole acre.

At the time this FEIS was being finalized there was a new fire in progress that included portions of the Pacific Connector pipeline route. The Stouts Creek Fire started near Milo, Oregon, on July 30, 2015. By September 1, 2015, the fire had grown to approximately 26,500 acres and had burned into portions of the proposed pipeline route between about MPs 96 and 109. When the fire has been controlled, the BLM and Forest Service will survey the area to assess the impacts of the fire and how it changes habitat along the pipeline route. See also additional discussion in section 4.1.9.1 of this FEIS.

Construction of the Pacific Connector pipeline could increase the risk of fires. However, the exact risk of fires would be dependent on local conditions and construction activities. The risk for fires would be greatest in the areas crossed by the Project that experience hot, dry conditions, and lowest in the areas that experience cool, wet climates. The pipeline route crosses a wide range of ecozones, with different vegetation types, elevations, and climates. For example, the city of Klamath Falls on the east end of the pipeline route is located at an elevation of about 4,100 feet above MSL in the high desert sagebrush steppes of the Klamath Basin, and averages 13 inches of precipitation per year with 21 days over 90°F. In contrast, the city of Coquille, on the west end of the pipeline route, at an elevation of 50 feet above MSL, is located on the west

side of the Douglas-fir forested Coast Range, and averages 55 inches of precipitation per year with just one day over 90°F.

Certain activities associated with construction and operation of the Pacific Connector project (such as prescribed burning of slash, mowing, welding, refueling with flammable liquids, and parking vehicles with hot mufflers or tailpipes on tall dry grass) could increase the risk of wildland fires, especially if these activities occur within the fire season. Even small fires, created during these activities, could have far-reaching consequences on vegetative communities. For example, large forest fires could occur if small, low-intensity herbaceous ground fires, ignited within the herbaceous cover maintained along the permanent right-of-way, utilize the more dense vegetation located near forest edges as a ladder, allowing access to the forest's canopy. This could trigger a high intensity crown fire that could spread to adjacent areas, away from the pipeline's route. If fire frequencies were to increase due to Project activities, vegetative communities could shift to a species composition more adapted to higher fire frequencies. Members of the public have stated it is possible that the cleared right-of-way could serve as a fire break for large crown fires, thereby reducing the extent of a fire's spread (see appendix W); however, as discussed above, the presence of the cleared right-of-way could also increase the risk of crown fires occurring in the first place.

Pacific Connector prepared a *Fire Prevention and Suppression Plan* (Appendix K to the POD, which was included in Pacific Connector's June 2013 application to the FERC) to reduce the risk of wildland and structural fires. This plan contains measures to limit fire risk, such as requiring that all employees participate in a fire training program. Other fire prevention measures that Pacific Connector would implement include prohibiting employees from smoking when working or driving through forested areas; allowing only permitted campfires; burning slash under permitted conditions; restricting blasting activities to between 1:00 p.m. and 8:00 p.m., with no fuses used, and firefighting gear at blasting locations; equipping all non-turbo-charged engines in vehicles used on the right-of-way with approved spark arresters; requiring power saws to meet spark arrestor guidelines, have exhaust screens, and be used more than 20 feet from refueling areas; parking all vehicles in designated areas; having vehicles carry firefighting gear and placing appropriate tools at work sites; and requiring one 5-gallon water pump for each welding unit. In addition, Pacific Connector would coordinate with appropriate landowners and local fire districts to ensure that fire prevention and suppression activities consider pipeline safety. In addition, Pacific Connector prepared a *Prescribed Burning Plan* (Appendix R to its POD).

4.5.1.3 Environmental Consequences on Federal Lands

The Pacific Connector pipeline route would cross lands managed by federal agencies including the Forest Service, BLM, and Reclamation. The pipeline would pass through portions of federal land designations that are intended to protect vegetation or habitats: such as Riparian Management Areas, Riparian Reserves, and LSRs. These federal land designations, as well as the effects that the pipeline would have on these areas, are addressed in section 4.1.

BLM – Forest Operations Inventory

The BLM tracks vegetation, land management treatments, and disturbance within each district during operations inventories. These data and/or attributes are then transferred to a GIS coverage called the Forest Operations Inventory (FOI). The FOI describes and classifies forest

cover (vegetation), site class, denudation cause, dominant species, understory species, treatments, age class, and stand condition (BLM 2006a).

Table O-6 in Appendix O lists the acres of impact that would occur to FOI from both construction and operation of the pipeline. As shown in table O-6, there would be approximately 801 acres of impact during construction of the pipeline to FOIs, which includes about 174 acres on the Coos Bay District, 335 acres on the Roseburg District, 274 acres on the Medford District, and 18 acres on the Lakeview District.

Forest Service – Plant Series and Plant Association Groups

The Forest Service classifies potential vegetation based on plant series, and plant association groups (PAGs). Plant series are based on the climax dominant trees of a stand (e.g., the Douglas-fir series). Plant series can be subdivided into PAGs, which are described primarily by the presence or absence of plant species, as well as the abundance of a species based on environmental variables, including soil, aspect, slope, slope position, and moisture. Not all three National Forests crossed by the Pacific Connector pipeline route have identified PAGs or plant series, and these unidentified areas are noted as "not currently in model" (Forest Service 1996). Table O-7 lists the acres of impact that would occur to PAGs and plant series from both construction and operation of the pipeline. As shown in table O-7, there would be approximately 587 acres of impacts during construction of the pipeline to PAGs and plant series, which includes about 212 acres on the Umpqua National Forest, 283 acres on the Rogue River National Forest, and 92 acres on the Winema National Forest. The Douglas-fir series would be the most heavily affected PAG.

The following describes the seven plant series that would be crossed by the pipeline, based on GIS coverage.

Douglas-Fir Series

Douglas-fir occurs in all PAG series within elevations ranging from sea level to 5,600 feet. Usually overstory presence of Douglas-fir indicates recent ground disturbance while presence and dominance in the understory can indicate hot, dry conditions, which is characteristic of the Douglas-fir Series. Many other tree species may be present that are also tolerant of drought-like conditions, such as ponderosa pine, incense cedar, and canyon live oak (*Quercus chrysolepis*). Within Umpqua National Forest, the following shrubs/plant associations may occur within the Douglas-fir Series: poison oak (*Toxicodendron diversilobum*), canyon live oak, chinquapin, salal, and species associated with ultramafic parent materials. Potentially canyon live oak and Douglas-fir may occur on the Rogue River National Forest.

Mountain Hemlock Series

In Southwest Oregon, mountain hemlock occurs at high elevations, ranging from approximately 3,950 feet to 6,690 feet in the Cascades, with cold temperatures and moderate precipitation. Associated parent material is highly variable, although pumice, andesite, and basalt are the most common. Mountain hemlock and Shasta red fir are dominant tree species in the overstory, with western white pine and Douglas-fir occasionally occurring. Within the Rogue River National Forest, the Mountain Hemlock Series may be associated with grouse huckleberry in deep soils at higher elevations, Pacific rhododendron at lower elevations and warmer conditions, and/or with the wildflower sidebells pyrola (*Pyrola secunda*).

Shasta Red Fir Series

The Shasta Red Fir Series is representative of a variety of California red fir found in southwest Oregon and northern California generally at higher elevations (4,000 to 6,900 feet) where the climate is cool and moist. Shasta red fir is typically the dominant tree in the overstory, although on warmer sites, white fir is present and on cooler sites, mountain hemlock is present. Within the Rogue River National Forest, the mountain sweet-root/Shasta Red Fir Series association may potentially be found which is typically located at sites with lower precipitation. In the Winema National Forest, the Shasta Red Fir series is found within the Cascade Province of Southwest Oregon.

White Fir Series

This species is most abundant in Southwest Oregon and will occur on a variety of sites and therefore is not specific to slope, aspect, soil type, or elevation. White Fir Series generally occurs on cool sites, with an average rainfall varying between 45 inches in drier areas of the Cascades to 102 inches near the coast. As a result of frequent disturbances, other early seral species become the dominant overstory tree in the White Fir Series, such as Douglas-fir and Shasta red fir, which are present within the Rogue River National Forest. Also, dwarf Oregon-grape is common and widespread within the Series and may occur within the area crossed by the pipeline. Based on GIS coverage, white fir-Shasta red fir is crossed on the Winema National Forest.

Grand Fir Series

No specific description has been created for this series. However, based on GIS coverage, grand fir trees may be dominant within stands located in the Umpqua National Forest, with a canyon live oak association.

Jeffrey Pine Series

This species is scattered throughout Jackson and Douglas Counties and usually occurs on dry, ultramafic parent material, mainly serpentine and peridotite with high exposed gravel, surface rock, and bedrock components. As a result of the serpentine/periodotite parent material this series is associated with, many unique and rare species can be found. This series is found within a wide elevational range, from 1,200 feet to 6,000 feet; however, most occurrences are concentrated near 2,000 feet. It can occur on all aspects and slope positions although it is most common on the southerly aspect and mid-slope position. Often Douglas-fir and incense cedar are associated with the Jeffrey Pine Series, which has an open canopy characteristic. Within the Umpqua National Forest, Jeffrey pine (*Pinus jeffreyi*) has the potential to occur with high grass understory coverage.

Western Hemlock Series

This plant series is known to occur in drier conditions on Umpqua National Forest, and the associations crossed by the pipeline are salal, Oregon-grape, and rhododendron. The series is associated with low to moderate elevations. Because of the frequent disturbances in southwest Oregon, the overstory of this series is generally dominated by Douglas-fir with the understory predominately western hemlock; however, within the western hemlock/salal-dwarf Oregon-grape association, both western hemlock and Douglas-fir are present in the overstory.

Measures Implemented on Federally Managed Lands

Listed below are the avoidance and minimization measures that would be implemented on federally managed lands, in addition to those described above:

- Compensation for impacts would be negotiated on a case-by-case basis.
- Disturbed areas would be replanted to prevent noxious weed germination, and disturbed areas would be revegetated with seed mixes described in the ECRP (Appendix I of the POD).
- The authorized officer for the BLM or Forest Service may inspect and approve straw material used on federal lands to verify that it is certified noxious weed free. Gravel/rock used on federal lands would be from weed-free sources as well, and approved by the agencies authorized representative.
- Pacific Connector has agreed to plant the easement with native trees/shrubs described in the ECRP. Affected riparian areas would be replanted extending 100 feet from the streambanks on federal lands. All plantings proposed for federally administered lands must be approved by each agency's authorized representative Agency silviculturists and botanists would determine when sites have been successfully revegetated.
- Replanting of NFS lands would be in accordance with agency vegetation requirements, which may include planting native hardwood and shrubs in addition to conifers to ensure species diversity.

The BLM, Forest Service, Reclamation, FWS, and Pacific Connector are currently working together to develop projects that could be implemented in order to mitigate for environmental impacts on federally-managed lands, as well as ensure that the Pacific Connector pipeline is consistent with the objectives of LMPs. The mitigation projects that have been identified to date that are a part of the proposed action may be found in section 2.1.4. Below is a brief summary and example of the projects that have been identified to date:

- The decommissioning of roads within LSRs that the Forest Service has determined are no longer required.
  - Roads which the Forest Service has identified as "surplus" or unneeded would be decommissioned and these roadbeds would be tilled to a depth of 18 inches. Tillage on federally managed lands would be directed by a Soil Scientist, and would use equipment designed to promote rooting depths needed to facilitate native vegetation recovery and proper water infiltration.
  - The process of decommissioning roads could result in short term impacts, including a temporary increase in erosion during road treatments, temporary disturbance to wildlife during treatments, temporary loss of vegetation if roads need to be cleared in order to remove culverts or side-cast materials, and an increased risk of invasive species as a result of soil disturbance. In addition, the creation of snags could result in short term impacts to vegetation during their installation within stream or terrestrial habitat.
- Conversion of matrix lands to LSRs and enhancement of converted lands.
- Purchasing commercial timber lands and passing the title to the BLM to replace Matrix Lands that would be reallocated to LSRs.

  - These lands could either be adjacent to the pipeline or be situated adjacent to existing BLM lands to block up ownership, increase connectivity, and reduce potential future fragmentation.

- Funding non-commercial silvicultural projects that would create or accelerate the development of old-growth characteristics on federal lands.
- Funding silvicultural projects (pre-commercial or commercial) aimed at reducing fuel loads and minimizing the risk of stand-replacing fires.
- Creating snags to enhance riparian or terrestrial habitat.
- Fence or otherwise exclude cattle and off-road vehicles from sensitive areas to protect habitat.

Noxious Weeds

The BLM objective for weeds is to contain and/or reduce noxious weed infestations with an integrated pest management approach (e.g., chemical, mechanical, manual, and/or biological) and avoid introducing or spreading noxious weed infestations in areas, as outlined in the BLM's multi-state environmental impact statement, Northwest Area Noxious Weed Control Program (BLM 1985) and its supplements, as well as the BLM's *Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report* (2007). The BLM is specifically concerned with the impacts of weeds on LSRs (see section 4.1) and seeks to eliminate or control weeds that adversely affect those areas. Elsewhere, the BLM surveys for noxious weed infestations, reports them to the ODA, and coordinates with them to reduce infestations while using methods that do not conflict with the objectives of each BLM district's RMP.

The Forest Service's objective for invasive plants and noxious weeds is similar to BLM's objectives (described above). Control of noxious weeds by the Forest Service is done in a variety of ways depending on the local national forest's plans for invasive species control. On NFS lands, preventive management is critical to an effective control program. The agency utilizes management direction provided in the *Pacific Northwest Region Invasive Plant Program: Preventing and Managing Invasive Plants Final Environmental Impact Statement* (Forest Service 2005b). Noxious weeds classified as target species that occur on federally managed lands are listed in table 4.5.1.2-5.

In order to prevent or limit the spread of invasive species and noxious weeds, all construction equipment would be inspected to ensure that it is clean and free of potential weed seed, prior to transporting equipment to the construction right-of-way. Because of the contiguous pattern of NFS lands crossed by the pipeline, equipment that could serve as a vector for invasive species would be inspected and cleaned at cleaning stations located at the borders of each National Forest, prior to clearing and grading activities. In addition, equipment would be cleaned prior to entering any mapped areas infested with noxious weeds of priority A and T and selected B listed weeds within each National Forest.

Because the BLM lands crossed by the pipeline are not contiguous, but are instead spread out in a checkerboard pattern, Pacific Connector feels that it is not practical to set up inspection and cleaning stations at each entry point. Instead, Pacific Connector proposes that where BLM lands are contiguous to NFS lands, the cleaning stations be located to include the adjacent BLM lands.

Additionally, equipment would be inspected and cleaned at stations located adjacent to mapped noxious weed infestation areas that were identified during pre-construction surveys on federally-managed lands. The cleaning stations would be located and approved by the EIs and authorized agency representative; these locations would also be mapped for future monitoring efforts to determine if potential infestations occur at these sites and, if they do, to ensure that appropriate control treatments are applied. Monitoring efforts for weed species would be similar to those described above, except that Pacific Connector has proposed to conduct monitoring on federally managed lands annually for a period of at least three to five years. However, the BLM and Forest Service have indicated that they would require that monitoring on federally managed lands be conducted every three to five years for the life of the Project, and that this would be a condition of the Right-of-Way Grant. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary a revised *Integrated Pest Management Plan* that addresses BLM and Forest Service requirements related to monitoring of invasive plant species on federally managed lands, and documentation that the revised plan was found acceptable by the BLM and Forest Service.**

Vegetative Pathogens

The existing conditions related to known occurrences of insects or pathogens are identical to the discussion presented in section 4.5.1.2. Insects or pathogens that have the potential to occur within the project area include Douglas-fir beetle, fir engraver, flatheaded borer, mountain pine beetle (ponderosa and sugar pine), western pine beetle, lodgepole pine needle cast, Port-Orford-cedar root disease, annosus root rot, laminated root rot, dwarf mistletoe, sudden oak death, and the black stain root disease (see section 4.5.1.2). The effects that could occur as well as the measures that would be implemented for the prevention of infestation by insects or pathogens on federally managed lands would be similar to those discussed above, with the exception of the following:

- *Douglas-fir beetle*—No Douglas-fir down wood, 12 inches or larger in diameter, would be left in areas on NFS lands where there are known infestations of Douglas-fir beetle.
- *Fir engraver*—Pacific Connector would use the BLM and Forest Service fuel loading specifications to minimize slash accumulations.
- *Port-Orford-cedar root disease*—All equipment entering NFS lands would comply with all Forest Service *P. lateralis* mitigation requirements. The Forest Service (Region 6) and BLM prepared management objectives for affected federally managed lands in 2004 to help control the spread of the fungus. The objectives focus on maintaining disease-free watersheds, preventing spread through sanitation, seasonal restrictions for activities, and reestablishing Port-Orford-cedar using resistant and non-resistant seedlings.
- *All pathogens*—Directional tree falling would be required on all NFS lands, including areas with no known insect/disease occurrence, to prevent residual tree damage/injury and disease infection.

Wild-Harvesting of Non-Timber Forest Products

Wild-harvesting is the act of gathering food, decorative, or medicinal botanical products that grow naturally on lands not normally associated with agriculture. The non-timber forest

products harvested near the pipeline route are of three categories: floral greens, edibles, and medicinals. Some of the more common of these are salal, beargrass, seasonal evergreen boughs, Christmas trees, mushrooms, berries, nettles, prince's pine (*Chimaphila umbellate*), Oregon-grape (*Mahonia nervosa*), and St. Johnswort (*Hypericum perforatum*). This harvesting of non-timber forest products is widespread on public lands in the Pacific Northwest and can occur year-round (OPB 2006).

The Forest Service and BLM grant permits to wild-harvest for both recreational and commercial uses. The permit process provides forest managers with the means to track demand for products, the amount of products removed from the forests, and to protect sensitive resources (Forest Service 2006c). The Forest Service divides these permits into two major categories: (1) convertible, and (2) non-convertible. The convertible permits are for products, other than timber sales, for which the volumes collected can be converted into board feet, such as permits to collect fire wood. Non-convertible permits are for other products such as mushrooms or berries for which the volumes collected depend on the specific permit applied for; however, the Forest Service estimates that only 25 to 33 percent of harvests are done through this permitting process in some locations (OPB 2006).

Some recreational and commercial harvesters could be temporarily displaced during pipeline construction. Additionally, some of the forest products typically harvested would be removed during vegetation clearing for the Pacific Connector pipeline. However, the pipeline right-of-way and roads would also create new access into forested areas. As a result, it is possible that wild harvesting could increase as a result of the operation of the pipeline project.

4.5.2 Timber

4.5.2.1 Jordan Cove Project

There is no known merchantable timber at the site of the Jordan Cove LNG facilities. The trees that would be cut at the site of the facilities are not considered merchantable; however, Jordan Cove has committed to conduct a timber cruise at the site prior to construction to confirm this. If any merchantable trees are found within the site, they would be salvage logged and sold while the unmerchantable timber, timber slash, and brush would be pulverized in a tub grinder and stockpiled as mulch. The mulch would be saved for future erosion control of recontoured sand dunes created post-construction.

4.5.2.2 Pacific Connector Pipeline

Pipeline construction would require clearing all timber from a 95-foot-wide temporary right-of-way and TEWAs. Timber removal and construction activities would span a two-year period. Year One would mostly consist of vegetation clearing and timber removal along the majority of the pipeline route, and some pipeline installation in select areas, such as at HDDs and within the Klamath Basin. Year Two would consist of the remaining timber removal not completed during Year One, the majority of pipeline installation activities, and construction of aboveground facilities.

While Pacific Connector anticipates that timber clearing would typically be done from May through November (the usual dry period in Oregon), timing restrictions would be imposed within habitat for federally listed NSO and MAMU (see section 4.7). Timber clearing within MAMU

stands or within 300 feet of MAMU stands would occur outside of the MAMU breeding season (April 1 to September 15) in order to prevent impacts to nesting MAMU. Timber removal is expected to occur during Year One of the Pacific Connector construction window; however, if timber removal is not completed prior to the MAMU breeding season, timber removal would continue later in Year One and early in Year Two (between September 16 and March 31) to avoid the MAMU breeding season. Habitat removal within 0.25 mile of an NSO activity center would occur outside of the breeding season (from October 1 through February 28) whether in Year One or in Year Two.

The degree of impact that would occur to forest and timber resources would depend on the logging methods used, quantity of lumber removed, and the age of affected stands. The Pacific Connector pipeline would cross approximately 41.3 miles of LSOG forests, 43.6 miles of mid-seral forests, and 60.9 miles of recently harvested forested lands (see table 4.5.1.2-1). Table 4.5.2.2-1 lists the log types that occur along the pipeline's route.

TABLE 4.5.2.2-1

Merchantable Timber to be Cleared for the Proposed Pacific Connector Pipeline, by Class and Age

Type of Timber	Diameter to Breast Height (inches dbh)	Inside Top Bark Height Diameter (inches)	Age
Small conifer sawlog	10-20	6-10	26–60 years
Medium conifer sawlog	20-30	8-12	61–100-125 years
Large conifer sawlog	30 and larger	8-16	125–250 years; with an unquantified population of ancient relic trees 300 to 500 years

While timber cruises have not yet been conducted, information available indicates that approximately 1,642 acres of large mature trees over 40 years in age and approximately 1,240 acres of small to medium trees under 40 years in age would be harvested during construction of the pipeline (see table 4.5.1.2-2). A portion of these 1,240 acres of small to medium trees would not be merchantable (e.g., those less than 25 years in age). Future timber production would be lost on these young stands. The exact number and board feet of these non-merchantable trees would be determined during timber cruises. Operation of the pipeline would permanently affect approximately 530 acres of forest (see table 4.5.1.2-3),[79] so this amount would be removed from the future timber base. This impact would be because trees would not be allowed to grow within the maintained easement within 15 feet of the centerline. This would include about 314 acres of trees more than 40 years old, and about 215 acres of trees under 40 years old.

Timber cruises would be conducted prior to vegetation clearing to determine timber volumes, values, and species composition within forested lands. Pacific Connector would be required to retain qualified foresters and logging engineers to develop site-specific logging plans for each area to be logged. These plans would identify the size, height, volume, and value of trees in each portion of the construction right-of-way, how the timber would be felled and yarded, where landings and log decks would be placed, the haul routes that would be used to remove the logs, and how logging debris would be disposed of. The FERC requires that all operations be contained within the certificated work area, so it is important to identify methods for falling, yarding, decking, and any additional temporary roads that may be needed for hauling logs prior to the start of construction. Logging methods would vary by location, and would not be known

[79] Less than one acre would be permanently affected as a result of access roads (see table 4.5.1.2-3).

until timber contractors evaluate site-specific conditions. The logging contractors would be solicited by a request for proposal. These proposals would be evaluated by Pacific Connector and contracts would be awarded to the most qualified bidder(s). The exact timber harvest and decking requirement locations would be determined by the contractor within the access roads and staging areas already approved for the pipeline.

Merchantable timber would be removed and sold according to landowner stipulations. In limited areas, TEWAs have been identified for log storage and decking along the pipeline alignment that would be located in existing cleared areas adjacent to existing roads where feasible log storage could occur for extended periods, if necessary. Pacific Connector has designed the construction right-of-way to minimize additional TEWAs, in order to reduce overall project disturbance. However, the construction footprint is not large enough in many areas to both accommodate the logs cleared from the right-of-way and accomplish efficient construction activities simultaneously; therefore, cut timber would be removed from the right-of-way to avoid project delays due to right-of-way congestion.

Clearing of forest is a two-step process: tree felling followed by yarding. Pacific Connector's *Clearing Plan* outlined 15 different scenarios that may be used to cut and remove timber from the right-of-way along the pipeline route, based on slope, stand density, and tree types.

The specific logging methods would not be determined until after a contractor has been selected through the bidding process for each construction spread. Pacific Connector expects that the use of all logging methods may be necessary during clearing to efficiently remove timber from the right-of-way, depending on the site-specific geographic conditions. Timber cutting can be done by mechanical means (e.g., using tracked feller-buncher, saw, or shear) or by hand methods with a chainsaw. Alternative harvest equipment could include tracked crawler stroke-delimber and tracked crawler-chipper. Yarding can be done by cable or helicopter. Ground-based skidding and cable yarding would likely be the standard methods. Ground-based skidding would use tracked grapple and rubber-tired grapple equipment. Ground-based yarding could use shovel logging methods (with tracked feller-buncher, hydraulic grapple heel boom, or dangle-head processer).

In some isolated rugged topographic areas with poor access, helicopter logging may be used. Cable and helicopter logging methods would minimize the potential for soil compaction. Helicopter yarding is currently proposed for the following locations, but the exact locations would not be finalized until a contractor is selected for project construction:

MP 18.1 – 19.3	MP 77.8 – 79.9	MP 101.3 – 102.3
MP 37.1 – 38.4	MP 92.4 – 94.5	MP 108.5 – 110.4
MP 46.7R – 47.2R	MP 95.1 – 97.1	MP 116.3 – 117.8
MP 60.5 – 61.5	MP 97.7 – 98.0	MP 123.3 – 125.1

Any timber cleared from the right-of-way that would be used for instream or upland wildlife habitat diversity structures would be stored on the edge of the right-of-way or in temporary extra work areas for later use during restoration efforts. Prior to clearing operations, the EI or Pacific Connector's authorized representative would flag existing snags on the edges of the construction right-of-way or TEWAs where feasible to save from clearing. These snags would be saved as and used in LWD placement projects to benefit primary and secondary cavity nesting birds,

mammals, reptiles, and amphibians. During this process, other large diameter trees on the edges of the construction right-of-way and TEWAs would also be flagged to save/protect as green recruitment or habitat/shade trees, where feasible. Some of these trees would be girdled to create snags to augment the number of snags along the right-of-way to benefit cavity nesting birds, mammals, reptiles, and amphibians; however, snags that are determined to be a threat to worker safety would be removed.

Pacific Connector proposes that all operations and tree felling would occur within the certificated construction work area limits, and that trees within the certificated construction work area limits would be felled or sheared so as to prevent damage to adjacent trees, facilities, or structures. This may not be practical in steep areas where trees often must be felled on the contour to reduce breakage. Much of the forested portion of the route crosses steep mountainous areas. Failure to fall trees properly would result in a loss of timber available to local industries and loss of value to the landowners and land management agencies. Also, logging roads in some areas crossed by the pipeline have not been used in many years and are covered with young trees. These roads would require clearing and major reconstruction if needed for hauling logs.

Danger trees are those trees at risk of falling on workers or vehicles and thus would need to be removed for safety reasons. A tree may be at risk of falling for a number of reasons including the tree's location and the presence of defects, insects, disease, work activities, and weather conditions. Such trees would be felled in advance of logging, pipeline construction, road construction/reconstruction, and road maintenance. Additionally, danger trees could be created from trees felled for the pipeline. This would occur if trees outside of approved construction areas are damage during felling of harvested timber. While this could result in growth loss, for which Pacific Connector would compensate the land-management agency (or landowner on private lands) for any trees removed and any loss in timber productivity, the FERC requires that all operations be contained within the certificated work areas. Danger trees would be designated by qualified Pacific Connector representatives, in accordance with OSHA standards and the Forest Service/BLM–published *Field Guide for Danger Tree Identification and Response* (Forest Service and BLM 2008). Danger trees would be directionally felled, when consistent with OSHA guidelines, away from the construction right-of-way if trees are to be left, and towards the construction right-of-way if trees are to be removed. Since this would require a variance to FERC requirements, consultation with authorized agency representatives would be required prior to approval. Pacific Connector would compensate the respective land manager/owner for any merchantable danger trees that are felled. If danger trees are identified outside of the approved construction limits, the location of the trees, access to them, and removal would have to be identified and approved by an authorized agency representative using the FERC variance process.

Logs would not be stored next to conifer trees bordering the sides of the right-of-way to avoid damage to live trees. Logs planned for removal from the site would be hauled off the site as soon as practical following yarding in order to prevent disease problems, as well as potential theft problems. Slash pieces larger than 8 inches in diameter may be decked for short periods in agency or landowner designated and approved storage areas or in places where roads cross the right-of-way and made available for removal by firewood permits or for habitat improvement projects. However, Pacific Connector has stated that they may place LWD in UCSAs adjacent to standing conifers.

Where feasible, logs yarded out of wetlands or riparian zones would be skidded with at least one end suspended from the ground so as to minimize soil disturbance. Pacific Connector proposes that any debris entering a waterbody as a result of felling and yarding of timber would be removed as soon as practical after entry into the waterbody and shall be placed outside the 100-year floodplain where practical. Logs and slash would not be yarded across perennial streams unless fully suspended. During logging/clearing operations, the direction of log or slash movement would be conducted to minimize sediment delivery to waterbodies, including intermittent streams. Logs firmly embedded in the bed or bank of waterbodies that are in place prior to felling and yarding of timber would not be disturbed, unless they prevent trenching and fluming operations. Any existing logs that are removed from waterbodies to construct the pipeline crossing would be returned to the waterbody after the pipeline has been installed, backfilling is complete, and during the time the streambanks are being restored.

Pacific Connector would implement the following measures to reduce impacts on timber:

- All tree felling and vegetation clearing would occur within the certificated construction work areas, except for danger trees adjacent to the right-of-way, additional work areas, and travel corridors. Trees within the certificated construction work areas would be directionally sheared or felled so as to prevent damage to adjacent trees, facilities, or structures.
- Danger trees would be felled in advance of logging, pipeline construction, road construction/ reconstruction, and road maintenance. Danger trees would be directionally felled, using chainsaws, away from the permanent right-of-way if trees are to be left and towards to right-of-way if trees are to be removed.
- Landings would not be located in wetlands.
- Logs and slash would not be yarded across perennial streams unless fully suspended over the stream and adjacent banks. Where yarding across intermittent streams is necessary, log movement would be designed to minimize sediment delivery to streams.
- Logs firmly embedded in the bed or bank of waterbodies that are in place prior to felling timber would not be disturbed during logging and yarding operations unless they prevent trenching and fluming operations.
- TEWAs would be in currently cleared areas next to roads.
- Most timber removal would be accomplished through ground skidding and cable yarding; helicopter yarding may be used in some areas that are difficult to access. Where ground skidding is used, the following measures would be employed to minimize significant detrimental soil disturbance (compaction and displacement):
  - low ground weight (pressure) vehicles would be used;
  - logging machinery would be restricted to the 30-foot permanent right-of-way wherever possible to prevent soil compaction;
  - the removal of soil duff layers would be avoided in order to maintain a cushion between the soil and the logs and the logging equipment;
  - designed skid trails would be used to restrict detrimental soil disturbance (compaction and displacement) to a smaller area of the right-of-way over the pipeline trenching area; and

  - landings, yarding, and load-out areas used for timber harvesting would be scarified or subsoiled (depending on the vegetation to be restored) after use and prior to the rainy season where the potential for sediment delivery to waterbodies is possible.

- Logging slash would be treated immediately. Material designated to remain on site to meet resource concerns would be placed in designated UCSAs along the edge of the right-of-way and then scattered/redistributed across the right-of-way during final cleanup and reclamation (following seeding). In upland areas, stump removal would be limited to the trenchline and areas where grading is necessary to construct a safe, level working plane.
- Off-site slash disposal and/or burning may occur in areas where slash is concentrated, such as landings. Slash would be machine or hand piled with the outer edge of piles no closer than 20 feet from the outer drip line of live trees, and burned according to state burning requirements and landowner stipulations. Burns would occur during the wet season.
- Outside of the 30-foot-wide permanent pipeline easement, kept clear of trees with roots that could compromise the integrity of the pipeline coating, the temporary construction area would be restored and revegetated using native seeds and saplings according to the ECRP.

State Lands

Less than 1 percent of the Pacific Connector pipeline would cross State Forests. The proposed route would cross the Southwest Oregon and the East Oregon Forest Practices Region, which contains mature forest. Trees within this portion the right-of-way would be cut and merchantable trees would be sold as directed by ODF. As stipulated within ORS 527.670(3), a written plan must be submitted to the ODF State Forester before extracting timber within:

- 100 feet of a stream classified as Type F (stream with fish or fish and domestic water use) or Type D (stream with domestic water use but no fish use);
- 300 feet of a specific site involving threatened or endangered wildlife species, or sensitive nesting, roosting, or water sites;
- 300 feet of any resource site identified in OAR 629-665-0100 (Sensitive Bird Nesting, Roosting, and Watering Resource Sites on Forestlands), OAR 629-665-0200 (threatened and endangered species that use Resource Sites on Forestlands), or OAR 629-645-0000 (Significant Wetlands); and
- 300 feet of any nesting or roosting site, or critical habitat of threatened or endangered species listed by the FWS or by the ODFW Commission.

Pacific Connector would prepare and submit to the ODF State Forester for approval a written plan describing how the pipeline would be in compliance with the Forest Practices Act (OAR 629-605-0170), prior to harvesting activities. In addition to the written plan, Pacific Connector would be required to submit a Notification to the ODF. The Notification serves three purposes: notification of a forest operation (ORS 527.670), a request for a Permit to Use Fire or Power Driven Machinery (PDM, ORS Chapter 477), and notice to the Department of Revenue of timber harvest (ORS 321.550).

4.5.2.3 Environmental Consequences of Timber Extraction on Federal Lands

Pacific Connector produced a *Right-of-Way Clearing Plan for Federal Lands* that outlined how it would clear timber along the pipeline route. It also produced a *Prescribed Burning Plan* to outline procedures for burning slash along the right-of-way after forest-clearing activities.[80]

Timber cruises on federally managed lands would be conducted by the land management agencies or by a third-party contractor approved by the land management agency (but financed by Pacific Connector), according to a timber cruise design that the agencies approve. Each National Forest and the four BLM Districts crossed by the pipeline would administer its own timber sale contract. Pacific Connector would be the contractor for harvesting activities on federal lands, although logging would likely be done by subcontractor.

Timber sale boundary designation, volume estimation, appraisal, and contract preparation would be accomplished as negotiated between Pacific Connector and the federal land managers. Tree-marking would be done via agency tracer paint used under the supervision and accountability of the respective agency. Pacific Connector would be responsible for logging and marketing the timber. Any timber sold from federal land must be processed domestically and not exported.

The agencies would use a Tree Measurement Timber Sale Contract with the standard provisions for payment and log accountability. Many of the operational requirements typically detailed in such a timber sale contract, such as erosion control, road maintenance, and slash disposal, are expected to be contained in the Right-of-Way Grant and would be incorporated into the timber sale contract. Performance bonding typically required in such a timber sale, if included in the grant and considered adequate, would be used to cover operations performed under the timber sale contracts. Agency sale administrators would oversee timber disposal operations to ensure they are carried out following any site-specific requirements as well as to ensure proper log accounting for specially-designated revenues. Logs from different federal agencies may be segregated at shared landings.

The BLM would require that Pacific Connector purchase all merchantable timber (7 inches dbh). The BLM does not intend to establish a value for young trees below merchantable size thresholds removed during clearing and pipeline construction. The authority and procedures the BLM would use to dispose of merchantable timber on BLM lands involved in the pipeline are addressed in the Title 43 CFR 5400 regulations. BLM may sell the right-of-way timber by competitive bidding or through negotiated sale where it is impracticable to obtain competition. Right-of-way timber would be sold under lump sum timber sale contract(s) at not less than the appraised value as determined by the BLM. Timber sale contracts would be prepared, offered, and administered by each BLM District involved. The Forest Service would appraise and establish a separate contract rate for two products: 1) sawtimber (minimum of 6 inches diameter inside bark), and 2) non-sawtimber (minimum of 3 inches diameter inside bark). The Forest Service would establish a value for reproduction timber destroyed by the Pacific Connector Pipeline Project. The authority and procedure the Forest Service would use to dispose of merchantable timber cut for construction of the pipeline are addressed under Title 36 CFR

[80] Both plans were filed as part of the POD (Appendices R and T, respectively), as stand-alone reports included with Pacific Connector's June 2013 application to the FERC.

223.12, Permission to cut, damage, or destroy trees without advertisement. This regulation authorizes the Forest Service, under the issuance of a right-of-way or special use authorization, to sell the timber directly to Pacific Connector at the current appraised value. Pacific Connector intends to negotiate one contract with the Forest Service covering all three National Forests crossed by the pipeline route.

Table 4.5.2.3-1 summarizes the estimated volume of timber that would be harvested on federally managed lands. The timber volume estimates provided in table 4.5.2.3-1 were derived using professional forestry methodologies and protocols to provide a basic timber volume inventory for the pipeline. A cruise-inventory of stand types (conifer, brush, riparian, roads, rock pits, etc.) was compiled along forested areas of the pipeline project route using aerial photography and ground visits. Each stand type was ground visited and inventory-cruise plots were established in each type to result in a 5 to 8 percent level of accuracy for determining Scribner decimal C log rule gross and net volumes. Twenty percent of plots were full measure quarter-acre (58.9 feet circular). To determine gross thousand board feet (MBF) timber volumes, "Local" volume tables were developed for each species by stand type to determine gross volume by two inch diameter class total height. Dilworth, MB&G, Atterbury, and Forest Service timber cruising protocols were used to determine volume, grade, and cruise downfall. No further deductions were taken for harvesting breakage or local scaling rules-of-thumb factors for hidden defects.

TABLE 4.5.2.3-1

Forest Stand Type and Net Volume (MBF) on BLM and NFS Lands

		Timber Class (MBF)				
County	**Jurisdiction**	**Small Conifer Sawlog**	**Medium Conifer Sawlog**	**Large Conifer Sawlog**	**Mixed Conifer/Hardwood**	**Total Volume (MBF)**
Coos a/	BLM	360	270	1,680	24	2,334
Douglas	Forest Service	360	595	1,764	35	2,754
	BLM	480	702	2,016	40	3,238
Jackson	Forest Service	600	540	3,192	51	4,383
	BLM	480	486	1,680	22	2,668
Klamath	Forest Service	240	135	1,008	20	1,403
	BLM	108	54	420	17	599
Total	***Forest Service***	***1,200***	***1,270***	***5,964***	***106***	***8,540***
	BLM	***1,428***	***1,512***	***5,796***	***103***	***8,839***
	Total	**2,628**	**2,782**	**11,760**	**209**	**17,379**

a/ There are no NFS lands crossed by the Pacific Connector pipeline in Coos County.
MBF – thousand board feet

Pacific Connector estimated that about 17,379 MBF of timber would be cut and removed from the pipeline right-of-way across federal lands. To put these values into perspective, approximately 15.8 MBF are needed to build a 2,000-square-foot house; therefore, this would be enough timber to build approximately 1,100 houses of this size. Pacific Connector proposes that slash from timber clearing be stored on or at the edge of the right-of-way and scattered/redistributed across the right-of-way during final cleanup and reclamation according to BLM and Forest Service fuel loading specifications to minimize fire hazard risks. This material would be pulled back onto the right-of-way during final cleanup after seeding. Where it is not feasible to pull the slash back onto the right-of-way after seeding, seeding in these areas (broadcast or hydroseeding) would occur with specifications to ensure adequate seed coverage. Slash would not be stored for prolonged periods of time within areas infested by pathogenic insects such as Douglas-fir beetle, Douglas-fir engraver beetle, Douglas-fir pole beetle, or

flatheaded borer. Scattering the slash across the right-of-way would hinder OHV traffic on the right-of-way and would act as a natural mulch to minimize erosion.

Section IV.F.3.e of the FERC's *Plan* states that if wood chips are used as mulch to not use more than 1 ton per acre of chips and to add an equivalent of 11 pounds of available nitrogen where chips are used as mulch. The purpose of Section IV.F.3.e is to ensure that revegetation efforts are not hindered due to the decaying process of large amounts of wood chips which can bind up soil nitrogen and impede revegetation. Because more than 1 ton per acre of woody material (logs, slash, and chips) may be scattered across the right-of-way during final cleanup in many areas, Pacific Connector proposed a modification to Section IV.F.3.e of the FERC's *Plan*. Pacific Connector claims it would be impractical and infeasible to remove this material from the right-of-way, and it is a typical silvicultural practice in the Project area to leave forest slash in logged areas. Pacific Connector would utilize the fuel loading standards of the BLM and the Forest Service as the limit for the quantity of woody debris that would be distributed across the right-of-way to minimize fire hazard risks for this proposed modification. Furthermore, it is expected that the woody slash material would not deplete soil nitrogen in the short term, during revegetation establishment, because the size of the woody material that would be scattered on the right-of-way would be large and would not readily decay in the short term. However, as proposed in the Section 10.8 of the ECRP, Pacific Connector would apply a standard fertilization rate of 200 pounds per acre bulk triple-16 fertilizer (16:16:16 - nitrogen, potassium, and phosphorus) on all disturbed areas to be reseeded, except in wetlands. This fertilization rate would apply 32 pounds per acre of elemental nitrogen, potassium, and phosphorus. The elemental nitrogen rate would also satisfy FERC's requirement to add nitrogen where wood chips are used as mulch (see Section IV.F.4.e. of the FERC's *Plan*). The use of fertilizers on federally managed lands would require approval and coordination with the respective agency prior to use. We find this proposed modification acceptable.

On NFS lands, the maximum amount of slash that would be scattered across the right-of-way would be 12 tons per acre, which would be distributed over the following fuel loading size classes:

Fuel Loading Specification by Size Class	
Size Class (diameter)	**tons/acre a/**
0-1/4 inch	<1
1/4–3 inches	4-8
3-8 inches	7-12

a/ Total fuel load should not exceed 12 tons per acre.

On BLM lands, the maximum amount of slash that would be scattered across the right-of-way would be 15 tons per acre, which would be distributed over the following fuel loading size classes:

Fuel Loading Specification by Size Class	
Size Class (diameter)	**Tons/Acre a/**
0-1/4 inch	< 1
1/4 -8 inches	5-8
>8 inches	10-15

a/ Adapted from Forest Service Fuel Loading Standards.

As provided by the Forest Service, dead and downed woody debris greater than 16 inches in diameter does not contribute to fire hazard and would be maintained on site. Slash may be chipped and scattered across the right-of-way provided that the average depth of wood chips covering the area does not exceed 1 inch following application. This chip depth would be sufficient to stabilize the soil surface from erosion while allowing grass seed to germinate and seedlings to develop. It is not expected to significantly increase fuel hazards as long as the maximum tonnage for fuel loading does not exceed 12 tons per acre. On BLM and NFS lands, larger slash pieces (more than 8 inches in diameter) may be removed from the project area and decked in designated storage sites, as stipulated by these agencies, or on the right-of-way at road crossings. This material would be made available to the public through the agencies' firewood programs.

In areas where the fuel loading exceeds these standards, Pacific Connector would machine or hand pile and burn the excess material depending on the site location. Burning would occur during the appropriate burning season and according to the conditions permitted by the BLM, the Forest Service, and the ODF (OAR 629-615-300). Pacific Connector has outlined measures for burning slash and excess small timber in its *Prescribed Burning Plan*. Burning on federal lands would follow the *Interagency Prescribed Fire Planning and Implementation Procedure Guide* (BIA et al. 2008). The Forest Service would seek all necessary air pollution emission permits and approvals from appropriate Oregon state agencies before allowing a prescribed burn. In fact, on NFS lands, the Forest Service may decide to conduct the burns for the pipeline project.

Pacific Connector would submit a reforestation plan to the BLM and the Forest Service for approval during easement acquisition. Following construction, previously forested areas within the temporary construction right-of-way and TEWAs would be replanted in accordance with Oregon reforestation rules (OAR 629-610-0000 through 629-610-0090), BLM Management Directions, and Forest Service Standards and Guidelines (i.e., National Forest Management Act requirements and Forest stocking standards). However, areas within the 30-foot-wide permanently maintained right-of-way would remain cleared and maintained in an herbaceous state to facilitate periodic checks of the pipeline. This would result in a permanent loss of timber production on approximately 119 acres within BLM lands and on approximately 104 acres of NFS lands. Pacific Connector would compensate the Forest Service and BLM for this lost in productivity. The BLM and Forest Service would each be responsible for determining the value of the timber that would be affected by the Pacific Connector pipeline on lands they manage.

Note that not all cleared areas would be replanted. The 30-foot-wide right-of-way would remain cleared and maintained in an herbaceous state to facilitate periodic checks of the pipeline. This would result in a loss of timber production over the operational life of the Project on approximately 119 acres within BLM lands and on approximately 104 acres of NFS lands. Because timber production would be foregone during this period, Pacific Connector would compensate the BLM and Forest Service for a corresponding loss of productivity. The BLM and Forest Service would each be responsible for determining the value of the timber production losses that would be caused by the Pacific Connector pipeline on lands they manage. Compensation would be based on standard timber cruise protocols.

4.6 WILDLIFE AND AQUATIC RESOURCES

4.6.1 Terrestrial Wildlife

The project area provides suitable habitat for a number of wildlife species associated with the coastal, mid-coastal, interior foothills, and mountain terrains that construction and operation of the Project could affect. The types of wildlife habitat that would be affected by the Project and the wildlife species potentially located in those habitats are described below. Wildlife species that have special status under federal or state laws or statutes are discussed in section 4.7.

4.6.1.1 Jordan Cove LNG Terminal

Approximately 178 species of amphibians, reptiles, birds, and mammals were recorded in uplands on or adjacent to the Jordan Cove Project site (i.e., the LNG terminal facility, South Dunes Power Plant, and North Point workers camp) during surveys conducted in October 2012, in early 2006, and from June to December 2005.

ODFW Habitat Categories

Characterizations of wildlife habitats potentially affected by construction of the Project are based on resource agency consultations, on-the-ground surveys, and published reports. In accordance with its Fish and Wildlife Habitat Mitigation Policy, the ODFW has established the following six classifications for habitats, based on dominant plant, soil, and water associations of value to the support and use of fish and wildlife:

- Category 1 – irreplaceable[81], essential habitat[82] that is limited;[83]
- Category 2 – essential habitat that is limited;
- Category 3 – essential habitat, or important[84] habitat that is limited;
- Category 4 – important habitat;
- Category 5 – habitat having a high potential to become essential or important habitat; and
- Category 6 – habitat that has a low potential to become essential or important habitat.

The area affected by the construction of the LNG terminal and associated facilities (including the South Dunes Power Plant, workers camp, etc.) encompasses approximately 397 acres, and an additional 49 acres from temporary disturbance associated with establishing mitigation sites (see table 4.6.1.1-1). Several areas within the terminal tract would be preserved and not affected by construction, while other areas may be restored to higher value habitat by contouring, landscaping, and vegetation plantings typical of the coastal dune setting of the North Spit. Restored

[81] "Irreplaceable" means that successful in-kind habitat mitigation to replace lost habitat quantity and/or quality is not feasible within an acceptable period of time or location, or involves an unacceptable level of risk or uncertainty, depending on the habitat under consideration and the fish and wildlife species or populations that are affected. "Acceptable", for the purpose of this definition, means in a reasonable time frame to benefit the affected fish and wildlife species (OAR 635-415-0025).
[82] "Essential Habitat" means any habitat condition or set of habitat conditions that, if diminished in quality or quantity, would result in depletion of a fish or wildlife species (OAR 635-415-0025).
[83] "Limited habitat" means an amount insufficient or barely sufficient to sustain fish and wildlife populations over time (OAR 635-415-0025).
[84] "Important Habitat" means any habitat recognized as a contributor to sustaining fish and wildlife populations on a physiographic province basis over time (OAR 635-415-0025).

construction areas would be converted to ODFW Habitat Category 4. Table 4.6.1.1-1 lists the temporary and permanent acres of impact to each habitat type for each Project component. Of the jurisdictional terminal facilities, the slip and access channel would affect the most acres of land (66 acres), including ODFW habitat categories 2, 3, 4, and 6. Of the non-jurisdictional facilities, the South Dunes Power Plant would affect the most acres of land (58 acres) comprising the same categories listed above for the slip and access channel. For temporary construction areas, a majority of the habitat affected would be Category 6; however, Categories 2 (less than 1 acre), 3 (33 acres), and 4 (47 acres) would have some impacts from temporary construction.

TABLE 4.6.1.1-1

Acres of ODFW Habitat Affected by the Construction and Operation of the Project

Area a/	Land Area (acres)	Land Affected by Construction (acres) b/
Slip and Access Channel [12] (Access Channel and Marine Slip)	*66*	*66*
Shallow Subtidal (Category 3)	0	3 c/
Salt Marsh (Category 2)	0	<1 c/,d/
Eelgrass (Category 2)	0	3 c/
Deep Subtidal (Category 3)	0	15 c/
Algae/Mud/Sand (Category 2) f/	0	4 c/
Intertidal Unvegetated Sand (Category 2) f/	0	4 c/
Coastal Dune Forest (Category 3)	0	16
Shrub (Category 4)	0	<1
Herbaceous (Category 4)	0	19
Developed (Category 6)	0	1
Marine Access Pipeway [3] (LNG Transfer Line)	*9*	*9*
Coastal Dune Forest (Category 3)	0	9
Developed (Category 6)	0	<1
LNG Tank Area [5] (LNG Storage Tank Area)	*27*	*27*
Coastal Dune Forest (Category 3)	0	6
Herbaceous (Category 4)	0	21
Liquefaction Process Area [4]	*20*	*20*
Coastal Dune Forest (Category 3)	0	20
Developed (Category 6)	0	<1
Refrigerant Storage Area [2]	*2*	*2*
Coastal Dune Forest (Category 3)	0	<1
Herbaceous (Category 4)	0	1
Flare Area [7] (Ground Flare)	*1*	*1*
Coastal Dune Forest (Category 3)	0	<1
Herbaceous (Category 4)	0	<1
Fire Water Ponds [6] (Terminal Fire Water Ponds)	*4*	*4*
Herbaceous (Category 4)	0	4
Terminal Site Access [1] (North Terminal Access)	*4*	*4*
Scrub-Shrub Wetland (Category 2)	0	<1
Coastal Dune Forest (Category 3)	0	1
Herbaceous (Category 4)	0	2
Construction Dock [8] (Barge Berth)	*3*	*3*
Shallow Subtidal (Category 3)	0	<1
Algae/Mud/Sand (Category 2)	0	<1 c/
Intertidal Unvegetated Sand (Category 2)	0	1
Coastal Dune Forest (Category 3)	0	<1
Developed (Category 6)	0	<1
Control Building/Plant Warehouse/Maintenance Building [R1A] (Terminal Operator Building and Warehouse)	*8*	*8*
Coastal Dune Forest (Category 3)	0	4
Unvegetated Sand (Category 3)	0	<1
Herbaceous Shrub (Category 4)	0	1
Developed (Category 6)	0	2
Access/Utility Corridor [R1](Utility Corridor and East Access Road)	*11*	*11*
Emergent Wetland (Category 2)	0	<1
Forested Wetland (Category 2)	0	<1
Coastal Dune Forest (Category 3)	0	3

TABLE 4.6.1.1-1

Acres of ODFW Habitat Affected by the Construction and Operation of the Project

Area a/	Land Area (acres)	Land Affected by Construction (acres) b/
Unvegetated Sand (Category 3)	0	4
Riparian Forest (Category 3)	0	<1
Herbaceous Shrub (Category 4)	0	2
Open Water (Category 2)	0	<1
Developed (Category 6)	0	<1
Gas Processing Area [9, 9A]	*13*	*13*
Salt Marsh (Category 2)	0	<1 c/,d/,e/
Algae/Mud/Sand (Category 2)	0	<1 c/,d/
Herbaceous Shrub (Category 4)	0	10
Emergent Wetland (Category 2)	0	<1
Herbaceous (Category 4)	0	1
Open Water (Category 3)	0	<1
Developed (Category 6)	0	2
Stormwater Pond/Laydown [11] (g/) (Shared Jurisdiction between FERC and EFSC) (Stormwater Pond)	*11*	*11*
Herbaceous Shrub (Category 4)	0	11
Developed (Category 6)	0	<1
Pacific Connector Meter Station	*0 h/*	*0 h/*
Herbaceous Shrub (Category 4)	0	0
Industrial Wastewater Pipeline Relocation	*13*	*13 (5)*
Herbaceous (Category 4)	0	6 (0)
Herbaceous Shrub (Category 4)	0	<1 (0)
Shrub (Category 4)	0	<1 (0)
Developed (Category 6)	0	7 (5)
Water/Raw Water Line (Raw Water Pipeline Extension)	*3*	*3 (1)*
Herbaceous (Category 4)	0	<1 (0)
Developed (Category 6)	0	2 (1)
North Point Workforce Housing Project Bridge	*<1*	*<1*
Salt Marsh (Category 2)	0	<1 c/,e/
Algae/Mud/Sand (Category 2)	0	<1 c/
Shrub (Category 4)	0	<1
TOTAL JURISDICTIONAL FACILITIES	**195**	**195**
Non-Jurisdictional Facilities		
South Dunes Power Plant	*58*	*58*
Emergent Wetland (Category 2)	0	1
Coastal Dune Forest (Category 3)	0	<1
Shrub (Category 4)	0	<1
Herbaceous (Category 4)	0	12
Herbaceous Shrub (Category 4)	0	13
Open Water (Category 3)	0	<1
Developed (Category 6)	0	31
Southwest Oregon Resource Security Center (SORSC)	*8*	*8*
Forested Wetland (Category 2)	0	<1
Emergent Wetland (Category 2)	0	<1
Coastal Dune Forest (Category 3)	0	6
Herbaceous (Category 4)	0	<1
Shrub (Category 4)	0	<1
Developed (Category 6)	0	<1
TOTAL NON-JURISDICTIONAL FACILITIES	**66**	**66**
Temporary Construction Areas		
Heavy Equipment Truck Haul Road o/	*8*	*8*
Coastal Dune Forest (Category 3)	0	<1
Herbaceous (Category 4)	0	<1
Herbaceous Shrub (Category 4)	0	<1
Shrub (Category 4)	0	<1
Developed (Category 6)	0	7
Slurry/Decant Water Pipeline Route (p/) (Slurry and Return Water Pipelines)	*1*	*1*
Developed (Category 6)	0	1
Field Supervision Trailers (Terminal Construction Trailers)	*- i/*	*- i/*
Tank Staging Area	*- i/*	*- i/*

TABLE 4.6.1.1-1

Acres of ODFW Habitat Affected by the Construction and Operation of the Project

Area a/	Land Area (acres)	Land Affected by Construction (acres) b/
Concrete Batch Plant Area	*- k/*	*- k/*
Tank Roof Fabrication	*- j/*	*- /*
Process Staging Area	*- j/*	*- j/*
Offices (Construction Offices at Roseburg Forest Products Property)	*1*	*1*
Developed (Category 6)	0	1
Laydown (Laydown Area at Roseburg Forest Products)	*13*	*13*
Developed (Category 6)	0	13
Open Areas	11	11
Developed (Category 6)	0	11
Parking (Parking at Roseburg Forest Products)	*1*	*1*
Developed (Category 6)	0	1
Craft Areas (Craft Areas at Roseburg Forest Products)	*<1*	*<1*
Developed (Category 6)	0	<1
Warehouse/Storage (Warehouse/Storage at Roseburg Forest Products)	*1*	*1*
Developed (Category 6)	0	1
Fabrication (Fabrication Areas at Roseburg Forest Products)	*4*	*4*
Developed (Category 6)	0	4
LNG Loading Berth Dune (Southeastern Berth Dune Area)	*15*	*15*
Coastal Dune Forest (Category 3)	0	13
Developed (Category 6)	0	2
Sand Dune Area (Northern Terminal Sand Dune Area)	*7*	*7*
Scrub-Shrub Wetland (Category 2)	0	<1
Coastal Dune Forest (Category 3)	0	6
Herbaceous (Category 4)	0	<1
Laydown Area	*21*	*21*
Coastal Dune Forest (Category 3)	0	14
Herbaceous (Category 4)	0	8
Laydown Area (Gas Processing Plant Laydown Area)	*4*	*4*
Herbaceous Shrub (Category 4)	0	3
Developed (Category 6)	0	<1
North Point Workforce Housing Project Site (North Point Workers Camp)	*48*	*48*
Shrub (Category 4)	0	5
Herbaceous Shrub (Category 4)	0	13
Herbaceous (Category 4)	0	18
Developed (Category 6)	0	12
Construction Laydown g/	*- l/*	*- l/*
Construction Laydown g/	*- l/*	*- l/*
Laydown – South Dunes g/	*- m/*	*- m/*
Excavated Materials Haul Road	*- n/*	*- n/*
TOTAL TEMPORARY CONSTRUCTION AREAS	**136**	**136**
Preserved Wetlands Area [E3] (Eastern Henderson Marsh)	*11*	*0*
Emergent Wetland (Category 2)	4	0
Scrub-Shrub Wetland (Category 2)	4	0
Coastal Dune Forest (Category 3)	<1	0
Herbaceous (Category 4)	2	0
Preserved Wetlands Area [E1](Northeastern Terminal Wetlands Area)	*28*	*0*
Forested Wetland (Category 2)	17	0
Emergent Wetland (Category 2)	2	0
Coastal Dune Forest (Category 3)	8	0
Shrub (Category 4)	<1	0
Herbaceous Shrub (Category 4)	<1	0
Preserved Wetlands Area [E5] (Western South Dunes Power Plant Wetlands Area)	*7*	*0*
Emergent Wetland (Category 2)	4	0
Coastal Dune Forest (Category 3)	1	0
Herbaceous Shrub (Category 4)	2	0
Open Water (Category 4)	<1	0
Developed (Category 6)	<1	0
TOTAL UNDISTURBED AREAS	**45**	**0**
Wetland Mitigation Sites g/		
West Jordan Cove Mitigation Area	*3.7*	*3.7*
Salt Marsh (Category 2)	0.5	0.5

TABLE 4.6.1.1-1

Acres of ODFW Habitat Affected by the Construction and Operation of the Project

Area a/	Land Area (acres)	Land Affected by Construction (acres) b/
Herbaceous (Category 4)	0.1	0.1
Herbaceous Shrub (Category 4)	2.1	2.1
Riparian Forest (Category 3)	0.7	0.7
Developed (Category 6)	0.3	0.3
West Bridge Mitigation Area	*2.0*	*2.0*
Scrub-Shrub Wetland (Category 2)	0.4	0.4
Unvegetated Sand (Category 3)	0.1	0.1
Coastal Dune Forest (Category 3)	0.4	0.4
Riparian Forest (Category 3)	0.1	0.1
Shrub (Category 4)	0.4	0.4
Developed (Category 6)	0.6	0.6
Kentuck Mitigation Area	*43.6*	*43.6*
Emergent Wetland (Category 2)	42.5	42.5
Open Water (Category 4)	1.1	1.1
TOTAL WETLAND MITIGATION AREAS	**49.3**	**49.3**
TOTAL PROJECT AREA	**491**	**446**

a/ Numbers or letters in brackets refer to area designations shown on figure 2.1-2.
b/ Under *Jurisdictional Facilities* and *Non-jurisdictional Facilities*, acres shown represent both temporary and permanent effects. Numbers in parentheses represent permanently affected acres where they differ from temporarily affected acres. *Temporary Construction Areas* and *Wetland Mitigation Sites* would only have temporary effects.
c/ The estuarine habitat acreages affected presented in this table may vary slightly from those used in the U.S. Army Corps of Engineers (COE) 404/Section 10 Permit Application and other areas of this report. Minor adjustments to affected area boundaries, including adjustments created to allow for buffers around estuarine resources, were made for the COE permit application. These adjustments were made to ensure the Project footprint reviewed in the permit process is sufficient to address potential modifications that may occur during that process, including potential changes to the Project footprint in the final design and any additional mitigation measures that may be required to address potential impacts to estuarine resources. The ODFW habitat acreages remain as being based on reasonable boundaries at the time the Project was designed. All other references to estuarine impacts shall be based on the adjusted acreage amounts used in the COE permit application, which include a contingency to ensure all areas affected by the Project will be covered by the permit process.
d/ Effects presented in the Section 10/404 permit are combined for Mill Site/South Dunes Site and include the Gas Processing/Shared areas.
e/ Salt Marsh is considered "Intertidal" in the 6/13/2013 Section 404 Submittal by DEA.
f/ Algae/Mud/Sand + Intertidal Unvegetated Sand is equal to "Intertidal", as referenced in the COE 404/Section 10 Permit Application and other areas of the Resource Report.
g/ These areas are associated with the construction and operation of the gas processing facility and are included with the areas for the LNG Terminal even though they are adjacent to the non-jurisdictional South Dunes Power Plant site.
h/ Pacific Connector Pipeline Project metering area may be used for laydown depending on the timing of Project construction. Effects due to operation of this area are addressed in Pacific Connector's FERC resource reports.
i/ Individual temporary construction area is included in total for Area 5.
j/ Individual temporary construction area is included in total for Area 4F.
k/ Individual temporary construction area is included in total for Areas 4F and 6.
l/ Individual temporary construction area is included in Area 10.
m/ Individual temporary construction area is included in Area 11.
n/ Area is included in Project site area and access/utility corridor.
o/ Area calculation based upon the length of the heavy equipment truck haul road to the point where the road joins with the access/utility corridor or other areas already included in the totals for temporary construction impact.
p/ Area calculation based upon the length of the pipelines from the slip to the access/utility corridor, at which point the affected area is already included in the area affected by the access/utility corridor.
q/ Areas presented in this table are the maximum area disturbed during construction and may be greater than the areas used to determine mitigation requirements for DSL and COE Permits.

Below we discuss the habitats found within the Jordan Cove terminal tract, their vegetation cover, associated wildlife, and ODFW habitat categories.

Upland Habitats

Uplands on the North Spit contain coastal dune forest, riparian forest, shrubs, grasslands (herbaceous), and unvegetated sand dunes. Dominant overstory for coastal dune forest include Douglas-fir, western hemlock, shore pine, Sitka spruce, and Port-Orford-cedar, with an

understory including evergreen huckleberry, salal, bearberry, rhododendron, California wax myrtle, and manzanita. Shore pine and Sitka spruce forests constitute the habitat with the greatest structural complexity on the North Spit and support the greatest diversity of wildlife species. The trees, snags, and downed logs in these forests provide important breeding, foraging, and cover habitat for a variety of wildlife species: upland amphibians seek cover in downed logs, and many bird species, including raptors, woodpeckers, and songbirds, nest and forage in these habitats.

Coastal dune forest and riparian forest habitats are classified as Category 3 because they are essential to wildlife but not limited (OAR 635-415-0025). Species that depend on these habitat types include the American marten, bats, and some songbirds. Loss of this habitat category could result in the depletion of some species on a local scale. Construction of the Project would affect about 100 acres of coastal forested dune habitat.

Herbaceous, herbaceous shrub, and shrub habitat types are all classified as Category 4 because they are not essential or limited, but they are still important to wildlife. The vast majority of these habitats lie on dredge spoils covered by weedy herbaceous and shrub species. Shrub species present within these habitats include young shore pine and invasive species such as Scotch broom and Himalayan blackberry. Herbaceous vegetation in these habitat types includes native species such as seashore lupine, small-head clover, and beach strawberry, together with invasive species such as European beachgrass, colonial bentgrass, and sweet vernal grass. These habitats have been extensively degraded historically, and only provide habitat for generalist species such as deer, small mammals, and a limited suite of songbirds (DEA 2014). No specific wildlife species are known to depend on these habitats, and their loss would not likely result in depletion of any species. Construction of the Jordan Cove Project would affect a total of about 155 acres of herbaceous, herbaceous shrub, and shrub habitat.

Open Water or Wetland Habitats

Open water and wetland habitats on the North Spit are composed of several freshwater lakes, ponds, forested and shrub wetlands, and emergent wetlands and marshes, together with the Coos Bay estuary and its associated shoreline, including mudflats. The overstory in forested wetlands on the North Spit consists of shore pine, Hooker willow, red alder, and Sitka spruce, with an understory of Pacific crabapple, Douglas spirea, twinberry, and slough sedge. Scrub-shrub wetlands are commonly dominated by Hooker willow, with salmonberry, slough sedge, skunk cabbage, and Pacific crabapple. Emergent wetlands are typically dominated by slough sedge, with spreading rush, water parsley, Pacific silverweed, salt grass, cattail, bulrush, and aquatic floating plants like pond lily. Salt marsh and algae-covered mudflats are also included in the wetland habitat types.

Habitats found in this environment support a rich terrestrial wildlife community, including mammals, birds, reptiles, and invertebrates; aquatic species found these habitats are discussed below in section 4.6.2. Terrestrial wildlife species that use open water and wetland habitats (inland, estuarine, or marine) on the North Spit are generally specialized, or are strongly associated with one habitat type. However, there are dozens of species that may occur within the project area that are very well adapted to utilizing one, two, or all three of these open water and wetland habitats, as seasonal conditions warrant. Resident and migrant shorebirds congregate on the tidally inundated mudflats along the shore of Coos Bay, to forage on the invertebrates in the

shallow waters and exposed mudflats, especially during low tides. Raptors known to use open water and shoreline habitats include the bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern harrier (*Circus cyaneus*), and peregrine falcon (*Falco peregrinus*). Mammals that also forage in wetlands and near shore environments include raccoon (*Procyon lotor*), mink (*Neovison vison*), and striped skunk (*Mephitis mephitis).*

Forested, scrub-shrub, and emergent wetlands are classified as Category 2, because they are essential for wildlife, and limited, but can be replaced through mitigation. Construction of the LNG terminal would affect about 38 acres of wetlands (see table 4.4.3.1-1).

Construction of the access channel to the terminal would include 29 acres of open water within Coos Bay (see figure 4.6-2 in section 4.6.2). This area contains salt marsh, eelgrass, intertidal, and subtidal habitats. Approximately 12 acres of this area that would be affected by the construction and operation of the LNG terminal is also classified as Category 2, because it is essential for wildlife, and limited, but can be replaced through mitigation.

Developed Habitat

Developed areas include portions of the LNG terminal site that have been significantly disturbed by previous development and industrial use, including land use activities such as demolished mill foundations/concrete pads, unvegetated cut slopes, rocked yards, paved roads, parking lots, gravel roads, concrete laydown areas, log deck storage areas, and sandy roadside areas. Developed lands have limited potential to become important or essential wildlife habitat, and therefore are classified as Category 6. About 102 acres of developed lands would be affected by construction of the Jordan Cove Project.

ODFW Habitat Category Mitigation Measures

On May 22, 2014, Jordan Cove filed its *Wildlife Habitat Mitigation Plan* with the FERC, to comply with the ODFW Fish and Wildlife Habitat Mitigation Policy under OAR 635-415-000 to 00025 (see appendix S of this EIS). According to that policy, project proponents can protect and maintain habitat areas to replace or mitigate for impacts on Category 1-4 habitats. Construction of the Jordan Cove Project facilities would affect a total of approximately 27 acres of Category 2, 115 acres of Category 3, and 120 acres of Category 4 habitats (note than numbers are approximate due to rounding in table 4.6.1.1-1). To mitigate for the loss of those habitats, Jordan Cove would acquire or control about 259 acres of county or privately owned land at three parcels outside of its terminal tract, but still in the vicinity of the North Spit (table 4.6.1.1-2; see also figure 4 in the *Wildlife Habitat Mitigation Plan* [appendix S]). These parcels would be set aside for long-term preservation, and maintained by a third-party non-profit organization that meets the requirements of ORS 271.714(3)(b).[85] The mitigation parcels would mitigate for impacts shown in table 4.6.1.1-1. Jordan Cove is continuing to work with ODFW to finalize its Project-specific *Wildlife Habitat Mitigation Plan* to comply with state policy.

[85] Currently, Jordan Cove is negotiating with the Coos Watershed Association to fulfill the role of the non-profit third party to preserve and manage the habitat mitigation areas.

TABLE 4.6.1.1-2

Proposed Mitigation Parcels, Vegetation Types, and Acres of Habitat Categories To Be Preserved

			Habitat Type (acres)					
Parcel	**Acres of Mitigation**	**Owner**	**Coastal Dune Forest**	**Riparian Forest**	**Shrub**	**Herbaceous Shrub**	**Herbaceous**	**Unvegetated Sand**
P (Panhandle)	105	Port	33	0	4	30	64	1
S (North Bank)	70	Private	69	1	0	0	0	0
W (Lagoon)	84	Private	0	0	5	23	27	2
Total	**259**	--	**102**	**1**	**9**	**53**	**91**	**3**

Note: Acreages rounded to nearest whole acre. Rows/columns may not sum correctly.
Source: Jordan Cove *Wildlife Habitat Mitigation Plan* (appendix S of this EIS).

Terrestrial Animals in the Project Area

Terrestrial wildlife that may occupy the project area includes mammals, birds, amphibians, reptiles, and invertebrates.

Mammals

The BLM has documented 58 mammal species on the North Spit (BLM 2005). This includes large mammals, such as mountain lion (*Felis concolor*), Roosevelt elk (*Cervis elaphus roosevelti*), American black bear (*Ursus americanus*), and black-tailed deer (*Odocoileus hemionus*). Wildlife surveys conducted for Jordan Cove in 2005, 2006, and 2012 documented 11 mammal species within the terminal tract (LBJ 2006; SHN 2013): beaver (*Castor canadensis*), Roosevelt elk, Virginia opossum (*Didelphis virginiana*), North American porcupine (*Erethizon dorsatum*), mountain lion, Townsend's chipmunk (*Neotamias townsendi*), black-tailed deer, harbor seal (*Phoca vitulina*), raccoon, Douglas' squirrel (*Tamiasciurus douglasii*), and American black bear. Nine species of bats are known to occur on the North Spit. While bat-specific surveys were not completed by Jordan Cove, the mosaic of habitat types within the area suggests bat presence is potentially high. Unidentified bats were observed in one of the buildings on the Roseburg Forest Products property on July 21, 2005.

The construction and operation of the LNG terminal would reduce the amount of habitat available for big game species, and vehicle traffic related to the Project would increase the potential for collisions. However, due to the limited amount of natural habitat that would be affected within the LNG terminal tract, the amount of dune and wetland habitat that would be preserved, the amount of previous disturbance at the site, and existing industrial activities in the area, we conclude that the Project would not have significant population-level adverse effects on mammal species that currently occupy the North Spit.

Breeding and roosting sites for bats at the LNG terminal tract are limited, because of the small amount of forest that would be affected, as well as the absence of more typical bat habitat such as cliffs, rock outcrops, bridges, caves, and mines. Some habitat for those species that roost under bark is available in the dune forest habitat on the LNG terminal site. As with other mammals, it is not anticipated that construction and operation of the LNG terminal would have significant adverse effects on bat populations.

Birds

Migratory birds, which include all native birds in the U.S., with the exception of upland game birds, are protected under the MBTA, as described in section 1.5.1.10. Additionally, EO 13186 was enacted, in part, to ensure that the environmental analysis of a federal action evaluates the impacts of that action on migratory birds, and the federal agency and its project proponents avoid, minimize impacts, conserve species, and restore and enhance migratory bird habitat. EO 13186 states that emphasis should be placed on species of concern, priority habitat, and key risk factors. In March 2011, FERC and FWS finalized an MOU to implement EO 13186. Conservation of migratory bird habitats, avoiding or minimizing take of migratory birds, and developing effective mitigation measures to restore or enhance habitats on lands affected by energy projects are included as obligatory elements in the MOU. The MOU also places emphasis on, but is not exclusive to, birds of conservation concern (BCC).

The project area is located within the Pacific Flyway path for migratory birds. Birds that are known or that likely occur along the waterway and within the LNG terminal site include seabirds, shorebirds, waterfowl, passerines (songbirds), wading birds, and raptors. The BLM has documented 275 avian species using habitats on or near the North Spit of Coos Bay (BLM 2005). In addition, LBJ Enterprises (2006) documented 151 avian species during surveys of the LNG terminal tract, including two additional species not documented by the BLM.

The FWS maintains a list of migratory BCC that was developed as a result of a 1988 amendment to the Fish and Wildlife Conservation Act; the list was most recently updated in 2008. The Fish and Wildlife Conservation Act mandates that the FWS "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing" under the ESA. The goal of the BCC list is to prevent sensitive, rare, or otherwise vulnerable species from being listed under the ESA, by implementing proactive management and conservation actions and ensuring that these species be considered in accordance with EO 13186. BCC that potentially occur in the project area are listed in table 4.6.1.1-3. Federally- or state-listed species that are also BCC are not included below, as they are discussed in more detail in sections 4.7.1 and 4.7.2.

TABLE 4.6.1.1-3

Birds of Conservation Concern in the Project Area, Timing of Potential Occurrence, and Expected Habitat

Common Name	Scientific Name	Timing of Potential Occurrence	Expected Habitat
bald eagle	*Haliaeetus leucocephalus*	year-round	Near large bodies of water
peregrine falcon	*Falco peregrinus*	winter/year-round	Open habitats, nests on cliffs
black oystercatcher	*Haematopus bachmani*	year round	Coastal beaches, bays, and estuaries
whimbrel	*Numenius phaeopus*	Migration	Coastal marshes, beaches, rocky shores
long-billed curlew	*Numenius americanus*	Winter	Fields, dry prairies, mudflats
marbled godwit	*Limosa fedoa* (ssp. *beringiae* only)	Winter	Beaches, mudflats, shallow pools
red knot	*Calidris canutus*	Migration	Beaches and mudflats
short-billed dowitcher	*Limnodromus griseus*	Winter	Beaches, mudflats, shallow ponds
Caspian tern	*Sterna caspia*	Migration	Coastal areas
black swift	*Cypseloides niger*	Migration	Forages over forests and open areas
rufous hummingbird	*Selasphorus rufus*	summer/migration	Coniferous forests
olive-sided flycatcher	*Contopus cooperi*	Summer	Coniferous forests
vesper sparrow	*Pooecetes gramineus* (ssp. *affinis* only)	Very unlikely to occur in vicinity of Project	Open fields and pastures

TABLE 4.6.1.1-3

Birds of Conservation Concern in the Project Area, Timing of Potential Occurrence, and Expected Habitat

Common Name	Scientific Name	Timing of Potential Occurrence	Expected Habitat
Western grebe	*Aechmophorus occidentalis*	Winter	Marshes, lakes, and bays
lesser yellowlegs	*Tringa flavipes*	Migration	Marshes, ponds, wet meadows, lakes and mudflats
Hudsonian godwit	*Limosa haemastica*	Rare	Marshes, beaches, flooded fields, and tidal mudflats
Allen's Hummingbird	*Selasphorus sasin*	Summer	Chaparral, thickets, brushy hillsides, open coniferous woodlands, and gardens near coast
willow flycatcher	*Empidonax traillii*	Summer	Low brushy vegetation in wet areas
purple finch	*Carpodacus purpureus*	Year-round	Wooded areas

Sources: FWS (2008a); Sibley (2000); NatureServe (2009, 2013)

Seabirds

Thirteen seabird species breed along Oregon's coast, with offshore rocks and islands providing critical nesting habitat and important rest-over locations. Seabirds depend on relatively undisturbed coastal nesting habitats and on the rich coastal waters for food (Oregon Ocean Resources Management Task Force 1991). Foraging habitat can differ by species; some species such as the sooty shearwater (*Puffinus griseus*) and the northern fulmar (*Fulmarus glacialis*) are found primarily along the mid and outer shelf, while California gull (*Larus californicus*) and western gull (*Larus occidentalis*) occur only in the nearshore (Oregon Ocean Resources Management Task Force 1991). Foraging sea birds can be encountered along the LNG vessel transit route, at the terminal site, and in adjacent Coos Bay water.

Shorebirds

Coos Bay is one of a number of important areas for shorebirds between San Francisco Bay and British Columbia. Key areas for migrating shorebirds include Coos Bay and the beaches and deflation plains in the ODNRA. Coos Bay's extensive eelgrass (*Zostera marina*) beds, productive sloughs, intertidal algal flats, and substantial tidal marshes provide valuable habitat for thousands of shorebirds. Foraging habitat for shorebirds includes inter-tidal mudflats, rocky inter-tidal, estuaries, salt marshes, and beaches; salt marshes are used for resting and preening. The vast majority of shorebirds are migratory and non-breeders in Coos Bay. An important exception is the western snowy plover (*Charadrius alexandrinus nivosus*), which nests on upper beaches on the North Spit (this species is discussed in more detail in section 4.7). Shorebirds are most likely to be encountered along the beaches of the North Spit, and within the bay along tidal mudflats, salt marshes, and other exposed estuarine habitat.

Waterfowl

Waterfowl habitat is as diverse as the birds themselves, varying from ocean surf to fields and open meadows to upland streams (FWS 2007a). The southern Oregon coast provides wintering and migratory habitat for waterfowl of the Pacific Flyway. Coos Bay is recognized as an important migration and wintering waterfowl location. Coos Bay had the third highest total count of waterfowl on the Oregon Coast in a March 1992 aerial survey. Waterfowl are most likely to be encountered within Coos Bay and the immediate near shore habitat.

Passerines (Songbirds)

Breeding and feeding habitat for migratory passerines is associated with terrestrial and wetland habitat within Coos Bay. Important habitat includes coastal scrub-shrub, coastal dune forest and palustrine wetlands. In the case of swallows, human-made structures can be important structures for nesting colonies. Passerines are likely to occur in all habitats at the terminal site.

Neotropical migrants (birds that breed in North America and overwinter in the tropics) were observed during surveys of the waterway and LNG terminal. These are largely forest-nesting species and thus could be affected by vegetation clearing that would be required for construction and operation of the LNG terminal and slip. Examples of neotropical migrants detected at the LNG terminal site include olive-sided flycatcher (*Contopus cooperi*), Wilson's warbler (*Wilsonia pusilla*), orange-crowned warbler (*Vermivora celata*), and Swainson's thrush (*Catharus ustulatus*).

Wading Birds

Several wading bird species are resident within the Coos Bay area and the North Spit. Wading birds are typically colonial when nesting and therefore are sensitive to anthropogenic disturbance at breeding sites. Wading birds hunt in a variety of habitat types from fields and meadows to palustrine and estuarine wetlands. Wading birds are likely to occur in the shoreline habitats at the terminal site.

At least two historic great blue heron (*Ardea herodias*) rookeries occur close to the Jordan Cove LNG terminal site area. One rookery is located about 2,000 feet to the east of the LNG terminal site and about 300 feet from Jordan Cove Road (on both sides of Trans-Pacific Parkway) (LBJ 2006). This rookery was first visited by Project biologists on November 1, 2006, during a site visit with ODFW and BLM biologists. At that time, the rookery was found to be inactive although it contained nests. The BLM biologist noted that it has been inactive the previous two breeding seasons (BLM 2006b). Another historical rookery is located adjacent to the LNG terminal site on the south side of Henderson Marsh; it has not been active for several years (BLM 2006b). No evidence of great blue heron breeding in the area was observed during the 2005, 2006, 2012, or 2013 surveys.

Raptors

Raptors (i.e., hawks and owls) are abundant year-round residents in Coos Bay. The BLM has observed 14 species (BLM 2005), and surveys conducted by LBJ (2006) detected both peregrine falcons and bald eagles near the Jordan Cove site. Coos Bay and the North Spit provide a mosaic of habitat types with abundant prey for raptors. White-tailed kites were observed during 2005 surveys especially near Henderson Marsh. Ospreys are relatively common near river estuaries and bays and nests on human-made structures including the Roseburg Forest Products facility lights.

Predatory birds are most likely to be encountered within terrestrial habitats in the Coos Bay area. Osprey, falcons, and eagles may occur in the nearshore habitats along the waterway for LNG vessel transit and at the terminal site. Falcons in particular are likely to be associated with salt marsh and tidal mudflats where shorebirds are likely to be abundant.

Potential Project-related Effects on Birds and Proposed Mitigation Measures

Migratory bird species would likely experience disturbance due to the construction and operation of the Jordan Cove Project. Effects on birds would most likely be related to modification of habitat. However, areas affected by the Jordan Cove Project are relatively small in comparison to the total habitat available in Coos Bay, and within the larger Bird Conservation Region 5. Effects to migratory birds from both jurisdictional and non-jurisdictional facilities are included in this analysis and mitigation approach.

Nesting habitat for migratory birds occurs within areas that would be cleared for the LNG terminal and related facilities. The Project would alter and disturb breeding and non-breeding habitat and could affect prey populations. The removal of 67 acres of coastal dune forest, 67 acres of grasslands (herbaceous), and 40 acres of shrubs could affect nesting and foraging opportunities for songbirds and raptors that occupy upland habitats. The impact of the construction of the slip and access channel on wetlands would be the permanent loss of approximately 8 acres of intertidal, 3 acres of shallow subtidal, and 3 acres of eelgrass. These are all habitats utilized by seabirds, waterfowl, wading birds, and shorebirds. The loss of wetland habitat would be offset by the creation of in-kind mitigation areas proposed by Jordan Cove at the Kentuck Slough, West Jordan Cove, and West Bridge wetland mitigation sites.

The great blue heron rookery located 300 feet from the Jordan Cove Road would be subject to potential disturbance from noise from construction traffic using Jordan Cove Road. The rookery is currently subject to noise from truck traffic delivering chips to the Roseburg wood chip export facility. Similarly, the historic rookery on the south side of Henderson Marsh could be affected by construction noise if the rookery was active during site construction. Jordan Cove would conduct spring status assessments annually of both great blue heron rookeries, as reuse by this species could occur. If biologists from other agencies (such as ODFW and BLM) conduct rookery surveys on the North Spit, Jordan Cove may use the results of these agency surveys. If either rookery becomes active, Jordan Cove, in consultation with ODFW, would develop an appropriate mitigation plan depending on the status of construction or potential for indirect effects. No mitigation for potential impacts would be required as long as the rookeries are inactive.

During operation of the Project, birds would be at risk of colliding with terminal facilities, including the LNG storage tanks. This risk is expected to be low given the visibility of the facilities, but could increase during storms, dense fog, at night, or at other times with reduced visibility. The facilities would be well lit at night, which could attract birds. There is some evidence that high intensity continuous anti-collision lights on structures may result in an increased number of bird strikes, especially at night or during fog and overcast conditions. The number of strikes can apparently be reduced by strobe or blinking the anti-collision lights. The LNG storage tanks would not be illuminated with high-intensity lighting. The intensity and number of lights would be limited to what is required for security and operations. With the low-intensity lighting to be used, the likelihood of adverse effects to birds from collisions with the LNG storage tanks is minimal. Birds may also be drawn to the terminal flares. For example, some 7,500 songbirds were killed in September 2013 when they flew into the flare at the Canaport LNG import terminal in Saint John, New Brunswick, Canada (CBC News 2013).

Birds would also be at risk of colliding with LNG vessels in the waterway during operation of the terminal. Although the annual ship traffic would increase due to the Project, LNG vessels in the navigation channel would be traveling slowly and escorted by tugboats. Even with the addition of 90 LNG vessel visits a year, the number of deep draft ships using Coos Bay would be less than historic levels. Therefore, we conclude that LNG vessel marine traffic in the waterway would not cause significant adverse effects to birds.

Jordan Cove proposes to implement various measures to avoid, minimize, and in some instances mitigate, impacts on birds and their local habitats. If the construction schedule allows, all vegetation clearing at the LNG terminal would be conducted prior to March 1 or after August 31 to ensure most nesting birds have fledged. If construction activities must occur during the nesting season, Jordan Cove would conduct focused pre-construction surveys to determine if there are active migratory bird nests present to ensure that impacts to nesting birds are avoided. The surveys would be conducted within the construction limits and within 100 feet (200 feet for raptors) of the construction limits. If active nests are encountered within the limits of the survey, construction and vegetation removal activities would be halted in the immediate vicinity until a qualified biologist has determined that the individuals have fledged from the nest (evacuated) or that the nest has failed from natural causes. If no active nest is encountered within the limits of the survey, construction and vegetation removal would proceed with caution with an eye out for active bird nests. Empty or abandoned nests would be removed; permits are not required to remove an empty or abandoned nest or to remove or alter the structure the nest is built in or on (FWS 2003). Jordan Cove would coordinate with the FWS prior to proceeding with construction, and any consultation exchange with the FWS would be provided to the FERC. Further description of avoidance, minimization, and mitigation measures to decrease impacts to migratory birds is provided in the *Migratory Bird Conservation Plan* filed with FERC on February 13, 2015.

Structures associated with the Project would be monitored to discourage use by avian predator species. Frequent inspections would ensure that nests are not being constructed and all nests found would be removed immediately, before birds could lay eggs. It is anticipated that there would be sufficient inspections (i.e., daily) and other activities mandated by safety and security requirements to keep the structures nest free. However, in the unlikely event that a nest becomes established and it is not discovered until eggs or young birds are present, the disposition of the nest would be handled in accordance with the provisions of the MBTA in consultation with the FWS.

The flares at the LNG terminal would probably not adversely affect birds. This is because these would be ground flares at low elevation (115 feet high), and would only be used for temporary periods, such as during start-up and upset situations. Jordan Cove can also implement measures that would minimize impacts on birds from terminal lighting. However, Jordan Cove would not develop its final lighting plan until final design. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file with the Secretary its final lighting plan, for review and approval by the Director of OEP, to include measures that would reduce impacts on wildlife, together with documentation that the plan was developed in consultation with appropriate resource agencies, including the FWS, NMFS, and ODFW.**

Additionally, in February 2015 both Jordan Cove and Pacific Connector filed their own draft *Migratory Bird Conservation Plan*. Both companies continue to work with FWS to finalize their plans; therefore, **we recommend that:**

- **Prior to construction, Jordan Cove and Pacific Connector should each file with the Secretary a copy of their final *Migratory Bird Conservation Plan*, and documentation that their plans were developed in consultation with the FWS.**

Amphibians and Reptiles

The BLM recognizes 11 species of amphibians (8 salamanders, 3 frogs) occurring on the North Spit (BLM 2005). Despite the presence and continual threat of invasion by non-native bullfrogs (*Rana catesbeiana*), two native amphibian species were observed within suitable habitat during the wildlife surveys conducted 2005, 2006, and 2012 for the LNG terminal (LBJ 2006; SHN 2013)—the northern red-legged frog (*Rana aurora*) and northwestern salamander (*Ambystoma gracile*)—which are abundant within some wetlands within the terminal tract.

The BLM has observed at least 10 species of reptiles on the North Spit (BLM 2005), including the northwestern pond turtle (*Clemmys marmorata marmorata*). However, the northwestern pond turtle was not observed during wildlife surveys of the Jordan Cove LNG terminal area (LBJ 2006; SHN 2013). Reptiles observed during Project surveys in 2005, 2006 and 2012 included the northern alligator lizard (*Elgaria coerulea*) and northwestern garter snake (*Thamnophis ordinoides*) (LBJ 2006; SHN 2013). Potential Project-related impacts on amphibians and reptiles would include mortality from construction if they were not able to avoid equipment or traffic, and habitat loss. Fill activity in wetlands would impact amphibians and reptiles. Removal of dune forest for the Project would reduce habitat for the clouded salamander, should this species occur in these areas. Jordan Lake and nearby wetlands on the east side of the terminal tract may offer suitable breeding habitat for the western toad, although the species was not found during surveys of the site. Jordan Cove would mitigate for the loss of habitat and wetlands by acquiring nearby parcels that would preserve upland vegetated habitats and wetlands.

Jordan Cove proposed that in order to mitigate potential impacts on amphibians and reptiles it would conduct pre-construction surveys for the northern Pacific pond turtle, northern red-legged frog, and clouded salamander. Individuals located within the construction area would be captured and transported to suitable nearby habitats, agreed to with the ODFW.

Invertebrates

Inland sand dunes at the North Spit are used extensively by certain species of terrestrial insects, primarily beetles, centipedes, and millipedes. Flying insects are also common throughout the site and are fed upon heavily by barn swallows (BLM 2005). Potential Project-related impacts on terrestrial invertebrates would include mortality from construction if they were not able to avoid equipment or traffic, and habitat loss. Jordan Cove would mitigate for the loss of habitat by acquiring nearby parcels that would preserve upland vegetated habitats and wetlands.

General Impacts on Terrestrial Wildlife from Construction and Operation of the Project

During construction of the Project, direct impacts on animals could include mortality if less mobile individuals are unable to avoid equipment or vehicles or cannot flee away from an oil or

fuel spill. More mobile species would likely be displaced from the terminal area during active construction to adjacent similar habitats. Wildlife near the LNG terminal could also be disturbed by construction activities and noise, and may move farther away.

However, the primary impact on wildlife from construction and operation of the LNG terminal would be habitat loss. The natural habitats that are most important to wildlife would include forested dunes and wetlands. About 67 acres of dune forest would be permanently removed for operation of the terminal. The Project would affect about 4 acres of wetlands and about 32 acres of open water including salt marsh, eelgrass, intertidal, and subtidal habitats. Jordan Cove would mitigate for the loss of wildlife habitat by acquiring 259 acres at three nearby parcels that would be preserved as replacement habitat, as discussed above.

There could be indirect effects on wildlife because of increased human presence resulting from the Project. Construction of the LNG terminal would take approximately 42 months, and the number of construction personnel would peak at 2,100 workers. Approximately 145 people would be employed during operation of the terminal. The current number of people employed at facilities operating on the North Spit is approximately 110 (Southport – 70, Roseburg – 20, DB Western – 20). The increase in the number of people in the area could potentially lead to indirect effects on wildlife, such as food or trash attracting predators. However, during construction and operation, the Project site would be kept clear of construction debris and food wastes that could attract predators. Covered, animal-proof receptacles would be provided in eating and break areas, parking lots, and at appropriate locations around the construction site. During construction, the site would be policed on a daily basis to remove any food or other debris left by construction workers. During operations, the Project site would be regularly inspected to ensure that no garbage is allowed to accumulate.

Noise associated with construction of the Project could also affect wildlife. Construction-related noise could affect animal behavior, foraging, or breeding patterns, and cause wildlife species to move away from the noise or relocate in order to avoid the disturbance. Noise from construction of the LNG terminal should be similar to typical commercial construction programs, which have noise levels averaging between 47 to 57 A-weighted decibels (dBA) when measured 2,000 feet away (H&K 1994). Noise from construction of the terminal is discussed in detail in section 4.12.2.4. Construction of the terminal would occur over a period of about three years. Noise associated with construction would be intermittent, and may be operated on two 10-hour shifts, 6 days per week, with the potential to increase to a 24/7 schedule if required. However, given the high level of current activity on the North Spit, including existing industrial operations and vehicle and rail traffic,[86] and the temporary and short-term nature of Jordan Cove's construction activities, Project-related construction noise is not expected to adversely affect wildlife in the region.

Operation of the Project may also affect wildlife. For example, the terminal would be visited by about 90 LNG vessels per year. It is possible that an LNG vessel in transit in the waterway could strike seabirds or shorebirds, an oil or fuel leak from a ship could affect terrestrial wildlife along the shorelines of the navigation channel, or vessel traffic may cause shoreline erosion. Jordan Cove and the operators of the LNG vessels would implement measures that would reduce the

[86] Current ambient noise levels measured at the BLM boat ramp parking lot on the North Spit about 2 miles south of the Jordan Cove terminal site ranged from 40.8 to 47.6 dBA. See section 4.12.2.4 of this EIS.

potential for oil or fuel spills from LNG vessel marine traffic in the waterway. LNG vessels have a double hull that would keep fuel and oil onboard and prevent a spill. Furthermore, each LNG vessel would maintain a shipboard oil pollution emergency plan. Studies conducted by Jordan Cove have shown that LNG vessels transiting at slow speeds within the Coos Bay navigation channel are not likely to result in large waves that could cause major shoreline erosion.[87]

Lighting at the LNG terminal would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting that would primarily be located on shore, in and adjacent to the slip. When an LNG vessel is not in the berth, the lighting would be reduced to that required for security. Other industrial facilities on the North Spit (Roseburg, Southport, DB Western) already have night lighting. We have recommended above that Jordan Cove produce a final lighting plan prior to construction, for our review and approval, that outlines measures to be implemented to ensure that facility lighting would not have major impacts on wildlife.

Operation of the South Dunes Power Plant would result in increased emissions of nitrogen oxides and carbon monoxide. Estimated air emissions, air quality standards and compliance with regulatory requirements, and proposed mitigation measures for air quality are addressed in detail in section 4.12.1 of this EIS. The LNG terminal would be required to operate in compliance with U.S. ambient air quality standards, which were established to protect individuals from adverse impact from criteria air pollutants. While some types of wildlife with permeable skin may absorb airborne pollutants directly and are thus particularly sensitive to increases in air pollution, compliance with federal and state standards is expected to also protect wildlife by minimizing increases in air quality degradation and pollution.

Operational noise from the Jordan Cove Project could have long-term impacts on wildlife on the North Spit. We predict that operational noise from the LNG terminal would have an equivalent sound level (L_{eq}) of 42 dBA and day-night sound level (L_{dn}) of 48.4 dBA when measured about 1.4 miles away. This compares to current ambient L_{dn} noise levels of about 47.4 to 51.6 dBA in the city of North Bend, just southwest of the airport (see section 4.12.2.4 of this EIS). Because there is existing noise generated by other industrial facilities on the North Spit, and noise from the Jordan Cove Project would be less than the FERC standard of 55 dBA at noise sensitive areas (NSA), we conclude that operational noise from the terminal would not significantly affect wildlife.

Mitigation for impacts related to the construction of the terminal and supporting facilities is covered under the ODFW Habitat Category Mitigation Measures section above, and in more detail in Jordan Cove's *Wildlife Habitat Mitigation Plan* (appendix S). Special status species that could be affected by the Project, and relevant mitigation for those impacts, are discussed in section 4.7.

4.6.1.2 Pacific Connector Pipeline Project

The areas crossed by the Pacific Connector pipeline route provide diverse habitats for wildlife, including forests, shrublands, and grasslands. These habitats support an array of wildlife species.

[87] See *Technical Report – Draft, Volume 2 – Jordan Cove Energy Project and Pacific Connector Gas Pipeline, Coastal Engineering Modeling and Analysis*, filed by Jordan Cove as Appendix H.2 in Resource Report 2 included with its May 2013 application to the FERC.

Overall, 47 amphibian and reptile, 278 bird, and 106 mammal species are known or suspected to occur in the project area, based on their habitat associations (habitats known or likely to be crossed by the pipeline) or direct observation.

Wildlife Habitats

Wildlife associations with habitats in the Pacific Connector Pipeline Project area include the following (adapted from Johnson and O'Neil 2001):

- close association: a species is known to depend on a specific habitat for part or all of its life history requirements (feeding and reproduction) implying that the species has an essential need for a particular habitat for its maintenance and viability;
- general association: a highly adaptable species that is supported by a number of habitats that provide for its maintenance and viability; and
- present: a species that occasionally uses a habitat that provides marginal support for its maintenance and viability.

Sixteen wildlife habitats (Johnson and O'Neil 2001) coincide with one or more Oregon GAP vegetation types found in the Pacific Connector pipeline area. These wildlife habitat categories are: (1) Westside Lowland Conifer-Hardwood-Forest, (2) Montane Mixed Conifer Forest, (3) Southwest Oregon Mixed Conifer-Hardwood Forest, (4) Ponderosa Pine Forest and Woodlands, (5) Westside[88] Oak and Dry Douglas-fir Forest and Woodlands, (6) Western Juniper/Mountain Mahogany Woodlands, (7) Sagebrush Steppe, (8) Westside Grasslands, (9) Eastside Grasslands, (10) Herbaceous Wetlands, (11) Westside Riparian-Wetlands combined with Eastside Riparian-Wetlands, (12) Agriculture, Pastures, and Mixed Environs[89]**,** (13) Developed-Urban and Mixed Environs, (14) Coastal Dunes and Beaches, (15) Open Water-Lakes, River, and Streams, and (16) Bays and Estuaries. Wildlife species associations with these habitats provide a basis for evaluating Project effects on biodiversity and in some cases, on individual species. One additional category is not specifically addressed within Johnson and O'Neil (2001), but is well represented within the project area: Shrublands. Table 4.6.1.2-1 lists the miles of each of these habitat types crossed. Westside Lowland Conifer-Hardwood Forest and Southwest Oregon Mixed Conifer-Hardwood Forest are the habitats most affected, with 63.4 and 48.3 miles impacted, respectively.

Specialized habitat features also occur within the vicinity of the project area. Such features include cliffs that provide nesting for peregrine falcons and possibly other raptors. Snags provide roosting locations for several bat species, and nesting locations for cavity-nesting birds. LWD is present, which could be used by reptiles and amphibians.

Grasslands and/or meadows provide habitats for animals that are adapted to areas dominated with perennial bunchgrasses and forbs. A wide variety of species use grasslands and meadows, including songbirds, amphibians, and reptiles. We estimate that the pipeline route would cross about 12.3 miles of grasslands (see table 4.6.1.2-1).

[88] Westside versus eastside in these habitat definitions refer to west or east of the Cascade Range.
[89] Mixed environs refer to border areas between developed or agricultural areas, such as fencerows, roadsides, field borders, and shelterbelts.

TABLE 4.6.1.2-1

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/f/ (miles)	Mid-Seral Forest Crossed b/f/ (miles)	Clearcut/ Regenerating Forest Crossed c/f/ (miles)	Total Miles	Percent of Total Project Mileage per Vegetation Type	Number of Species Associated d/
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	9.2	21.3	32.9	63.4	27.4	32 – Herpetofauna 113 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	1.6	0.9	4.0	6.4	2.8	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	24.4	9.7	14.3	48.3	20.8	35 – Herpetofauna 125 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	3.7	4.7	5.9	14.4	6.2	31 – Herpetofauna 124 – Birds 56 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	2.5	2.4	0.0	4.9	2.1	32 - Herpetofauna 113 – Birds 62 – Mammals
	Western Juniper and Mountain Mahogany Woodlands	0.0	4.3	3.8	8.1	3.5	19 - Herpetofauna 86 – Birds 34 – Mammals
	Subtotal	**41.3**	**43.6**	**60.9**	**145.9**	**62.9**	
Grasslands Shrubland	Shrub-steppe	–	–	–	15.5	6.7	22 – Herpetofauna 75 – Birds 46 – Mammals
	Westside Grasslands	–	–	–	10.2	4.4	26 – Herpetofauna 84 – Birds 37 – Mammals
	Eastside Grasslands	–	–	–	1.9	0.8	20 – Herpetofauna 79 – Birds 44 - Mammals
	Subtotal	–	–	–	**27.6**	**11.9**	
Wetland/ Riparian e/	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	–	–	–	0.1	0.0	38 – Herpetofauna 154 – Birds 76 – Mammals
	Herbaceous Wetlands	–	–	–	5.6	2.4	18 – Herpetofauna 136 – Birds 43 – Mammals
	Subtotal	–	–	–	**5.7**	**2.5**	
Agriculture	Agriculture, Pastures, and Mixed Environs	–	–	–	32.1	13.8	32 – Herpetofauna 173 – Birds 77 – Mammals
	Subtotal	–	–	–	**32.1**	**13.8**	
Developed/ Altered	Urban and Mixed Environs	–	–	–	16.5	7.1	37 – Herpetofauna 131 – Birds 63 – Mammals
	Subtotal				**16.5**	**7.1**	
Barren	Coastal Dunes and Beaches	–	–	–	<0.1	0.0	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	–	–	–	**<0.1**	**0.0**	
Open Water	Open Water - Lakes, Rivers, and Streams	–	–	–	1.3	0.6	17 – Herpetofauna 94 – Birds 20 – Mammals
	Bays and Estuaries	–	–	–	2.5	1.1	1 – Herpetofauna 132 – Birds 12 – Mammals
	Subtotal	–	–	–	**3.8**	**1.6**	

TABLE 4.6.1.2-1

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/f/ (miles)	Mid-Seral Forest Crossed b/f/ (miles)	Clearcut/ Regenerating Forest Crossed c/f/ (miles)	Total Miles	Percent of Total Project Mileage per Vegetation Type	Number of Species Associated d/
	Project Total	**41.3**	**43.6**	**60.9**	**231.8**	**100.0**	

Note: Mileages rounded to nearest tenth of a mile; values less than 0.1 miles shown as "<0.1". Rows/columns may not sum correctly due to rounding.

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).

b/ Mid-Seral Forest (40 to 80 years).

c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).

d/ Numbers of species associated with each habitat type crossed by the Pacific Connector Project were summarized from Pacific Connector's Environmental Resource Report 3, Appendix 3D, Table 3D-1.

e/ Following wetland regulation protocols, the length of wetlands crossed is approximately 11.6 miles total for all Project elements. See section 4.4 for results of jurisdictional wetland delineation and discussion of Project impacts to wetlands.

f/ Cells with no data result from the fact that non-forested habitat types did not identify seral stage; thus, miles are identified only in the "total miles" column.

Wetlands provide habitat for migrating and breeding waterfowl, shorebirds, waterbirds, songbirds, mammals, amphibians, and reptiles (ODFW 2006b). Riparian zones (including forested wetlands) support high species diversity (Johnson and O'Neil 2001). In total, the pipeline route would cross about 5.7 miles of wetlands and riparian habitats.[90]

The pipeline route would cross about 146 miles of woodlands and forest habitats. Deciduous hardwood species, such as oak and tanoak, occur within the project area. Mixed coniferous and deciduous forests, deciduous-dominated riparian areas, and oak woodlands are found most often in Douglas and Jackson Counties. In Coos County, many of the historical deciduous woodlands have been reduced as a result of conifer plantings and changes in fire frequency and intensity, as well as conversion to agricultural and residential uses. A wide variety of species use deciduous and young conifer forest habitats, including songbirds, reptiles, and small mammals.

Mature (greater than 40 years old), late successional (80 to 175 years old), and old-growth (greater than 175 years old) forests are unique, important habitat elements. Tree species common in mature to old-growth forests are western hemlock, Douglas-fir, western redcedar, Sitka spruce, red alder, and bigleaf maple (Chappell et al. 2001). Bird species that are obligates of old-growth forests include the federally threatened NSO and MAMU (further discussed in section 4.7). Old-growth forests are most common along the pipeline route within the Klamath Mountains.

The acres of wildlife habitat (categories from Johnson and O'Neil 2001) that would be affected by construction of the Pacific Connector pipeline are listed in table 4.6.1.2-2. Westside Lowland Conifer Forest (1,435 acres), Southwest Oregon Mixed Conifer-Hardwood Forest (919 acres), Agriculture, Pastures, and Mixed Environs (896 acres), and Urban and Mixed Environs (696 acres) are the wildlife habitats that would be most affected by construction (table 4.6.1.2-2).

[90] Following wetland regulation protocols, the length of wetlands crossed is approximately 11.6 miles total for all Project elements. See section 4.4 for results of jurisdictional wetland delineation and discussion of Project impacts to wetlands.

At aboveground facilities, native habitats would be cleared, and on private lands the area would be permanently converted into developed-industrial land. During operation of the pipeline, a 30-foot-wide corridor, centered over the pipe, would be kept clear of trees. As a result, areas cleared of forest during pipeline construction would be maintained in a shrub/herbaceous state within this 30-foot-wide corridor. The remainder of the temporary pipeline construction right-of-way would be revegetated with native species. However, it would take a long time for forested and shrub-steppe habitat to regenerate. Other habitats within the temporary construction right-of-way would be restored relatively quickly. A 10-foot-wide corridor centered on the pipeline may be mowed annually and maintained in an herbaceous state. The remainder of the 30-foot-wide corridor within the permanent easement may be subject to vegetation clearing every three years. However, routine vegetation clearing would only be done between August 1 and April 15 of any year, to reduce impacts on nesting birds during the typical spring and summer breeding season. The acres of wildlife habitat that would be affected by operation of the Pacific Connector Pipeline are listed in table 4.6.1.2-3.

TABLE 4.6.1.2-2

Summary of Construction-Related Disturbance (acres a/) to Corresponding Habitat Type

			Pipeline Facilities									Subtotals	
General Habitat Type	**Mapped Habitat Type**	**Forest Stand by Age**	**Construction Right-of-Way**	**Hydrostatic Discharge Sites d/**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/Disposal**	**Access Roads (TARs/PARs/ Improvements) e/**	**Pipe Yards**	**Aboveground Facilities - Klamath Compressor Station**	**Subtotal by Age Class**	**Subtotal by Habitat Type**	**Percent of Total Habitat**
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O a/	105	0	23	107	0	<1	0	0	235	1,435	25.8
		M-S b/	255	0	67	115	4	2	7	0	450		
		C-R c/	386	<1	177	148	5	<1	33	0	750		
	Montane Mixed Conifer Forest	L-O a/	18	0	1	7	0	0	0	0	26	119	*2.1*
		M-S b/	9	0	<1	4	0	0	0	0	14		
		C-R c/	45	0	17	16	0	<1	0	0	78		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O a/	282	0	52	118	2	1	0	0	455	919	16.5
		M-S b/	113	0	32	47	0	3	0	0	194		
		C-R c/	161	0	46	62	<1	<1	0	0	270		
	Ponderosa Pine Forest and Woodlands	L-O a/	42	0	15	3	0	0	0	0	60	222	4.0
		M-S b/	57	<1	10	<1	<1	<1	0	0	68		
		C-R c/	69	0	16	7	<1	<1	0	0	93		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O a/	30	0	10	5	0	<1	0	0	45	84	*1.5*
		M-S b/	28	0	8	3	0	<1	0	0	39		
		C-R c/	0	0	0	0	0	0	0	0	0		
	Western Juniper and Mountain Mahogany Woodlands	L-O a/	0	0	0	0	0	0	0	0	0	103	1.9
		M-S b/	46	0	8	0	<1	<1	0	0	55		
		C-R c/	44	0	4	0	0	<1	0	0	48		
	Subtotal Forest-Woodland		1,689	<1	487	643	11	10	41	0	2,882	2,882	*51.8*
	Percent of All Forest-Woodland		*58.6*	*0.0*	*16.9*	*22.3*	*0.4*	*0.3*	*1.4*	*0.0*	*100.0*	*100.0*	
Grasslands -Shrubland	Sagebrush Steppe	n/a	62	0	14	0	7	<1	0	31	n/a	115	*2.1*
	Shrublands	n/a	120	<1	38	8	0	2	0	0	n/a	169	*3.0*
	Westside Grasslands	n/a	116	<1	94	6	<1	2	21	0	n/a	239	*4.3*
	Eastside Grasslands	n/a	22	0	4	<1	1	<1	92	0	n/a	120	*2.2*
	Subtotal Grasslands-Shrubland		320	<1	151	13	10	5	113	31	n/a	643	*11.6*
Wetland / Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O a/	0	0	0	0	0	0	0	0	0	4	*0.1*
		M-S b/	<1	0	<1	0	0	0	0	0	2		
		C-R c/	2	0	<1	<1	0	0	0	0	3		
		Shrub	<1	0	<1	0	0	0	0	0	n/a	<1	*0.0*
	Herbaceous Wetlands	n/a	65	0	34	<1	0	<1	0	0	n/a	98	*1.8*
	Subtotal Wetland / Riparian		69	0	35	<1	0	<1	0	0	n/a	103	*1.9*
Agriculture	Agriculture, Pastures, and Mixed Environs		364	<1	195	1	3	5	325	0	n/a	896	*16.1*
	Subtotal Agriculture		364	<1	195	1	3	5	325	0	n/a	896	*16.1*

TABLE 4.6.1.2-2

Summary of Construction-Related Disturbance (acres a/) to Corresponding Habitat Type

			Pipeline Facilities									Subtotals	
General Habitat Type	**Mapped Habitat Type**	**Forest Stand by Age**	**Construction Right-of-Way**	**Hydrostatic Discharge Sites d/**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/Disposal**	**Access Roads (TARs/PARs/ Improvements) e/**	**Pipe Yards**	**Aboveground Facilities - Klamath Compressor Station**	**Subtotal by Age Class**	**Subtotal by Habitat Type**	**Percent of Total Habitat**
Developed / Barren	Urban and Mixed Environs	n/a	21	0	80	<1	61	<1	533	1	n/a	696	12.5
	Roads	n/a	144	0	68	17	2	<1	12	0	n/a	244	*4.4*
	Beaches	n/a	0	0	7	0	0	0	0	0	n/a	7	*0.1*
	Subtotal Developed / Barren		166	0	155	17	63	<1	545	1	n/a	947	*17.0*
Open Water	Open Water - Lakes, Rivers, Streams	n/a	11	0	5	2	<1	<1	<1	0	n/a	19	0.3
	Bays and Estuaries	n/a	74	0	2	0	0	0	0	0	n/a	76	*1.4*
	Subtotal Open Water		86	0	7	2	<1	<1	<1	0	n/a	95	*1.7*
	Subtotal Non-Forest		1,005	<1	543	33	76	11	983	32		2,683	*48.2*
	Percent of All Non-Forest		*37.5*	*0.0*	*20.2*	*1.2*	*2.8*	*0.4*	*36.6*	*1.2*		*100.0*	
Project Total		n/a	2,694	1	1,030	676	87	21	1,024	32		5,565	
Percent of Pipeline Facilities		n/a	*48.4*	*0.0*	*18.5*	*12.1*	*1.6*	*0.4*	*18.4*	*0.6*		*100.0*	

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

c/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

d/ Small brush or trees may be cleared by a rubber-tired rotary or flail motor (brush hog) or by hand with machetes/chainsaws. No soil disturbance would occur. A rubber-tired hoe would be utilized to lay the discharge line and to remove the saturated hay bales or filter bags upon completion of hydrostatic discharge.

e/ Portions of some of the PARs are located within the construction right-of-way and, therefore, there is some duplication in the acreage calculations. Impacts associated with existing access roads that would be improved (e.g., by widening) would affect an additional 14 acres. Habitat types affected by existing road improvement activity identify the habitat type adjacent to the access road, although the majority of the 14 acres is assumed to be road surface or immediate roadside that has been previously disturbed.

TABLE 4.6.1.2-3

Summary of Operation-Related Disturbance to Habitat by the Proposed Pacific Connector Pipeline (acres a/)

General Vegetation Type	Mapped Vegetation Type	Forest Stand by Age	Pipeline Facilities: *30-foot Maintenance Corridor*	Pipeline Facilities: Permanent Access Roads	Pipeline Facilities: Subtotal Late Successional Old-Growth Forest	Pipeline Facilities: Subtotal Mid-Seral Forest	Pipeline Facilities: Subtotal Clearcut / Regenerating Forest	Pipeline Facilities: Subtotal By Habitat Type e/	Permanent Easement (50-foot)	Road Improvements	Aboveground Facilities	Total Operation Impacts by Habitat Type
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O b/	33	<1	33	78	120	232	56	<1	<1	232
		M-S c/	78	<1					132	2		
		C-R d/	120	<1					202	<1		
	Montane Mixed Conifer Forest	L-O b/	6	0	6	3	15	24	10	0	<1	24
		M-S c/	3	0					5	0		
		C-R d/	14	<1					24	<1		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O b/	88	0	88	35	52	175	147	1	<1	175
		M-S c/	35	0					59	3		
		C-R d/	52	<1					86	<1		
	Ponderosa Pine Forest and Woodlands	L-O b/	13	0	13	17	21	52	23	0	0	52
		M-S c/	17	0					29	<1		
		C-R d/	21	0					36	<1		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O b/	9	0	9	9		18	15	<1	0	18
		M-S c/	9	0					15	<1		
		C-R d/	0	0					0	0		
	Western Juniper and Mountain Mahogany Woodlands	L-O b/	0	0	0	15	14	29	0	0	<1	29
		M-S c/	15	0					25	<1		
		C-R d/	14	<1					23	0		
Subtotal Forest-Woodland			530	<1	150	158	222	530	885	9	<1	530
Grasslands-Shrubland	Sagebrush Steppe	n/a	19	0	n/a	n/a	n/a	19	31	<1	31	49
	Shrublands	n/a	38	<1	n/a	n/a	n/a	39	64	2	<1	39
	Westside Grasslands	n/a	37	<1	n/a	n/a	n/a	38	62	1	<1	38
	Eastside Grasslands	n/a	7	0	n/a	n/a	n/a	7	12	<1		7
Subtotal Grasslands-Shrubland			101	<1	**n/a**	**n/a**	**n/a**	102	*169*	4	31	132
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O b/	0	0	0	<1	<1	<1	*0*	0	0	<1
		M-S c/	<1	0					<1	0		
		C-R d/	<1	0					<1	0		
		Shrub	<1	0	n/a	n/a	n/a	<1	<1	0	0	<1
	Herbaceous Wetlands	n/a	20	<1	n/a	n/a	n/a	20	34	<1	0	20
Subtotal Wetland/Riparian			22	<1	**n/a**	**n/a**	**n/a**	22	*36*	<1	0	22
Agriculture	Agriculture, Pastures, and Mixed Environs	n/a	116	<1	n/a	n/a	n/a	117	193	<1	1	117
Subtotal Agriculture			116	<1	**n/a**	**n/a**	**n/a**	117	*193*	<1	1	117

TABLE 4.6.1.2-3

Summary of Operation-Related Disturbance to Habitat by the Proposed Pacific Connector Pipeline (acres a/)

General Vegetation Type	Mapped Vegetation Type	Forest Stand by Age	Pipeline Facilities: *30-foot Maintenance Corridor*	Pipeline Facilities: Permanent Access Roads	Pipeline Facilities: Subtotal Late Successional Old-Growth Forest	Pipeline Facilities: Subtotal Mid-Seral Forest	Pipeline Facilities: Subtotal Clearcut / Regenerating Forest	Pipeline Facilities: Subtotal By Habitat Type e/	Permanent Easement (50-foot)	Road Improvements	Aboveground Facilities	Total Operation Impacts by Habitat Type
Developed / Barren	Urban and Mixed Environs	n/a	7	<1	n/a	n/a	n/a	7	11	0	1	8
	Roads	n/a	54	<1	n/a	n/a	n/a	54	86	0	<1	54
	Beaches	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	0	<1
	Subtotal Developed / Barren		60	<1	**n/a**	**n/a**	**n/a**	61	*98*	0	1	61
Open Water	Open Water - Lakes, Rivers, and Streams	n/a	5	<1	n/a	n/a	n/a	5	8	0	0	5
	Bays and Estuaries	n/a	9	0	n/a	n/a	n/a	9	15	0	0	9
	Subtotal Open Water		14	<1	**n/a**	**n/a**	**n/a**	14	*23*	0	0	14
	Subtotal Non-Forest		313	2	0	<1	<1	315	518	5	33	347
	Project Total		843	2	150	158	222	845	1404	14	34	877

General: Columns and rows do not necessarily sum correctly due to rounding. Acres rounded to nearest whole acre. Values less than 1 acre shown as "<1".
Acres of impacts to non-vegetated areas are included within this table for consistency in values reported within this document.

a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.

b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

d/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

e/ Subtotal by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves located within the 30-foot maintenance corridor).

Shaded cells identify acres of wildlife habitat within the defined area but are not included in the overall Project total because: 1) only the 30-foot Maintenance Corridor included within the 50-foot Permanent Easement is expected to be affected during operations and maintenance activities, and 2) no additional maintenance would occur on access roads improved for construction of the project.

ODFW Habitat Characterization

Pacific Connector has coordinated extensively with ODFW to categorize habitats according to ODFW's Habitat Mitigation Policy (see February 13, 2015, response to DEIS recommendation #21). On February 13, 2015, Pacific Connector filed a *Wildlife Habitat Mitigation Plan* for impacts on non-federal lands. Pacific Connector will continue to consult with ODFW on additional mitigation actions where necessary, and to prepare the final *Wildlife Habitat Mitigation Plan*. We are recommending above (section 4.6.1.1) that Pacific Connector file its finalized *Migratory Bird Conservation Plan* with the FERC prior to construction.

Table 4.6.1.2-4 summarizes the impacts on ODFW Habitat Categories resulting from construction and operation of the pipeline project. ODFW habitat categories across all lands (non-federal and federal) most affected by construction and operation of the Project are Categories 2 (1,694 acres) and 6 (852 acres). ODFW Habitat Category 1 would be the least affected (80 acres).

TABLE 4.6.1.2-4

Summary of ODFW Habitat Categories and Impact (Acres) from the Pacific Connector Pipeline Project within Non-Federal and Federal Lands a/

Proposed Action	Project Component	ODFW Habitat Category (acres of Habitat Affected) b/ 1	2	3	4	5	6
Impact on Non-Federal Lands							
Construction	Removed c/	17	889	747	657	712	749
Impact	Modified d/	1	130	126	111	1	10
Operational	30' Maintenance Corridor e/	4	201	132	135	77	35
Impact	Aboveground Facilities f/	0	<1	31	<1	<1	<1
Impact on Federal Lands							
Construction	Removed c/	63	804	89	35	<1	103
Impact	Modified d/	21	249	14	6	<1	7
Operational	30' Maintenance Corridor e/	18	197	17	8	<1	18
Impact	Aboveground Facilities f/	0	<1	0	<1	0	<1
Total Pipeline Project Impacts (Federal and Non-Federal Lands)							
Construction	Removed c/	80	1694	836	692	713	852
Impact	Modified d/	22	379	140	117	1	16
Operational	30' Maintenance Corridor e/	22	399	149	143	77	53
Impact	Aboveground Facilities f/	0	<1	31	<1	<1	<1

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Summarized from Table 2 in the Habitat Categorization for the Project (see Appendix 3F of Resource Report 3).

b/ Category 1 – irreplaceable, essential habitat that is limited
Category 2 – essential habitat that is limited
Category 3 – essential habitat, or important habitat that is limited
Category 4 – important habitat
Category 5 – habitat having a high potential to become essential or important habitat
Category 6 – habitat that has a low potential to become essential or important habitat

c/ Construction components considered for habitat removal include construction right-of-way, temporary extra work areas, aboveground facilities, pipe storage yards, hydrostatic test sites, rock source and disposal sites, and temporary and permanent access roads. Although habitat may not necessarily be removed (i.e., an industrial site used for a pipe storage yard), acres have been included in the "removed" column.

d/ Modified acres include habitat potentially affected within identified uncleared storage areas (UCSAs).

e/ Within the 30-foot maintenance corridor, habitat would be maintained in an herbaceous and/or shrub state, cutting or removing vegetation greater than 6 inches in height; however, in areas with pre-construction habitat types of agricultural land, bare ground such as beaches, waterbodies, wetlands, and estuarine habitat types, the maintenance corridor would be restored to its pre-construction habitat type or land use. This acreage does not include aboveground facilities.

f/ Aboveground facilities, including meter stations and communication towers, block valves, and a compressor station, would be maintained in a non-herbaceous, industrial state (graveled and/or concrete) for the life of the project.

Pacific Connector is continuing to work with ODFW to finalize its Project-specific *Wildlife Habitat Mitigation Plan* in order to comply with State policy.

Terrestrial Animals in the Project Area

Mammals

Based on their distributions in southwestern Oregon and habitat associations described by Johnson and O'Neil (2001), 107 species of mammals may be present in habitats that coincide with and/or are adjacent to the Pacific Connector pipeline. The most numerous groups likely to occur are rodents (46 species, such as Baird's shrew, coast mole, least chipmunk, and Douglas' squirrel), carnivores (19 species, such as coyote, gray fox, black bear, and mink), and bats (13 species; see section below). Mammal species with special state or federal status are discussed in section 4.7.

The highest diversity of mammals can be expected in the Johnson and O'Neil (2001) Agriculture, Pastures, and Mixed Environs habitat (77 species with some association), followed by Eastside and Westside Riparian-Wetlands habitat (76 species). Mammalian species diversity is also relatively high in Westside Lowland Conifer-Hardwood-Forest (66 species), Southwest Oregon Mixed Conifer-Hardwood Forest (64 species), Westside Oak, Dry Douglas-Fir Forest and Woodlands (62), Montane Mixed Conifer Forest (60 species), as well as in Developed-Urban and Mixed Environs (63 species). The lowest species diversity of mammals is expected in Bays and Estuaries (12).

Impacts discussed below under General Impacts on Terrestrial Wildlife would be relevant to mammals. Because it will not be known where mammals are specifically located, impacts were quantified by impacts to habitats in which they could occur (see table 4.6.1.2-1). The Project would be cutting a narrow swath out of larger areas of potentially suitable habitat. Because of the low percentage of all available habitat in the area being affected, the Project is not expected to have population-level impacts on these species. For more information on special status mammal species that could be affected by the Project, see our BA (FERC 2015) and the BE (appendix L of this EIS).

Wild Horses

The BLM and the Forest Service manage wild horses to ensure healthy herds and healthy rangelands in Oregon. The Pokegama Herd Management Unit (HMU) is located in the southwestern corner of Klamath County and the southeast corner of Jackson County, on both private and BLM lands within the Lakeview District. While the pipeline does not cross it, the HMU is in the general vicinity of the Project. From 1972 to 2005, the average number of horses in the HMU was 42.7, but the population has ranged from 23 horses in 1973 to 55 horses in 1992, 1995, 1996, 1999, and 2000. These counts are based on ground and aerial surveys. Relative to other wild horse herds (which increase about 22 percent per year), the Pokegama herd has a low yearly increase of 4 to 5 percent. This may be due to illegal removal or mountain lion predation (BLM 2002d). The Project is not expected to impact the Pokegama wild horse herd.

Bats

Fifteen species of bat occur in Oregon; 13 of the species potentially occur within the project area. All of the species except for little brown myotis, big brown bat, and Brazilian free-tailed bat have some special status, whether identified by the State as sensitive, the FWS as a Species of

Concern, or by the BLM or the Forest Service as a Sensitive Species. Special status species are discussed in section 4.7; special status bats are listed in table O-3 of appendix O. Uses of different habitats that may occur along the pipeline route vary between little brown myotis, big brown bat, and Brazilian free-tailed bat (table 4.6.1.2-5).

TABLE 4.6.1.2-5

Non-Special Status Bat Species and Associated Habitats Likely to Occur Within the Project Area

Species	Distribution in Southern Oregon	Habitats	Foraging Habitat
Little brown myotis *Myotis lucifugus carissima*	Yearlong throughout Oregon	Associated with all habitats described in table 4.6.1.2-1	Forages for insects in scattered trees, along edges of dense timber, near water in shrub-grassland
Big brown bat *Eptesicus fuscus*	Yearlong throughout Oregon	Associated with all habitats described in table 4.6.1.2-1	Forages for insects over forest canopy, along roads/edges through trees, forest clearing
Brazilian free-tailed bat *Tadarida brasiliensis mexicana*	Non-migratory southern Oregon only	Westside Lowland Conifer-Hardwood Forest, Southwest Oregon Mixed Conifer-Hardwood Forest, Ponderosa Pine Forest and Woodlands, Westside Oak and Dry Douglas-fir Forest and Woodlands, Western Juniper and Mountain Mahogany Woodlands, Shrub-steppe, Westside Grasslands, Westside Riparian-Wetlands, Herbaceous Wetlands, Agriculture, Pastures, and Mixed Environs, Urban and Mixed Environs, Open Water - Lakes, Rivers, and Streams	Forages for insects within heated buildings or outside during warm spells during winter. During other periods, will forage almost anywhere from valley bottoms to Cascade / Siskiyou Mtn. crest, foraging long distances, e.g., 30+ miles round trip per night

Sources: Maser and Cross (1981), Verts and Carraway (1998), Johnson and O'Neil (2001), Weller (2008), ODFW (2013a)

All of the bat species consume insects, and most are associated with tree-dominated habitats that occur within the project area. Bats have roosts used by nursing females and young, roosts used during daylight, and hibernacula that are used to survive during winter while hibernating or in torpor. White-nose syndrome is a disease of hibernating bats, caused by a fungus that affects skin for the nose, ears, and wings of hibernating bats (USGS 2013). The fatal disease is currently limited to the eastern United States, and has not been detected in Oregon. Bat populations in the state are being monitored for the disease because the epidemic appears to be moving from east to west (ODFW 2011a).

Timber clearing in winter and early spring would coincide with the bat hibernation period. Bats utilizing trees for hibernation could be killed by timber clearing. Timber clearing in spring and early summer would coincide with natal or maternity periods, but would not occur after April 1 in order to avoid the migratory bird nesting season. Females and young inhabiting roosts in tree cavities would likely be killed if occupied roost trees and/or snags were felled. Likewise, bats utilizing day roosts under loose bark or snag with cavities between April and September could be killed by timber clearing. Young bats would likely be killed if roost trees were felled before they were able to fly. Most bat species, especially Townsend's big-eared bat, are sensitive to disturbance and would abandon disturbed roosts (Csuti et al. 2001; Verts and Carraway 1998; ODFW 2013a). This disturbance and subsequent abandonment could have energetic repercussions, potentially decreasing successful reproduction and survival.

Noise from traffic and other sources is believed to interfere with bats' echolocation (Jones 2008). We estimate that noise from general construction of the pipeline could be about 72 dBA at 300 feet. Project-related traffic and other construction noise would be limited to daylight hours, except for HDDs, and would mostly avoid periods when bats use echolocation to forage. Consequently, Project noise would not have significant adverse effects on bat populations. Pipeline construction noise is discussed in more detail in section 4.12.2.2.

Night lighting could act as barriers to bat movements (Kuijper et al. 2008), reduce bat activity in the immediate vicinity (Stone et al. 2009), or have an opposite effect by attracting nocturnal insects (Svensson and Rydell 1998; Rydell and Racey 1993). The Klamath Compressor Station and Clarks Branch Meter Station would be equipped with outside lighting to support night work activities. During normal operations, nighttime work or maintenance activities would generally not be scheduled; therefore, these lights would only be used periodically and possibly for short periods during the winter when daylight hours are short.

Pacific Connector would build three new communication towers at the Klamath Compressor Station and Clarks Branch and Jordan Cove Meter Stations, ranging in height from 26 to 140 feet tall. In addition, Pacific Connector would use eight existing communication towers, the tallest of which would be 250 feet high at Winston. It is possible that bats could fly into the communication towers. Use of eight currently existing towers is not expected to impact habitat or wildlife more than has already been affected with the original construction and operation of these facilities. New towers are unlikely to have a significant impact on bats, as they would not have guy wires or lighting, which would decrease the possibility of collisions but would not entirely eliminate that risk.

Because it will not be known where bat roosts are specifically located, impacts to bats were quantified by impacts to habitats in which they could occur. Of forested habitats to be affected by the Project, 821 acres of late-successional forest and 820 acres of mid-seral forest would be affected during construction (table 4.6.1.2-2). Because of the low percentage of all available habitat in the area being cut, and the dispersed nature in which tree-roosting bats typically roost in the west, the Project is not expected to have population-level impacts on these bat species. For more information on special status bat species that could be affected by the Project, see the BE in appendix L.

Birds

Based on their distributions in southwestern Oregon, 278 bird species may be present in habitats that would be crossed by the Pacific Connector pipeline (Johnson and O'Neil 2001). The highest diversity of bird species can be expected in habitats associated with agriculture, pastures, and mixed environs (173 species). Many species are also associated with riparian-wetland habitats (154 species), herbaceous wetlands (136 species), bays and estuaries (132 species), and developed-urban and mixed environs (131 species; table 4.6.1.2-1). The fewest number of bird species are associated with sagebrush shrub-steppe (75) and eastside grasslands (79).

Annual breeding bird survey (BBS) counts were used to determine additional potential bird species presence within habitats crossed by the Pacific Connector pipeline. Fewer species have been documented on BBS routes (227 species observed) than the number of species associations of wildlife habitats coinciding with the project area (278 species expected). The disparity is

likely due to several factors: the BBS does not usually document all of the species possibly present at the time of the survey (i.e., nocturnal owls and birds that do not sing or call regularly); species reported are present only during the season of the survey; and survey routes may not include or be representative of all habitat types crossed by the pipeline. Regardless, the BBS survey counts can be used as an index of some species' population trends over time.

The Pacific Connector pipeline crosses two Bird Conservation Regions (BCRs): (1) BCR 5 – Northern Pacific Rainforest, from MP 1.5R to MP 168; and (2) BCR 9 – Great Basin, from MP 168 to MP 228.1. Bird species diversity and population trends in the region surrounding the project area were evaluated from data collected on 33 BBS routes that have been surveyed within 50 miles of the Project (17 routes within BCR 5, 16 routes within BCR 9). Of the 231 species observed on the BBS routes, 9 species are BCC within BCR 5 (excluding the MAMU, discussed in section 4.7) and 20 species are BCC within BCR 9. BCC in the project area are listed in table 4.6.1.2-6. Local population trends within each BCR were estimated from average number observed per BSS route if data were sufficient (average occurrence per route per year ≥1, average number of routes per year with species counted ≥5). Regional population trends within BCRs were obtained from USGS (Sauer et al. 2011).

TABLE 4.6.1.2-6

Birds of Conservation Concern in BCR-5 and BCR-9 that Have Been Observed on BBS Routes within 50 Miles of the Pacific Connector Pipeline Project with Regional and Local Population Trends, and Breeding Dates, if Known

Common Name Scientific Name	Regional BCR Trend 1993 to 2012	Local Trend 1994 to 2013	Confirmed Breeding Dates a/	
			Earliest	Latest
BCR-5, Northern Pacific Rainforest				
Pelagic Cormorant *Phalacrocorax pelagicus*	No Trend	Insufficient Data	22 Mar	26 Jul
Bald Eagle *Haliaeetus leucocephalus*	Increasing (p<0.05)	Insufficient Data	8 Mar	9 Aug
Northern Goshawk *Accipiter gentilis*	No Trend	Insufficient Data	10 May	9 Aug
Peregrine Falcon *Falco peregrinus*	Increasing (p<0.10)	Insufficient Data	26 Apr	26 Jul
Caspian Tern *Sterna caspia*	No Trend	Insufficient Data	14 Jun	19 Jul
Marbled Murrelet *Brachyramphus marmoratus*	No Analysis	Insufficient Data	No data	
Rufous Hummingbird *Selasphorus rufus*	Decreasing (p<0.05)	No Trend	22 Mar	2 Aug
Olive-sided Flycatcher *Contopus cooperi*	Decreasing (p<0.05)	No Trend	14 Jun	30 Aug
Willow Flycatcher *Empidonax traillii*	Decreasing (p<0.05)	No Trend	7 Jun	9 Aug
Vesper Sparrow *Pooecetes gramineus*	Decreasing (p<0.10)	Insufficient Data	26 Apr	16 Aug
Purple Finch *Carpodacus purpureus*	No Trend	No Trend	10 May	19 Jul
BCR-9, Great Basin				
Eared Grebe *Podiceps nigricollis*	No Trend	Insufficient Data	31 May	23 Aug
Bald Eagle *Haliaeetus leucocephalus*	Increasing (p<0.05)	Increasing (p<0.01)	8 Mar	9 Aug
Ferruginous Hawk *Buteo regalis*	No Trend	Insufficient Data	29 Mar	19 Jul
Golden Eagle *Aquila chrysaetos*	No Trend	Insufficient Data	22 Feb	19 Jul
Peregrine Falcon *Falco peregrinus*	Increasing (p<0.10)	Insufficient Data	26 Apr	26 Jul

TABLE 4.6.1.2-6

Birds of Conservation Concern in BCR-5 and BCR-9 that Have Been Observed on BBS Routes within 50 Miles of the Pacific Connector Pipeline Project with Regional and Local Population Trends, and Breeding Dates, if Known

Common Name Scientific Name	Regional BCR Trend 1993 to 2012	Local Trend 1994 to 2013	Confirmed Breeding Dates a/	
			Earliest	Latest
Yellow Rail *Coturnicops noveboracensis*	No Analysis	Insufficient Data	7 Jun	5 Jul
Snowy Plover *Charadrius alexandrinus*	No Analysis	Insufficient Data	17 May	5 Jul
Long-billed Curlew *Numenius americanus*	No Trend	Insufficient Data	19 Apr	12 Jul
Calliope Hummingbird *Stellula calliope*	No Trend	Insufficient Data	31 May	26 Jul
Lewis's Woodpecker *Melanerpes lewis*	No Trend	Increasing (p<0.05)	24 May	23 Aug
Williamson's Sapsucker *Sphyrapicus thyroideus*	No Trend	Insufficient Data	17 May	26 Jul
White-headed Woodpecker *Picoides albolarvatus*	Increasing (p<0.05)	Insufficient Data	24 May	26 Jul
Willow Flycatcher *Empidonax traillii*	Decreasing (p<0.05)	Increasing (p<0.05)	7 Jun	9 Aug
Loggerhead Shrike *Lanius ludovicianus*	No Trend	Insufficient Data	10 May	19 Jul
Pinyon Jay *Gymnorhinus cyanocephalus*	Decreasing (p<0.05)	Insufficient Data	7 Jun	19 Jul
Sage Thrasher *Oreoscoptes montanus*	Decreasing (p<0.05)	Decreasing (p<0.01)	10 May	26 Jul
Green-tailed Towhee *Pipilo chlorurus*	No Trend	No Trend	17 May	9 Aug
Brewer's Sparrow *Spizella breweri*	No Trend	No Trend	3 May	9 Aug
Black-chinned Sparrow *Spizella atrogularis*	No Analysis	Insufficient Data	No data	
Sage Sparrow *Amphispiza belli*	No Trend	Insufficient Data	10 May	9 Aug
Tricolored Blackbird *Agelaius tricolor*	No Trend	No Trend	12 Apr	9 Aug

a/ Breeding dates from Adamus et al. (2001).

For BCR 5 regional trends, peregrine falcons and bald eagles are increasing and for the rest of the birds either there is a decreasing trend (4), no trend (4), or no analysis (1). For BCR 5 local trends, there are either insufficient data (7 birds) or no trend (4 birds). For BCR 9 regional trends, bald eagle, peregrine falcon and white-headed woodpecker have increasing trends, the willow flycatcher, sage thrasher, and pinyon jay display a decreasing trend, and for the rest of the birds either there is a no trend (12) or no analysis (3). The local trend for BCR 9 is increasing for bald eagle, Lewis' woodpecker, and willow flycatcher and decreasing for sage thrasher. For the other birds in BCR 9, there are 3 exhibiting no local trend and the rest do not have sufficient data to report a trend.

Many migratory bird species have been observed during the annual Christmas Bird Count (CBC), sponsored by the Audubon Society. At least 243 bird species (common names are reported and have not been standardized) have been counted at seven locations proximate to the Pacific Connector Pipeline Project area. While 152 bird species have been reported by both BBS and CBC, 91 species have only been reported by the CBC. The species include various seabirds (auklets, murres, guillemots, jaegers, gulls, albatrosses, shearwaters, and cormorants), waterfowl (scoters, geese, swans), and shorebirds (dowitchers, sandpipers, plovers, turnstones).

Several raptor species are known or suspected to nest, migrate, and seasonally reside in the general vicinity of the pipeline route. Those reported for BBS routes in the region include turkey vulture, osprey, bald eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, red-shouldered hawk, Swainson's hawk, red-tailed hawk, ferruginous hawk, golden eagle, American kestrel, American peregrine falcon, and prairie falcon. Several additional raptor species have only been observed during CBC surveys. Those include rough-legged hawk, gyrfalcon, and merlin.

There are also several species of owls that have been documented on BBS routes and are likely to occur in the areas crossed by the pipeline. They include barn owl (*Tyto alba*), western screech owl (*Otus kennicottii*), great horned owl (*Bubo virginianus*), northern pygmy-owl (*Glaucidium gnoma*), barred owl (*Strix varia*), great gray owl (*Strix nebulosa*), short-eared owl (*Asio flammeus*), and NSO. Owls seen only during the winter CBC surveys include northern saw-whet owls and burrowing owls. Additionally, Johnson and O'Neil (2001) list flammulated owls (*Otus flammeolus*) and long-eared owls (*Asio otus*) as occurring in habitat types coinciding with the Pacific Connector pipeline route. The burrowing owl (*Athene cunicularia*), boreal owl (*Aegolius funereus*), flammulated owl, great gray owl, and northern pygmy owl have special state or BLM status and are addressed in section 4.7. The NSO has threatened state and federal status and is discussed in more detail in section 4.7.

Take of migratory bird occupied nests, eggs, pre-fledgling young, and potentially adults would be minimized by Pacific Connector's commitment to various seasonal restrictions during Project construction. Tree felling and brush removal on all construction spreads would be conducted outside of the primary migratory bird nesting season, which is April 1 through July 15. In addition, tree felling within 0.25 mile of an NSO activity center would occur after September 30 and before March 1, and tree felling within 300 feet of MAMU stands would occur after September 15 but before March 31. Additional restrictions for other migratory birds are listed in the February 13, 2015 draft migratory bird conservation plan. While these timing restrictions would minimize take of migratory birds, some direct mortality could occur outside of the peak nesting season. Therefore, species with existing declining population trends, whether on local or regional levels, including the BCC species included in table 4.6.1.2-6, are expected to be most affected by direct take, habitat loss, and alteration of habitats adjacent to the Project.

Numbers of migratory birds, nests, and eggs that might be taken during vegetation clearing and/or construction in BCRs 5 and 9 were estimated and summarized in table 4.6.1.2-7. Indirect effects to migratory birds such as nest parasitism and predation are discussed below. These effects could add to overall impacts to migratory birds described here.

TABLE 4.6.1.2-7

Numbers of Migratory Birds Potentially Nesting within Habitats Affected along the Pipeline Centerline in BCR 5 and BCR 9

	Migratory Bird Nesting Habitats Present in the Pacific Connector Pipeline Project Area														
Estimate for BCR	**Westside Lowland Conifer-Hardwood-Forest**	**Montane Mixed Conifer Forest**	**Southwest Oregon Mixed Conifer-Hardwood Forest**	**Ponderosa Pine Forest and Woodlands**	**Westside Oak, Dry Douglas- fir Forest and Woodlands**	**Western Juniper/Mountain Mahogany Woodlands**	**Shrub-Steppe**	**Westside Grasslands**	**Eastside Grasslands**	**Herbaceous Wetlands**	**Westside Riparian-Wetlands-Eastside Riparian-Wetlands**	**Developed—Urban and Mixed Environs**	**Agriculture, Pastures, and Mixed Environs**	**Total Estimated Birds/Nests**	**Total Estimated Eggs/Juveniles**
BCR-5, North Pacific Rainforest															
Miles of Habitat Crossed	62.89	3.98	44.23	9.53	5.40	0	6.57	9.89	0.40	3.21	0.35	0.26	9.42	∑ = 155.13 miles	
Total Birds in Habitat, All Species	1,103	52	773	134	98		16	57	0	6	0	0	124	2,363	10,035
Total Birds with Adequate Data a/	1,037	51	746	130	94	0	16	56	0	6	0	0	124	2,260	9,599
And with Likely Nesting b/	831	43	603	102	76	0	8	45	0	6	0	0	98	1,812	7,865
And with Possible Nesting b/	14	1	7	1	0	0	0	0	0	0	0	0	1	24	89
And with Unlikely Nesting b/	121	6	85	17	11	0	8	9	0	0	0	0	16	273	1,033
And with Unknown Nesting b/	71	1	51	10	7	0	0	2	0	0	0	0	9	151	613
Total with Inadequate Data a/	66	1	27	4	4	0	0	1	0	0	0	0	0	103	436
BCR-9. Great Basin															
Miles of Habitat Crossed	0	2.46	4.45	7.25	0	9.77	5.14	0	1.47	2.23	0.07	1.25	22.94	∑ = 57.03 miles	
Total Birds in Habitat, All Species		54	158	277		346	171		48	114	1	47	1,213	2,429	10,811
Total Birds with Adequate Data a/		52	152	264		334	169		47	97	1	45	1,154	2,315	10,285
And with Likely Nesting b/		20	78	139		170	68		15	36	0	20	543	1,089	4,955
And with Possible Nesting b/		0	2	4	0	3	19	0	8	17	0	4	156	213	1,695
And with Unlikely Nesting b/		32	63	106	0	140	71	0	21	30	1	19	366	849	2,982
And with Unknown Nesting b/		0	9	15	0	21	11	0	3	14	0	2	89	164	654
Total with Inadequate Data a/		**2**	**6**	**13**	**0**	**12**	**2**	**0**	**1**	**17**	**0**	**2**	**59**	**114**	**526**

a/ Adequate data determined for a species if observed (Sauer et al. 2014) on an average of 5 or more BBS routes per year with an average of 1 bird or more counted per route per year during the 20-year period, 1994 to 2013.

b/ Species nesting on right-of-way likelihood based on proportion of the home range/territory area (see Figure 3.5-1 in the *Migratory Bird Conservation Plan*) that would overlap the pipeline right-of-way, high proportions for small home ranges, low proportions for large.

To estimate the amount of bird and egg take, data were compiled for BBS routes within 50 miles of the Project. Numbers of birds for species observed each year on a route were divided by the length of the BBS route (birds per mile), averaged each year for routes reporting the species, and averaged for the 20-year period 1992 to 2011. For each species that had a close or general association with habitats affected by the Project, the average number of birds per mile was multiplied by miles of habitat affected in each construction spread 1 through 4 (miles of habitat affected are included in table 4.6.1.2-7). Each bird evaluated as likely or possibly nesting within the construction right-of-way was assumed to have a nest and clutch of eggs, the number of which was assumed to be the highest in the range of eggs for species' clutch size (Csuti et al. 2001; Marshall et al. 2006). Estimated numbers of birds, nests, and eggs vary by habitat and amount of habitat that would be affected by vegetation clearing and/or construction during each species' nesting season. Pacific Connector has developed seasonal timing restrictions for timber felling, logging, clearing and construction activities to minimize and avoid potential effects to migratory birds in the Project area (see summary above and Attachment B to Pacific Connector's February 13, 2015 filing). Those species' buffers were intersected with the pipeline centerline through nesting habitats crossed for each spread and the overall distance along the centerline was reduced by the amounts of buffers that were intersected. For example in Spread 1, the total length of centerline was 44.7 miles but was reduced to 24.8 miles due to timber restrictions within buffers for murrelets and spotted owls. Consequently, the effects to nesting birds, nests, and eggs were also reduced with reductions in estimated take under the MBTA.

Edge habitat created by the Project right-of-way is expected to have positive and negative impact on bird species. Expected positive effects are increased diversity and density of bird species, increased access to a variety of food resources, and increased ground cover favoring ground-nesting species (Rosenberg and Raphael 1986). Potential negative impacts include increased brood parasitism, increased nest depredation in grasslands, forests and edge habitats, and lower nesting success (Thomas and Towiell 1982; Burger et al. 1994; Vickery et al. 1994; Marini et al. 1995; Danielson et al. 1997; Brand and George 2000). There have been declines of sagebrush-dependent migratory passerine bird species with loss of sagebrush steppe vegetation and increased fragmentation in remaining sagebrush-dominated habitats (Knick and Rotenberry 1995; Knick et al. 2003). Densities of Brewer's sparrow and sage sparrow, as well as other species dependent on sagebrush for nesting habitat, were greatly reduced near well-field roads and pipelines compared to densities beyond 300 feet (Ingelfinger 2001). Nest parasitism by brown-headed cowbirds is especially likely in fragmented shrub-dominated habitats (Vander Haegen and Walker 1998). Such impact could be facilitated over the long term because maintenance of the 30-foot permanent easement would create areas of early-seral habitat throughout the operational life of the project. These corridor areas would not only provide habitat used by some wildlife species, but could also connect patches of suitable habitat, allowing wildlife to move between one patch and another (Turner et al. 2001).

Corvids, including common ravens and American crows (also jays and magpies), are opportunistic predators and will prey on other species' nests (Marzluff and Neatherlin 2006; Vander Haegen et al. 2002; Luginbuhl et al. 2001). Studies have shown that corvid populations expand and nest predation increases near human developments (Marzluff and Neatherlin 2006) and corvid predation increases in habitats that have been fragmented by humans (Vander Haegen et al. 2002). The local population of common ravens has been increasing during the breeding period within BCR 9 and during winter on CBC count circles in proximity to the Project. Potential impacts to

nesting birds by predatory corvids attracted to the right-of-way would be addressed by ensuring that all construction contractors practice appropriate and responsible trash disposal every day.

Bald eagles, northern goshawks, and peregrine falcons have nest sites within 3 miles, some much closer to the Project (ORBIC 2012). Other raptor species have been observed, some nesting, along the Project route during surveys focusing on other rare species. Bald eagles, ospreys, sharp-shinned hawks, Cooper' hawks, goshawks, golden eagles, red-shouldered hawks, red-tailed hawks, peregrine falcons, great horned owls, western screech owls, NSOs, barred owls, northern pygmy owls, great gray owls, and turkey vultures have been reported during surveys in 2007 and 2008 but nest sites were not included in the documentation. Some of these raptor species have probably nested in the Project vicinity in the past. As previously described for migratory birds, timber clearing and project construction during the breeding period would affect raptors by taking nest, eggs, young, and adults.

FWS has drafted *Guidelines for Raptor Conservation in the Western United States* (Whittington and Allen 2008). The draft guidelines recommend spatial buffers for nests of breeding raptors during the breeding periods, which vary by location across the western states. Table 4.6.1.2-8 lists the raptor species that have been reported along the Pacific Connector Pipeline Project route

TABLE 4.6.1.2-8

FWS Recommended Spatial Buffers Surrounding Raptor Nests of Species that May Occur in the Vicinity of the Pacific Connector Pipeline

Common Name	Scientific Name	Spatial Buffer (miles)c/
Hawks, Eagles, Falcons		
Osprey	*Pandion haliaetus*	0.25
Bald Eagle a/	*Haliaeetus leucocephalus*	0.5–1.0
Northern Harrier b/	*Circus cyaneus*	0.25
Sharp-shinned Hawk	*Accipiter striatus*	0.25
Cooper's Hawk	*Accipiter cooperii*	0.25
Northern Goshawk	*Accipiter gentilis*	0.50
Red-shouldered Hawk	*Buteo lineatus*	0.25
Red-tailed Hawk	*Buteo jamaicensis*	0.33
Ferruginous Hawk b/	*Buteo regalis*	1.00
Golden Eagle	*Aquila chrysaetos*	0.50
American Kestrel b/	*Falco sparvarius*	0.125
Peregrine Falcon	*Falco peregrinus*	1.00
Owls		
Western Screech Owl	*Megascops kennicottii*	0.125
Great Horned Owl	*Bubo virginianus*	0.125
Northern Pygmy Owl	*Glaucidium gnoma*	0.25
Burrowing Owl b/	*Athene cunicularia*	0.25
Northern Spotted Owl	*Strix occidentalis caurina*	0.50
Barred Owl	*Strix nebulosa*	0.25
Great Gray Owl	*Strix nebulosa*	0.25
Short-eared Owl b/	*Asio flammeus*	0.25
Northern Saw-whet Owl	*Aegolius acadicus*	0.125

Source: Whittington and Allen (2008)
Note: Includes special status species that are otherwise addressed in section 4.7.
a/ Spatial buffer dependent on line-of-sight to nest.
b/ Species added to table based on occurrence on BBS routes.
c/ Spatial buffers used in the Draft Migratory Bird Conservation Plan were based on buffers provided by the FWS, Forest Service, and BLM (see appendix F in FERC DEIS). Note that the National Bald Eagle Management Guidelines (FWS 2007) recommend a 660-foot (200 m) buffer surrounding nests during the breeding season applied to timber harvest, road construction, chain saw, and yarding operations (assumed similar to timber clearing & pipeline construction).

by one source or another and the recommended spatial buffers during nesting periods (not included in the table). Human disturbances within spatial buffers risk nest abandonment by adults and nest failure (Whittington and Allen 2008).

Surveys of known nests of raptor species with nesting buffers that intersect the pipeline right-of-way would be conducted prior to tree clearing. Those species include bald eagle, great gray owl, and peregrine falcon. If nests are active, clearing trees and disturbance by airplane or helicopter within buffers would be delayed until after the nesting period. Survey protocols are contained in the draft *Migratory Bird Conservation Plan* that was filed with the FERC on February 13, 2015.

Pacific Connector would use eight existing communication towers and construct three new towers (see table 2.1.2.2-2). Communications towers are estimated to kill millions of birds each year, with mortality near guyed towers greater than self-supporting towers. Also, the majority of bird-tower collisions are reported from towers over 500 feet tall (Gehring 2004). Most bird-tower collisions occur at night, generally during conditions with low visibility, and during the day under foggy conditions. Bird-tower collisions may also increase with lighting on the towers. Research indicates that white strobe lights on towers may create less of a hazard to migratory birds, although these types of lights are not allowed within three nautical miles of an airport. Additionally, some research has indicated that marking guy-wires to make them more visible may reduce avian mortality (FCC 2006).

Use of eight currently existing towers is not expected to impact habitat or wildlife more than has already been affected with the original construction and operation of these facilities. New towers would not have guy wires or lighting and are either 26 or 140 feet tall, which would decrease the possibility of bird collisions but would not eliminate that risk entirely. Some additional mortality could occur from collision with towers, but given the low height and the fact that towers do not have lighting or guy wires, additional mortality is expected to be minimal.

As described above, there could be take of migratory birds including nests, eggs, young, and adults from tree clearing occurring outside of the peak migratory bird nesting season. Where vegetation clearing cannot be avoided during the breeding season, Pacific Connector would have qualified biologists perform pre-construction surveys of the area to be disturbed, plus a 20-foot buffer adjacent to areas affected. If nests are encountered, Pacific Connector would work with FWS to avoid nests as feasible. Laws and regulations regarding the treatment of migratory birds, including the MBTA and EO 13186, are described above (see section 1.5.1.10). In accordance with the March 2011 MOU between the FERC and the FWS to implement the policies of EO 13186, a draft *Migratory Bird Conservation Plan* was developed in coordination with the FWS for the Project. The *Migratory Bird Conservation Plan* identifies avoidance and minimization strategies, as well as habitat restoration and compensatory mitigation actions. With incorporation of avoidance, minimization, and mitigation strategies, the Project is not expected to have population-level impacts on migratory bird species. We are recommending above (section 4.6.1.1) that Pacific Connector file its finalized *Migratory Bird Conservation Plan* with the FERC prior to construction.

Harvested Wildlife

Several species of mammals and birds are harvested by recreation and/or subsistence hunting. With the exception of wildlife harvest administered and managed under tribal authorities, hunting is regulated by the ODFW within defined Wildlife Management Units. Big game species that may

occur in the areas crossed by the Pacific Connector pipeline route include black-tailed deer, mule deer, Roosevelt elk, Rocky Mountain elk, black bear, and cougar. Demographic data and harvest data for harvested wildlife are compiled by ODFW and are available in online reports, listed by animals taken by each hunt unit. For example, 43,098 deer and 18,136 elk were taken in 2012 in the entire state of Oregon.

Two subspecies of mule deer occur within the Pacific Connector pipeline area: the larger Rocky Mountain mule deer, usually found east of the Cascade Mountain crest, and the black-tailed deer, generally found west of the Cascades (ODFW 2008a). A second species, Columbian white-tailed deer, was recently state and federally delisted (2003) and may occur between Olalla Creek and Clarks Branch Road in Douglas County (ODFW 2007a), within an area considered by ODFW and Douglas County "peripheral big game range" (Wood 2007). Black-tailed deer are considered management indicator species (MIS) for both the Umpqua and Rogue River National Forests (Forest Service 1990a, 1990b).

In eastern Oregon, mule deer are mainly confined to open woods or isolated mountain ranges, although they once ranged into sagebrush plains in canyons or rimrock. During the winter, a period considered critical for the mule deer, they descend to lower elevations to browse sagebrush, bitterbrush, rabbitbrush, juniper, and mountain-mahogany, which are high in fats (ODFW 2003a, 2011b; Csuti et al. 2001). In western Oregon, black-tailed deer are found in heavy brush areas at the edges of forests and chaparral thickets, but not in dense forests. Black-tailed deer prefer early successional stages created by clear-cuts or burns, providing grasses, forbs, and shrubs (ODFW 2008a; Csuti et al. 2001). Most black-tailed deer that summer in the high Cascades winter at lower elevations on the west slope, although some wintering may occur east of the Cascade crest (ODFW 2008a). Winter loss of black-tailed deer is generally far less than for mule deer, because the snow does not remain on the valley floors for extended periods and a crust does not form on the surface as it does on the east side of the Cascades (ODFW 2008a). Within Jackson County, black-tailed deer are highly migratory and often move along well-defined migration trails at night during the months between October and March (ODFW 2007a). In Douglas County, Columbian white-tailed deer are most often associated with riparian habitats, although they are known to use a variety of lower elevation habitat types, such as grasslands, grass shrub, oak woodlands, coniferous woodlands, and mixed deciduous and coniferous woodlands (FWS 2003a).

Rocky Mountain elk inhabit most of eastern Oregon and Roosevelt elk occupy most of western Oregon with concentrations in the Cascades and Coast ranges. They are known to make significant movements in response to disturbances from humans and predators, as well as seasonal weather patterns. Rocky Mountain elk is considered an MIS for both the Umpqua and Rogue River National Forests (Forest Service 1990a, 1990b).

Numerous studies have shown that both Rocky Mountain and Roosevelt elk are sensitive to human disturbances such as motorized travel on and off roads (Rowland et al. 2000). Roads are generally avoided by elk when they are open, but are heavily utilized by elk as travel corridors when closed. Several herds of elk are known to winter on the western slopes of the Cascades (ODFW 2003b). Summer elk forage consists of a combination of lush forbs, grasses, and shrubs, which is usually attained at higher elevations within wet meadows, springs, and riparian areas in close proximity to forested stands. Forage becomes less abundant and accessible in winter and the nutritional quality declines. Winter range is usually within forested sites, which provide protection against weather as

well as lichens and other plants used as forage (ODFW 2003b); however, in Jackson County, winter range also consists of other habitat types such as grassy meadows, recent clearcuts, industrial forestlands, agricultural fields, orchards and urban edges. Most elk range is on BLM and NFS lands (ODFW 2003b); however, within the Pacific Connector pipeline area, most winter range occurs on private lands (table 4.6.1.2-9). Jackson County has the most winter range affected by the Project, followed by Klamath County, then Douglas County.

TABLE 4.6.1.2-9

Designated Big Game Winter Range Crossed by the Pacific Connector Pipeline

	Miles Crossed Per Landowner			
Winter Range or Management Area	**BLM**	**Forest Service**	**Other a/, b/**	**Total**
Douglas County				
Big Game Winter Range – Umpqua National Forest	0.0	0.6	0.0	0.6
Douglas County Total	**0.0**	**0.6**	**0.0**	**0.6**
Jackson County				
Sensitive Wildlife Area c/	2.3	0.0	2.3	4.6
Especially Sensitive Deer and Elk Winter Range d/	11.1	1.4	19.7	32.3
Jackson County Total	**13.5**	**1.4**	**22.0**	**36.9**
Klamath County				
Deer Low/Medium Density Winter Range e/	0.0	0.0	4.3	4.3
Deer Low/Medium Density Winter Range f/	0.3	0.0	12.8	13.0
Elk Winter Range g/	0.0	0.0	1.2	1.2
Klamath County Total	**0.3**	**0.0**	**18.3**	**18.5**
Overall County	**13.8**	**2.0**	**40.3**	**55.4**

Note: Rows/columns may not sum correctly due to rounding. Mileages rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").

a/ Other includes non-federal lands, such as private, county, and state.

b/ Seasonal restrictions are specific to landownership. "Other" designation is stipulated by ODFW.

c/ Sensitive Wildlife Areas coverage was provided by ODFW from Jackson County big game GIS coverage. This area also incorporates Forest Service Deer Winter Range coverage (Trail Creek).

d/ Especially Sensitive Deer and Elk Winter Range coverage was provided by ODFW from Jackson County big game GIS coverage. This area also incorporates BLM Deer (Camel Hump, BFRA Salt Creek, Little Butte Creek South) and Elk (Camel Hump, BFRA Salt Creek) Winter Management Area coverages, as well as Forest Service Deer Winter Range coverages (Big Butte Creek, Lake Creek).

e/ Deer Low/Medium Density Winter Range coverage was provided by ODFW from digitizing efforts of Klamath planning maps. This is the Keno Unit Winter Range (Milburn 2007).

f/ Deer Low/Medium Density Winter Range coverage was provided by ODFW from digitizing efforts of Klamath County planning maps. This area also incorporates BLM Deer Winter Management coverages (Stukel, South Bryant).

g/ Elk Winter Range for Eastern Oregon(ODFW 2013; available online: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259).

Big-game winter ranges have been delineated for management planning efforts within Jackson and Klamath Counties and typically include winter ranges for both deer and elk (ODFW 2003a). The big-game winter management areas were digitized in GIS from Jackson and Klamath Counties' planning maps by ODFW and are still considered to be in draft form (Wood 2007). The delineated areas do not necessarily represent complete deer and elk winter ranges within each county, but designate areas that provide some level of protection for big-game winter range while allowing development to occur (Milburn 2007). Pacific Connector consulted with ODFW to ensure that the correct big game habitat coverages were considered (as described in Pacific Connector's April 27, 2015 data response filing with FERC). Upland game birds that may be harvested in the project area include sooty grouse, ruffed grouse, mountain quail, ring-necked pheasant, California quail, mourning dove, and wild turkeys (ODFW 2012b; Forest Service 2007). Harvested small game and furbearer species that occur in the project area are beaver,

bobcat, gray fox, red fox, marten, mink, muskrat, otter, raccoon, badger, coyote, nutria, opossum, spotted skunk, striped skunk, and weasel (Hiller 2011).

During construction of the Pacific Connector pipeline, there would be short-term, localized effects on hunter success rates within the affected hunt units. When construction in a particular hunt unit coincides with hunting seasons, hunter utilization and success in the immediate vicinity would probably be adversely affected for the duration of construction in that area. However, hunter success rates for any species in each affected hunt unit are relatively low despite seemingly extensive hunter efforts (ODFW 2014a).

Where the Pacific Connector pipeline crosses existing roads, the newly created corridor would be potentially accessible from each road and probably more so at points crossed where access roads are adjacent to previously dense and/or forested habitats. The Project would require construction of 13 PARs. Increased hunter success as a result of those access points is likely but any changes in success cannot be predicted or estimated because so little area (the pipeline corridor) within any given hunt unit would be subject to increased hunter access.

After construction, there could potentially be a secondary impact (Comer 1982) on harvest rates because of increased access by hunters using the pipeline right-of-way to access remote areas. In addition, big game species utilizing a cleared right-of-way may be more likely to be harvested than animals in forested habitat. Increased public recreation along cleared rights-of-way in the fall hunting season, especially near crossings of existing access points, has been documented elsewhere (Crabtree 1984).

Increased public access because of the cleared pipeline right-of-way could increase poaching of game animals and non-game wildlife on a local level. Enforcement of wildlife regulations is the responsibility of the Oregon State Police, Fish and Wildlife Division. Individual incidences of illegal harvest are reported in the Fish and Wildlife Division Newsletter. From those records, it appears that poaching is somewhat commonplace in southwest Oregon. In the April 2007 edition, a deer poaching investigation near the proposed route (Eagle Point, Jackson County) led to 130 charges, including 23 felonies, against 8 suspects. Those particular crimes involved several black-tailed deer (Freeman 2006) but, according to the April 2007 Fish and Wildlife Division Newsletter, other species that have been poached include elk, turkeys, and even livestock. More recent newsletters describe poaching in the area as well (January 2014, December 2013, and October 2013). There is no information to relate poaching effects to wildlife population status.

Within big game winter management areas in Douglas, Jackson, and Klamath Counties, mature and regenerating forest would be converted to an herbaceous/shrub vegetative cover for the long term, increasing the amount of forage available to big game adjacent to forested stands potentially used for thermal cover (table 4.6.1.2-10). Forested areas would be the most commonly affected, followed by grasslands/shrublands. Temporary impact areas that are forested, regenerating, or recently clear-cut stands removed during construction on big game winter range would be replanted with trees after construction of the pipeline, eventually providing similar habitat to that present prior to construction.

TABLE 4.6.1.2-10

Acres of Habitat Types Affected within Big Game Winter Ranges by Construction and Operation of the Pacific Connector Pipeline by Landowner

			Acres of Habitat Affected in Winter Range					
Project Component	**County**	**Landowner**	**Forest – Woodland**	**Regenerating or Clear-cut Forest**	**Grasslands/ Shrublands**	**Wetland/ Riparian a/**	**Other Terrestrial Habitat b/**	**Total Habitat**
Pacific Connector Pipeline and Facility Construction	Douglas	Umpqua National Forest	9	0	0	0	0	9
	Jackson	Medford BLM	114	28	68	0	<1	209
		Rogue River National Forest	12	4	3	0	0	20
		Private / State Forest	133	52	106	10	37	338
		Jackson County Total	*259*	*85*	*177*	*10*	*37*	*567*
	Klamath	Lakeview BLM	3	0	1	0	0	4
		Private/Other	39	29	99	<1	33	200
		Klamath County Total	*42*	*29*	*99*	*<1*	*33*	*203*
Total Pipeline and Facility Construction			**309**	**113**	**276**	**10**	**70**	**779**
Pacific Connector Operation/ Maintenance 30-foot Corridor c/	Douglas	Umpqua National Forest	2	0	0	0	0	2
	Jackson	Medford BLM	27	6	15	0	0	48
		Rogue River National Forest	4	1	1	0	0	5
		Private / State Forest	33	12	24	2	7	78
		Jackson County Total	*64*	*20*	*39*	*2*	*7*	*131*
	Klamath	Lakeview BLM	1	0	<1	0	0	1
		Private/Other	11	8	23	<1	7	50
		Klamath County Total	*11*	*8*	*23*	*<1*	*8*	*51*
Total Operation/Maintenance Corridor			**77**	**28**	**62**	**2**	**15**	**184**
Revegetation Outside 30-foot Maintenance Corridor d/	Douglas	Umpqua National Forest	7	0	0	0	0	7
	Jackson	Medford BLM	87	22	53	0	1	161
		Rogue River National Forest	8	3	2	0	0	15
		Private / State Forest	100	40	82	8	31	260
		Jackson County Total	*195*	*65*	*138*	*8*	*31*	*436*
	Klamath	Lakeview BLM	2	0	<1	0	0	3
		Private/Other	28	21	76	<1	26	150
		Klamath County Total	*31*	*21*	*76*	*<1*	*25*	*152*
Total Revegetation Outside Operation/ Maintenance Corridor			**232**	**85**	**214**	**8**	**55**	**595**

Note: Rows/columns may not sum correctly due to rounding. Acres rounded to nearest whole acre. Acreages less than 1 are shown as "<1".

a/ Wetland acreages rounded to nearest tenth of an acre. Acreages less than 0.1 acre shown as "<0.1".

b/ Other terrestrial habitat includes agriculture, developed, and barren. Restoration efforts will allow habitat type to be converted back to original state.

c/ Upland 30-foot Operation/Maintenance Right-of-Way will be maintained in an herbaceous/shrub state less than 6 feet in height. Riparian 30-foot Operation/Maintenance Right-of-Way will be maintained in an herbaceous/shrub state within a 10-foot corridor centered over the pipeline and the additional 10 feet either side of the pipeline will be maintained in an herbaceous/shrub/tree state less than 15 feet in height (see Typical Drawings 3430.34-X-0015, 3430.34-X-0016 and 3430.34-X-0017 in Appendix 1B to Resource Report 1).

d/ Habitat Revegetation: trees planted within forested habitats, including regenerating and clear-cut forest; grasses and shrubs planted within non-forested habitat and 30-foot maintenance corridor (except riparian areas). On private lands, revegetation will occur in consultation with the landowners.

Sources: BLM Deer and Winter Management Areas, Forest Service Deer Winter Range, ODFW 2007 GIS data delineated from County planning maps, ODFW 2013 Elk Winter Range for Eastern Oregon.

In addition, big game are expected to be displaced from habitats adjacent to construction-related disturbance. In general, deer and elk return to habitats from which they have vacated within some relatively short period of time, which would likely depend on the time of year, available hiding cover, and duration of local disturbances. Following reclamation of the pipeline corridor, big game may utilize the corridor for travel and for foraging, depending on vegetation species planted and rapidity of successful revegetation.

Construction of the Pacific Connector pipeline may coincide with big game calving and fawning times, generally in late spring (May to early June). Calving and/or fawning areas may be close to winter ranges or may be at higher elevations than winter range. During active construction, big game would most likely avoid construction areas and may be adversely affected in one or more ways, including increased energy expense if they escape from disturbances or are displaced to areas of deeper snow accumulation, use of suboptimal habitats that do not provide adequate functions (food, shelter, escape cover), and use of habitats that increase the risk of predation. The expected consequences of these responses would be decreased over-winter survival and decreased calving/fawning success (for example, see Bradshaw et al. 1998).

The BLM, Forest Service, and ODFW recommend the application of seasonal construction restrictions on big-game winter range. Pacific Connector would apply the following ODFW, BLM, and Forest Service recommended seasonal closures for big game winter range (with the exception of big game winter range located in Klamath Basin, where a waiver would be obtained): November 15 to April 1 (BLM), December 1 to March 31 (Forest Service), and non-federal lands from November 15 to April 1 (private and state). Timber felling and construction activities may occur within ODFW, BLM, and/or Forest Service big game winter ranges in Douglas (Umpqua National Forest), Jackson, and Klamath counties to minimize or avoid effects to migratory birds, NSO, and MAMU. Pacific Connector will consult with ODFW, BLM, and the Forest Service while finalizing the *Wildlife Habitat Mitigation Plan* to allow a variance/waiver for project activities within areas with recommended big game seasonal timing restrictions.

Elk and deer may use maintained pipeline rights-of way for feeding areas, especially when hunting is not occurring (Lees 1989; Jageman 1994). The Pacific Connector pipeline right-of-way would provide an opportunity for developing high quality feeding areas (Lees 1989) for elk and deer species, especially if noxious weeds are controlled and high-quality native forage is seeded. Within big-game winter range disturbed by the pipeline, Pacific Connector would seed disturbed areas with preferred deer and elk forage species. Additionally, Pacific Connector would control noxious weeds on the right-of-way on all lands crossed including both summer and winter rangelands, because it is a priority management objective to maintain native forage species (ODFW 2003a).

The ODFW expressed concern that open trenches during construction of the Pacific Connector pipeline could entrap deer and elk. To minimize potential impact of open trenches on big game within delineated big-game winter and summer range, Pacific Connector would leave breaks at least 5 feet wide at approximately 0.5-mile intervals, and at visible wildlife trails, to serve as routes for big game to cross the construction right-of-way until pipe is ready to be installed (Forman et al. 2003). Alternatively, Pacific Connector would install soft plugs (backfilled trench materials) in the trench after excavation at these distances to provide wildlife passage.

Additionally, 20-foot gaps would be left in spoil and topsoil stockpiles at all hard or soft plug locations, and a corresponding gap in the welded pipe string would be left in these locations. Suitable ramps would also be installed from the bottom of the trench to the top to allow any wildlife that enters the trench to escape.

Pacific Connector would install barriers at locations along its pipeline route to discourage unauthorized public access to the right-of-way. These barriers may include boulders, dirt berms, log barriers, signs, and locked gates. Slash from clearing operations would be redistributed on the right-of-way, to improve habitat and to make OHV travel difficult. These barriers should minimize OHV access to the right-of-way and reduce unauthorized hunting or poaching of game animals (see section 4.10.2.5 of this EIS for a further discussion about OHV traffic).

Amphibians and Reptiles

Based on their distributions in southwestern Oregon, 23 species of amphibians and 24 species of reptiles may be present in habitats that would be crossed by the Pacific Connector pipeline route (Leonard et al. 1993; Nussbaum et al. 1983). Habitats in the area of the pipeline that support the highest diversity of reptiles and amphibians include Wetlands/Eastside Riparian-Wetlands (38 species), Developed, Urban, and Mixed Environments (37 species), and Mixed Conifer-Hardwood Forest (35 species). One reptile species (western terrestrial garter snake) is potentially found within bays and estuarine habitats. Amphibian and reptile species that could potentially occur near the Project include, but are not limited to, tiger salamander, clouded salamander, tailed frog, western toad, western pond turtle, sagebrush lizard, rattlesnake, king snake, western fence lizard, gopher snake, and rubber boa.

Some amphibian species potentially occurring within the Pacific Connector Pipeline Project area are associated with a variety of habitats and as a result, are common and widespread with healthy populations, such as the Pacific tree frog and rough-skinned newt. Other species that have been documented within the project area, such as the Oregon spotted frog (listed as threatened under the ESA, addressed in section 4.7) and the foothill yellow-legged frog, are declining (ODFW 2006b). Amphibians demonstrate close associations with aquatic and riparian habitats, though they may occur in other habitat types if not too distant from water, for example, the ensatina (a lungless salamander), which is found in forests. Amphibians with extremely limited distributions and relatively specific ecological requirements may be more at risk of further population declines (Walls et al. 1992). Some threats to amphibians within habitats crossed by the Project include loss of habitat and its connectivity, changes in hydrology and water quality, predation, and competition with invasive species (ODFW 2006b).

Reptiles potentially within the Pacific Connector Pipeline Project area are also associated with a variety of habitats crossed, although not all are as closely associated with water and/or water-dominated features as amphibians. The primary threats to reptiles are habitat loss and fragmentation, predation, and competition with nonnative invasive species, such as turtles, fish, and bullfrogs (ODFW 2006b).

Impacts discussed below under General Impacts on Terrestrial Wildlife would be relevant to amphibians and reptiles. Because it will not be known where amphibians and reptiles are specifically located, impacts were quantified by impacts to habitats in which they could occur (see table 4.6.1.2-2). The Pacific Connector Pipeline Project would be cutting a narrow swath out of larger areas of potentially suitable habitat. Because of the low percentage of all available

habitat in the area being affected, the Project is not expected to have population level impacts on these species. For more information on special status amphibian and reptile species that could be affected by the Project, see the BE in appendix L. Habitat mitigation as described in the CMP (Appendix O of our BA) would benefit amphibian and reptile species affected by the Project.

Invertebrates

The Pacific Connector pipeline may affect terrestrial invertebrates. Arthropods occur within all habitat types crossed by the pipeline, though terrestrial mollusks (gastropods) are considerably more restricted. With few exceptions, terrestrial mollusks are generally found in moist habitats associated with springs, seeps, decaying wood, moist mature forests, and habitats maintained in the coastal "fog" zone near the ocean. Other invertebrate species would likely be widespread and abundant throughout the project area; some examples include *Peromyscopsylla selenis*, earthworm (*Lumbricus variegatus),* orb weaver spider (family *Araneidae)*, and grass spiders (*Agelenopsis* spp.*)*.

Impacts discussed below under General Impacts on Terrestrial Wildlife would be relevant to invertebrates. Because it is not possible to predict specific locations where invertebrates would occur, impacts were estimated based upon impacts to habitats in which they could occur (see table 4.6.1.2-2). Because of the low percentage of all available habitat in the area being affected, the Project is not expected to have population-level impacts on these species. For more information on special status invertebrate species that could be affected by the Project, see our BA (FERC 2015) and the BE in appendix L. Habitat mitigation as described in the CMP would benefit invertebrate species affected by the Project.

General Impacts on Terrestrial Wildlife and Measures to Reduce or Mitigate Impacts

Many species have very specific habitat requirements that may or may not be present in the project area and would not be described in the relatively broad habitat types used in this section (habitat types described by Johnson and O'Neil 2001). Consequently, the assumption has been made that if a species' occupied range is known or likely to coincide with the project area, and if general habitat types that would be affected by the Pacific Connector pipeline could include more specific habitat components required by that species, then the species could occur and be affected in some way by the Project.

Short-term impacts on wildlife would occur during construction, and also extend beyond for habitats that may not be returned to former levels of functionality for up to five years following restoration. Long-term impacts on wildlife occur when it takes longer than five years for affected habitats and their functions to be fully restored to their pre-construction condition. Direct impacts on habitats, whether by vegetation removal, conversion of one type to another, alteration of key components, or degradation due to proximity of disturbances, indirectly affect wildlife populations. Indirect impacts on wildlife are often subtle, difficult to document, and may be expressed over the long term. There may be some lag between the time of construction impacts on habitats and the detection of indirect impacts on wildlife populations. In addition to variability over time, indirect impacts on wildlife due to direct impact to habitats may be variable over space so that the expression of impact may occur some distance away from the impact source.

Individuals of some wildlife species may be directly affected by construction of the Project if they are killed by vehicles traveling to and from construction sites. Species most susceptible to vehicle-related mortality include those that are inconspicuous (salamanders, frogs, snakes, small mammals), those with limited mobility (amphibians), burrowing species (mice and voles, weasels, beaver, frogs and toads, snakes, subterranean mollusks), and wildlife with behavioral activity patterns making them vulnerable, such as deer that are more active at dusk and dawn, and wildlife that may scavenge roadside carrion (Leedy 1975; Bennett 1991; Forman and Alexander 1998; Trombulak and Frissel 2000). Direct mortality of species could also occur during right-of-way maintenance operations, such as mowing.

Other species are likely to be displaced from habitats that are cleared of vegetation (passerine birds, and tree-dependent/cavity-dependent birds and mammals such as woodpeckers and bats) and from areas adjacent to construction sites (waterfowl, raptors and medium-sized mammals). Populations may also be negatively affected if individuals emigrate from habitats affected by project-related disturbances. Displacement of mobile wildlife would most likely be a short-term effect. Once construction and restoration of the right-of-way is complete, displaced individuals are expected to return to the original area they occupied. However, if adjacent habitats are at carrying capacity for the species, displaced individuals could be adversely affected by competition for resources, increased susceptibility to predation, or disease that may be facilitated by crowding.

Activities associated with construction of the Pacific Connector Pipeline Project could decrease individuals' reproductive success by increasing neonate or nest abandonment and possibly by interfering with breeding behaviors, sustenance, and growth of fetuses and/or young, conception rates, and fetal survival. These direct impacts may negatively affect population growth through diminished rates of survivorship and fecundity.

Impacts, both long-term and short-term, could occur to amphibians and reptiles associated with waterbodies and the riparian areas. Removal of riparian vegetation along stream edges that are crossed by the Project could increase sedimentation input into the waterbody and/or increase water temperatures. Changes in hydrology could also occur within wetlands and waterbodies used for breeding, limiting dispersal or reducing breeding habitat (ODFW 2006b).

Construction of the pipeline through upland forests would require removal of deciduous and coniferous trees and would remove those habitat features over the long-term. It would take many years for trees to grow to their original size in temporary workspaces in cleared forested areas that are restored and revegetated after construction. Former forested habitats within Pacific Connector's 30-foot-wide operational right-of-way would be converted to shrub-sapling dominated or herbaceous cover for an extended period of time (50 years or more). This conversion could benefit some wildlife species that characteristically inhabit shrub or grassland habitats, but would be detrimental to wildlife species adapted to forest interiors. Construction through forested areas could also result in the removal of snags and LWD that are used by a variety of wildlife, including cavity nesters and bats.

Construction through existing shrub-dominated areas would mostly result in short-term habitat loss. After restoration and revegetation, grasses and shrubs would be allowed to regenerate across the entire right-of-way. There would be longer-term impacts in some areas, where shrubs, such as species of sagebrush, would require longer than 5 years to become reestablished to their

former condition and density. Loss of this habitat type could potentially affect certain species of birds and mammals that utilize shrubs, by reducing forage and nesting opportunities.

Noxious Weeds and Invasive Species

Short- or long-term impacts to wildlife habitat could also result if the pipeline causes the establishment and spread of noxious weeds, as well as other invasive species (animals and microbes) not native to a region. In general, habitats with more bare ground, such as grasslands, riparian areas, relatively dry, open forests, and disturbed areas such as roads are more susceptible to invasive species establishment than are dense, moist forests, high mountain areas, and serpentine areas that have relatively closed plant cover or have extreme climate or soils.

Noxious weeds often out-compete native vegetation. They displace native species by spreading rapidly and utilizing resources (nutrients, water, sunlight) that can eventually lead to a weed-dominated monoculture. Such transformed habitat can be unsuitable to former wildlife inhabitants. Often, as habitat quality degenerates, wildlife diversity declines. For example, purple loosestrife forms dense monocultures that inhibit native vegetation, causing decreasing species' diversity, limit water flows and wildlife access to water, and in some instances can make waterfowl nesting areas unsuitable (Whitson 1996).

In addition, weed infestations can create highly flammable fuel loads (Bio-Integral Resource Center, no date). Fires in wildlife habitat can directly kill animals that are not able to flee, and can modify habitat rendering it unsuitable for certain species. For a summary of noxious weed species found along the pipeline route, see table 4.5.1.2-4.

Clearing of vegetation from the linear right-of-way and soil disturbance from right-of-way grading could increase the chance of spreading noxious weeds through the removal of native, established species and soil disturbance, which could encourage the establishment of invasive plants. Equipment moving along the right-of-way could also bring seeds from one place to the next, aiding the spread of these species. Pacific Connector has measures in place to help prevent this as described in the ECRP and POD. Weed surveys would take place prior to vegetation removal, and areas would be pretreated through mowing and herbicide spot treatment. Any infested areas found would be cleared to minimize the spread of invasive plants. Equipment would also be inspected and cleaned of any dirt, plant seeds, and microbes prior to moving to new areas of the pipeline. During restoration, disturbed areas would be revegetated with native seed mixtures. Monitoring would take place to ensure that no non-native plants establish themselves in lands disturbed by pipeline activities. Due to measures that would be employed before, during, and after construction, the risk of the pipeline causing noxious weeds to spread in the area of the pipeline should be low.

Pacific Connector would mitigate for the spread of noxious weeds, forest pathogens, and soil pests by following the measures outlined in its *Integrated Pest Management Plan*.[91] Further measures for controlling the spread of noxious weeds are contained in its ECRP. See section 4.5.1.2 for more details on invasive plants and mitigation measures.

Invasive insects, mites (e.g., spruce spider mite), and terrestrial mollusks (e.g., the predatory spotted leopard slug) can similarly disperse along a newly created corridor where native

[91] See Appendix N to the POD, which was included in Pacific Connector's application to the FERC.

vegetation formerly presented barriers to dispersion. In general, invasive exotic wildlife species can adversely affect native species and their populations through various pathways, singly or in combination that include:

- introduction of disease or parasites to native wildlife;
- interbreeding (hybridization) with native wildlife;
- competition for habitat with native wildlife;
- degradation of habitat of native wildlife; and/or
- predation on native wildlife.

Measures outlined in the *Integrated Pest Management Plan* would help decrease impacts of invasive insects.

Invasive animals such as introduced bullfrogs have adversely affected various native frog populations through predation (Hayes and Jennings 1986), including populations of Oregon spotted frogs in Washington (Watson et al. 2000). Bullfrogs prey on and out-compete native frog species. They spread very quickly due to their prolific nature, lack of predators, ability to travel long distances over dry land, and wide habitat and diet preferences. Pacific Connector has developed BMPs to avoid the potential spread of the aquatic invasive species and pathogens of concern during Project hydrostatic testing operations (see the *Hydrostatic Testing Plan*[92]).

The range of the barred owl has expanded and this species competes with NSO for prey resources. Barred owl expansions have made headway into NSO habitat due to fire suppression allowing more trees to grow in the northern Great Plains, enabling the owls to cross over from the eastern United States into NSO range on the west coast. More aggressive than NSOs, they are able to out-compete the threatened species (Livezey et al. 2007). Impacts on NSO from barred owl expansion are further discussed in section 4.7.

Herbicides

Herbicides could affect native plant species, thereby affecting wildlife habitat and potentially the animals themselves. While adverse effects to wildlife tend to be low, some symptoms include breakdown of vital organs, reduction in numbers of healthy offspring, decreased fitness, and direct mortality (Forest Service 2005b). Amphibians can be deformed or killed by some herbicides if these chemicals get into the water. Herbicides tend to form residue on grasses more readily than other vegetation; therefore, wildlife that eats grass, as well as those species above them on the food chain, tend to be most susceptible to the effects of herbicides (Forest Service 2005b).

Currently, according to the Pacific Northwest Weed Management Handbook (Peachey et al. 2007), all herbicides used in forests to control brush and weed-trees include one of the following: 2,4-D, glyphosate, imazapyr, picloram, ticlopyr, and clopyralid, described below.

2,4-D is moderately toxic to animals but depends on species and formulations. For example, dogs are more sensitive to 2,4-D organic acids than rats and humans and dogs have developed malignant lymphomas when exposed to 2,4-D applications. 2,4-D does bio-accumulate, though general risk to browsing wildlife is considered low (Tu et al. 2001).

[92] See Appendix M to the POD, which was included in Pacific Connector's application to the FERC.

Glyphosate is of low toxicity to animals and birds. There appears to be relatively little bioaccumulation. Toxicity of glyphosate-based pesticides to amphibians varies with developmental stage because there is some evidence that some formulations may interfere with metamorphosis (Howe et al. 2004).

Similarly, imazapyr is of relatively low toxicity to birds and mammals and appears to be rapidly excreted in urine and feces with no residues accumulating in viscera, muscle, fat, or blood. Imazapyr has not caused mutations or birth defects in animals (Tu et al. 2001). Adverse effects to terrestrial and aquatic animals appear to be unlikely (Durkin and Follansbee 2004).

Picloram has long-term persistence in the environment, and chronic exposure of wildlife is of concern. Picloram is water soluble and thus highly mobile. Studies on mice found effects to offspring of adults that had ingested the herbicide, including death, low birth weights, and birth defects (Cox 1998a).

Triclopyr is only slightly toxic to birds and mammals although sub-lethal doses applied for 29 days in diets of forest songbirds caused weight loss and behavioral changes (Tu et al. 2001). A study of three species of frogs in Ontario, Canada, found that low concentrations of triclopyr butoxyethyl ester inhibited their avoidance behavior. Researchers concluded that exposure to 1.2 ppm of triclopyr is likely to paralyze the more sensitive tadpoles (Cox 2000). A metabolite of triclopyr, 3,56-trichlorol-2-pyridinol, is toxic to animals (Forest Service 2005b).

Clopyralid is relatively non-toxic to fish, birds, mammals, and other animals, although it does not degrade rapidly (soil half-life of 40 days). Consequently, herbivores consuming clopyralid may accumulate residues in their livers and kidneys (Tu et al. 2001). One study found that weights of rabbit fetuses decreased at both low and high doses of clopyralid. Skeletal abnormalities were also observed in these fetuses at all doses and at the highest dose, accumulation of excess fluid around the brain was evident, which resulted in small brains and enlarged skulls (Cox 1998b). Information is absent on adverse effects to terrestrial mollusks for the range of herbicides discussed.

In accordance with Pacific Connector's ECRP, only specific spots would be treated with herbicides to control noxious weeds, with landowner approval. Because the previously mentioned herbicides are generally of low toxicity to animals, direct adverse effects to wildlife from applied herbicides along the pipeline route or adjacent to aboveground facilities should be low, especially if applied according to directions on labels.

Noise

Noise from construction and operation of the Pacific Connector Pipeline Project is discussed in detail in section 4.12.2.2 of this EIS. We estimate that noise from general construction of the pipeline could range from the L_{eq} of about 93 dBA at 50 feet, to 85 dBA at 100 feet, and 72 dBA at 300 feet. Ambient sound levels in much of the Pacific Connector pipeline route area probably would be similar to the Arcata Fish and Wildlife Office's projections (FWS 2006a). Ambient sound is defined as the sound qualities as they might exist currently and might include human-generated sources over the long term. The typical ambient sound level for forest habitats ranges from 25 dB to 44 dB. Considering ambient sound as a base, noise levels associated with some common machines and activities that would be present during pipeline construction are included in table 4.6.1.2-11. Noise

from HDD drilling would range from L_{dn}[93] of about 34 to 79 dBA at the nearest NSAs. This compares to current ambient L_{dn} levels at these residences ranging from about 42 to 66 dBA. Double rotor helicopters may be used for timber clearing along a portion (26 miles) of the Pacific Connector pipeline route. This type of helicopter generates noise of about 92 dBA within 700 feet of its area of use. Operation of the Klamath Compressor Station would result in estimated L_{dn} noise of about 56 dBA at an NSA located about 1,000 feet away. Current ambient noise at this residence is an L_{dn} level of about 43 dBA.

TABLE 4.6.1.2-11

Common Sound Levels for Equipment/Activities Potentially Associated with the Pacific Connector Pipeline

Measured Sound Source	Range of Reported dB Values (at Distance Measured 50 feet)	Relative Sound Level a/
Forest Habitats	25 – 44	Ambient
Yelling	70	Low
Chain Saw (various types/conditions)	61 – 93	Low – Very High
Pickup Truck (idle to driving)	55 – 71	Very Low – Moderate
Mowers	68 – 85	Low – High
Log Truck	77 – 97	Moderate - Very High
Dump Truck	84 – 98	High - Very High
Rock Drills	82 – 98	High - Very High
Pumps, Generators, Compressors	87	High
Drill Rig	88	High
General Construction	84 – 96	High – Very High
Track Hoe	91 – 106	Very High – Extreme
Helicopter or Airplane (various types/conditions)	96 – 112	Very High – Extreme
Rock Blast	112 b/	Extreme
Logging Helicopter (Columbia double rotor)	108 – 123	Extreme

Source: FWS (2006a)
a/ A general, subjective ranking of noise levels created by the sources considered when used for analysis of relative noise effects on species.
b/ Blasting required for the Pacific Connector pipeline would be underground and muffled, which should result in a lower dB value at 50 feet.

Noise could potentially impact wildlife for a short duration during pipeline construction activities, including clearing and grading the right-of-way, and HDD operations. The average time a given point along the pipeline would be disturbed by construction noise is approximately 8 weeks. This would vary, as the speed at which crew would be able to work would be affected by terrain, construction methods, weather, and environmental windows. Some portions of HDD operations would occur as 12-hour work shifts, while other activities would normally occur as 24-hour-per-day operations. The overall duration of HDD operations should last from 2 to 4 weeks at each site.

Distances at which noise would attenuate to ambient levels would depend on local conditions such as tree cover and density, topography, weather (humidity), and wind, all of which can alter background noise conditions. Consequently, short-term impacts on wildlife by construction noise would vary along the length of the pipeline route.

Noise would most likely displace wildlife some distance away from noise sources especially if wildlife species are nearby. However, any short-term effects to wildlife by noise would occur

[93] $L_{eq(24)}$ is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the $L_{eq(24)}$ with 10 dBA added to the nighttime sound levels between the hours of 10 p.m. and 7 a.m. to account for the greater sensitivity of people to sound during the nighttime hours.

simultaneously with human presence and the presence of heavy machinery normally required for pipeline construction. Most likely, any impacts to wildlife due to noise could not be separated from those due to all other construction-related activities occurring concurrently. Noise and human presence would move along the construction right-of-way, albeit at a rather slow pace. Therefore, impacts to wildlife because of noise would be of short duration and spatially localized.

Research has demonstrated varying short-term reactions of wildlife to noise. Most research has focused on wildlife reaction to more constant noise generated by roads and high-volume traffic (e.g., Forman and Alexander 1998). However, some research has recorded wildlife reaction to airplanes, sonic booms, helicopters, artillery, and blasting that could produce similar reactions from noises associated with construction activities for the Pacific Connector Pipeline Project.

Golden et al. (1980) provided the following behavioral and physiological reactions of animals to known noise levels ranging between 75 and 105 dB from various disturbances, including aircraft:

- fish demonstrate reduced viability, survival, and/or growth (20 dB for 11 to 12 days);
- ungulates become nervous and/or run (82 to 95 dB) or panic (95 to 105 dB);
- waterfowl flock (80 to 85 dB), move and/or become nervous (85 to 95 dB), or startle (95 to 105 dB); and
- birds scare (85 dB).

Raptors and other forest-dwelling bird species have demonstrated more adverse impacts to project-generated sound during nesting and breeding when levels substantially exceed ambient conditions existing prior to a project (i.e., by 20 to 25 dB experienced by the animal) and when the total sound level is very high and exceeds 90 dB. Such impact could potentially result in egg failure or reduced juvenile survival, malnutrition or starvation of the young, or reducing the growth or likelihood of survival of young. However, these effects may be minimal; Awbrey and Bowles (1990) found that raptors flushed from their nests while incubating did not leave the eggs exposed for more than 10 minutes and concluded that multiple, closely spaced disturbances would be required to cause lethal egg exposure. Some raptors, for example osprey, refuse to be flushed from their nest despite closely approaching helicopters (Poole 1989).

Specific studies to determine impacts to wildlife from noise generated from construction of a pipeline have not been conducted. However, it is expected that construction noise in remote areas that are relatively free from noise would have a greater potential to disrupt wildlife. Potential impact to wildlife from some noises generated from construction activities can be evaluated to an extent, such as noise from vehicles and/or increased road traffic, blasting, helicopter timber harvest or pipeline delivery, and aerial fly-overs.

Animals could flee the area because of helicopter disturbance. In the case of birds, this could cause eggs to be left unincubated. For all animals, this disturbance could have negative energetic effects. Mitigation for helicopter noise includes operational restrictions, such as maintaining a high altitude and flight paths away from noise sensitive areas whenever possible. A lengthy discussion on helicopter noise effects to MAMU and NSO is provided in our BA (FERC 2015).

The DOT (2004) has summarized numerous studies and literature that have reported the effects of noise on wildlife, specifically focusing on impacts from roads. Overall, existing information suggests that fish are unlikely to be adversely affected by noise levels produced from road

traffic; reptiles and amphibians show some barrier effect due to roads (but no clear evidence of a noise effect alone); bird numbers and breeding can be strongly affected by the proximity of roads; large mammals can be repelled by road/vehicle noise; and small mammals do not appear to be adversely affected by road noise.

Blasting may be required for pipeline trench excavation in areas where hard, non-rippable bedrock occurs within the trench profile. Approximately 100 miles of the pipeline alignment is considered to have high blasting potential, although not all substrate within those areas identified may require blasting to achieve the required trench depth. Blasting activities may involve a single blast or a repetitive blasting sequence. Blasting during trench excavation is discussed in more detail in section 4.2.2.5.

Noise from blasting would be short term and localized. The noise associated with blasting activities is reported to be in the range of 112 dB within 50 feet of the trench (see table 4.6.1.2-11), and may cause alarm in wildlife such as mule deer. However, noise from blasting for this Project would be mitigated and expected to generate lower decibel levels, because charges would be underground and muffled with blasting mats. In comments on the DEIS, ODFW recommended the use of blasting mats whenever explosives are required; Pacific Connector is proposing to use blasting mats. We conclude that noise from blasting would not have significant adverse effects on wildlife and would not cause population-level impacts that may alter foraging or breeding behavior over the long term.

In 2005, a study was conducted during a 4,000-foot HDD crossing of the Nooksack River crossing in Whatcom County, Washington, to determine if drilling noise associated with the HDD (noise levels between 47 and 52 dBA at the study area) had a negative impact on wintering bald eagles. Eagles were observed from November 1, 2005, through April 7, 2006, and results indicated that bald eagles were not negatively affected by HDD rig activity (Edge Environmental, Inc. 2006).

Pacific Connector proposes to cross the Coos, South Umpqua, Rogue, and Klamath Rivers using HDD technology. Noise studies conducted for the HDD of each proposed crossing determined that, with the use of mitigation measures (such as special vinyl fabric acoustic tents or other barriers), noise levels at the four crossings are not expected to exceed current ambient noise levels. With mitigation, noise levels associated with the drilling equipment at each site are not expected to exceed the Oregon State noise regulations of 55 dBA during the day and 50 dBA at night within 25 feet of a residence. To ensure adequate mitigation and monitoring, we are recommending Pacific Connector file HDD noise mitigation plans for review and approval prior to construction (see section 4.12.2.4). Noise impacts on wildlife from the operation of the drilling equipment from the HDD crossings at Coos, South Umpqua, Rogue, and Klamath Rivers should be negligible.

A minimal increase in ambient noise levels would occur during periodic right-of-way vegetation maintenance activities (i.e., mowing, chainsaws) during operation. The major source of operational noise for the Project would be from the Klamath Compressor Station, which is located in an area surrounded by rural residences, agricultural lands, and rangelands and grasslands. Noise from the compressor station would be long term, but localized to one site. The expected increase in L_{dn} noise levels would range from 2.1 dBA to 16 dBA above current ambient noise at the nearby NSAs during normal station operations. In terms of environmental noise impacts, an increase to the ambient sound level of 10 dBA typically results in the perception of a doubling of sound. Consequently, the Klamath Compressor Station would have noise impacts on the surrounding NSAs because of the

very quiet existing ambient conditions. With appropriate mitigation measures, we expect the compressor station to operate below our standard of 55 dBA at all but the closest NSA, for which we have recommended additional monitoring and mitigation measures (see section 4.12.2.4). This sound level could have localized adverse effects on wildlife near the station.

Habitat Fragmentation and Edge

One manifestation of fragmentation is the amount of edge created through otherwise contiguous habitats. In the context of habitat fragmentation, edge is the portion of habitat (or ecosystem on a larger scale) "near its perimeter, where influences of the surroundings prevent development of interior environmental conditions" (Forman 1995:38). As compared to interior habitats, edge habitats generally support different species composition, structure, and species' abundance. For example, vertebrate species richness (bird and amphibian) has been positively associated with edges in fragmented Douglas-fir forests (Rosenberg and Raphael 1986), although species benefitted are typically habitat generalists.

Along with the creation of edge, pipeline construction would further fragment habitat. Habitat fragmentation has already occurred to some extent in the areas crossed by the pipeline route because of existing residential developments, tree harvests, roads, and utility corridors. These sources of habitat fragmentation are expected to increase in the foreseeable future outside of protected areas such as LSRs. Fragmentation can also affect the rate and scope of blowdowns in forested habitats (the effects of blowdowns are discussed in more detail within section 4.5).

Because the pipeline is linear, the created patch associated with the new edge would be narrow and elongated unlike edges created by forest practices (Forman and Gordon 1986). Creation of edges by the Project would affect seral stands differently. Douglas-fir or western hemlock would be replanted during restoration of temporary work areas, including TEWAs, within the pipeline right-of-way (except in the 30-foot wide maintenance corridor centered on the pipe), where conifers would be removed during construction activities. If 12-inch-tall Douglas-firs and western hemlocks are replanted during restoration and they are not harvested later, trees of both species could be about 70 feet tall in 50 years at the end of the Project life. Permanent impacts to forested habitats would include about 154 acres of LSOG forests, at least 169 acres of mid-seral forests, and 223 acres of clearcut/regenerating forests, because replanting on non-federal lands is dependent on landowner approval (see table 4.6.1.2-3).

Douglas-fir and western hemlock planted adjacent to edges of clearcut and/or early regenerating stands (assuming conifers from 1 to 10 feet tall at the time of construction) would modify edges with the seral stands from hard to soft to no edge as they grow. In 50 years, which is the operational life of the Project, trees replanted in temporary workspaces outside of the 30-foot maintenance corridor would similarly modify edges of regenerating and mid-seral stands adjacent to the right-of-way, from hard to soft edge characteristics as tree heights increase. As the replanted trees grow, edge contrasts would decrease, as would effects on forest interiors, because taller trees would reduce direct solar radiation and increase soil moisture and humidity along the edges of stand interiors (Chen et al. 1993; Heithecker and Halpern 2007).

Different species composition and abundance occurs in edge habitats (Forman and Gordon 1986) than within patch interiors, depending on species' tolerances for the variation in microclimatic parameters. Some terrestrial amphibians, for example, have narrow temperature and moisture

tolerances (Spotila 1972; Feder 1983). Moist, cool, and stable microclimatic conditions are essential to these species. Loss of canopy cover and coarse woody debris can affect amphibians' microclimatic conditions. Some wildlife species use right-of-way corridors created by pipelines and other linear utilities. For example, bird species' diversity in powerline corridors through forested vegetation was found to be higher in the corridor than within the adjacent forest (Kroodsma 1984). Often present along the edge are higher levels of flower and fruit production, pollinator, and frugivore densities and seed dispersal. Also, deer and elk use of available browse within corridors or on edges of corridors that are adjacent to hiding and thermal cover have been documented (Hartley et al. 1984; Brusnyk and Westworth 1985).

Few studies have evaluated the establishment of forage within pipeline corridors and utilization by big game. The study conducted in Alberta by Brusnyk and Westworth (1985) focused on forage and browse production on a 17-year-old pipeline right-of-way and on a 2-year-old right-of-way. They compared big game use (moose, deer, and elk) of forage on the two rights-of-way to use in adjacent undisturbed forest ecotones and undisturbed forest. Deer appeared to utilize browse in the 17-year-old corridor but returned to adjacent undisturbed forest, probably utilizing available hiding or thermal cover. Deer utilized the corridors for travel in early winter prior to limiting snow depths. Elk utilized forage on the two-year-old right-of-way primarily where portions were adjacent to forested habitats. The principal conclusion of this study was that pipeline corridors increased local habitat diversity and that diversity—juxtapositions of browse or forage to undisturbed forested habitat—influenced use of the corridors by ungulates, not necessarily due to increased vegetative production, per se, within pipeline rights-of-way.

Increased herbivore density provides a food source for predators (Forman 1995), so predator density can be increased along the edge. With heavy browsing at the edge, wind can penetrate further into the woods, effectively widening the edge; however, vegetation management within corridors can decrease bird densities (de Waal Malefyt 1984) and rabbit and deer densities (Hartley et al. 1984), depending on whether maintenance involves mowing or application of herbicides. Similar impacts are expected during maintenance operations, primarily by mowing or hand cutting Pacific Connector's right-of-way. Pacific Connector's operations would typically use mechanical methods or where access of machinery is infeasible then manual clearing is used to maintain the existing right-of-way, and herbicides are only used where necessary to control some noxious weeds.

During right-of-way restoration, Pacific Connector would create habitat diversity features within the right-of-way corridor, such as rock and brush piles, that would provide habitat for a variety of wildlife species including mollusks, amphibians, and small mammals. Such features reduce fragmentation effects of abrupt edge characteristics by creating local irregularities. LWD placed within and/or across the right-of-way may eventually contribute to microsite diversification and provide corridors for some wildlife (e.g., terrestrial mollusks) to travel across an otherwise potential barrier. Such movements would be essential to avoid potential genetic isolation of relatively non-mobile species.

4.6.1.3 Wildlife on Federal Lands

Wildlife species present on federal lands crossed by the Project would be similar to those discussed for all land ownerships above in section 4.6.1.2, including mammals, birds, amphibians, reptiles, and invertebrates. Wildlife on federal lands is managed under a variety of directives. Species managed on federal lands include NWFP S&M species, BLM and Forest

Service sensitive species, and federally threatened, endangered, and proposed species. The presence of and impacts to these species on federal lands are discussed in section 4.7.

The Forest Service additionally identifies MIS, which include wildlife monitored during forest plan implementation to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent (FSM 2620.5). On the Umpqua National Forest, MIS include NSO, pileated woodpecker, primary cavity excavators (nesters), pine marten, Roosevelt elk, Columbian black-tail deer, peregrine falcon, bald eagle, and steelhead (water quality indicator). On the Rogue River National Forest, MIS species include Columbian black-tailed deer, Roosevelt elk, pine marten, NSO, pileated woodpecker, and primary cavity excavators (nesters). On the Winema National Forest, MIS include NSO, pileated woodpecker, northern goshawk, three-toed woodpecker or black-backed woodpecker, bald eagle, mule deer, resident trout, and pine marten. Potential effects of the Project on MIS, and by association wildlife with similar habitat needs, are assessed in the MIS Report (appendix M of this EIS). Additionally, impacts to some of these species (Roosevelt elk, Columbian black-tailed deer, peregrine falcons, northern goshawks, mule deer, and bald eagles), including impacts on federal lands, are discussed above in section 4.6.1.2.

Fifteen of the 16 wildlife habitats crossed by the Project as a whole are crossed on federal lands; only the wildlife habitat "Bays and Estuaries" is not affected on federal lands. Wildlife species' associations with these habitats provide a basis for evaluating Project effects on wildlife. The acreage of each wildlife habitat affected on federal land during construction, and the number of herpetofauna (i.e., amphibians and reptiles), birds, and mammals associated with those habitats are shown below in table 4.6.1.3-1. Agriculture and Westside Riparian-Wetlands/Eastside Riparian-Wetlands have the highest number of associated species (282 and 268, respectively), but have very few acres affected. Southwest Oregon Mixed Conifer-Hardwood Forest has the most species associated of forest types (224) and has a substantial number of acres affected.

TABLE 4.6.1.3-1

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on Federal Land, and Wildlife Species Associated with Johnson and O'Neal (2001) Habitats

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/e/ (acres)	Mid-Seral Forest Crossed b/e/ (acres)	Clearcut/ Regenerating Forest Crossed c/e/ (acres)	Total Acres	Number of Species Associated d/
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	157	83	126	367	32 – Herpetofauna 113 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	26	14	67	107	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	374	93	130	597	35 – Herpetofauna 125 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	44	9	23	76	31 – Herpetofauna 124 – Birds 56 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	35	1	0	37	32 - Herpetofauna 113 – Birds 62 – Mammals

TABLE 4.6.1.3-1

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on Federal Land, and Wildlife Species Associated with Johnson and O'Neal (2001) Habitats

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/e/ (acres)	Mid-Seral Forest Crossed b/e/ (acres)	Clearcut/ Regenerating Forest Crossed c/e/ (acres)	Total Acres	Number of Species Associated d/
	Western Juniper and Mountain Mahogany Woodlands	0	3	0	3	19 - Herpetofauna 86 – Birds 34 – Mammals
	Subtotal	**637**	**204**	**346**	**1,186**	
Grasslands Shrubland	Shrub-steppe	–	–	–	68	22 – Herpetofauna 75 – Birds 46 – Mammals
	Westside Grasslands	–	–	–	20	26 – Herpetofauna 84 – Birds 37 – Mammals
	Eastside Grasslands	–	–	–	2	20 – Herpetofauna 79 – Birds 44 - Mammals
	Subtotal	–	–	–	**90**	–
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	–	–	–	<1	38 – Herpetofauna 154 – Birds 76 – Mammals
	Herbaceous Wetlands	–	–	–	1	18 – Herpetofauna 136 – Birds 43 – Mammals
	Subtotal	–	–	–	**2**	
Agriculture	Agriculture, Pastures, and Mixed Environs	–	–	–	1	32 – Herpetofauna 173 – Birds 77 – Mammals
	Subtotal	–	–	–	**1**	
Developed/ Altered	Urban and Mixed Environs	–	–	–	29	37 – Herpetofauna 131 – Birds 63 – Mammals
	Roads	–	–	–	81	N/A
	Subtotal	–	–	–	**110**	
Barren	Coastal Dunes and Beaches	–	–	–	2	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	–	–	–	**2**	
Open Water	Open Water - Lakes, Rivers, and Streams	–	–	–	2	17 – Herpetofauna 94 – Birds 20 – Mammals
	Subtotal	–	–	–	**2**	
	Project Total	**637**	**204**	**346**	**1,392**	

Note: Rows and columns may not sum correctly due to rounding. Acreages rounded to nearest whole acre; values less than 1 acre shown as "<1".

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).

b/ Mid-Seral Forest (40 to 80 years).

c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).

d/ Numbers of species associated with each habitat type crossed by the Pacific Connector pipeline were summarized from Pacific Connector's Environmental Resource Report 3, Appendix 3D, Table 3D-1.

e/ Cells with no data result from the fact that non-forested habitat types did not identify seral stage, thus acres are identified only in the "total acres" column.

Additionally, ODFW habitat categories affected by the Project on non-federal and federal lands are shown in section 4.6.1.2, table 4.6.1.2-4 above. These values provide context for the quality of wildlife habitat affected by the Project both within and outside federal lands.

Impacts on wildlife would be similar on federal lands to those discussed for all land ownerships above in section 4.6.1.2, including direct mortality to individuals unable to move away from construction equipment, noise and visual disturbance during construction, and habitat loss and modification. Less mobile wildlife species that are not able to move away from construction activities during clearing and site preparation could experience direct mortality. More mobile species would likely be displaced from the site during active construction. Wildlife in the vicinity of the Project could also be disturbed by construction activities and noise, and may move away from the construction site. However, the primary impact to wildlife from construction and operation of the Project would be habitat loss.

The discussion of impacts on big game in section 4.6.1.2 under Harvested Wildlife includes impacts to big game on federal lands. Table 4.6.1.2-9 lists the miles of designated big game winter range crossed by the Project within and outside federal lands, and table 4.6.1.2-10 lists the acres of habitat types within big game winter ranges affected by Project construction and operation within and outside federal lands.

Seasonal road closures on public lands have been applied to big-game winter range within BLM and NFS lands to minimize the effect of winter stress on deer and elk. Additionally, the BLM, Forest Service, and ODFW recommend the application of seasonal construction restrictions on big-game winter range. The following are recommended seasonal closures for big game winter range: November 15 to April 1 (BLM), December 1 to April 30 (Forest Service), and December 1 to March 31 (private and state). Pacific Connector notes that the numerous seasonal restrictions to protect applicable species pursuant to the ESA and the MBTA will require timber-clearing activities to be conducted outside nesting seasons during the spring and summer months. Therefore, Pacific Connector will be required to complete timber-clearing activities during recommended seasonal closures for big game winter range and appropriate waivers for recommended seasonal big game closures will be necessary.

Impacts to wildlife associated with habitats available in LSRs and Riparian Reserves would be generally similar to those described above wherein direct impact could occur during clearing and pipeline construction if individuals are killed, injured, and/or displaced to other locations where possible mortality increases and/or fecundity decreases. Direct impact to late-successional and riparian habitat (removal and/or conversion to different vegetation) may indirectly affect wildlife by decreasing the amount of habitat locally available and decreasing the effectiveness of adjacent habitats in providing life-requisite functions for wildlife. That impact would not be able to be mitigated on-site and is assumed to persist through the long term, although impact would be offset by the actions listed in the *Compensatory Mitigation Plan* (appendix F-1). Impacts to species inhabiting other, non-forested habitats within the affected areas in LSRs, Riparian Reserves and the Matrix would be similarly affected, although the amount of time required to restore affected habitats would be shorter. Impacts on federal lands and resources from the Project are addressed fully in section 4.1, including potential impacts to LSRs and Riparian Reserves.

Loss of snags is expected to be a long-term impact. Estimates of snag density (numbers per acre) that would be affected within the construction right-of-way and TEWAs were made on each of the three National Forests in the project area during timber reconnaissance conducted in 2007 (Chapman 2007). Estimates of snag density by size class (inches dbh) and decay class (hard or soft) are provided in table 4.6.1.3-2. Within the areas affected by construction, conifer snags less than 13 inches dbh are generally most dense on each forest, although there are numerous hardwood snags in that size category on the Rogue River National Forest. Most of the smaller snags (less than 13 inches dbh) were observed as hard wood, rather than softened due to decay.

TABLE 4.6.1.3-2

Snag Density Estimates on NFS Lands

National Forest	Tree Type	Decay Class	Estimates of Snag Density (Number per Acre) by Size Category (inches dbh)			
			<13	13-24	25-36	>36
Umpqua	conifer	Hard	5	<1	1	0
		Soft	<1	<1	<1	<1
Rogue River	conifer	Hard	1	<1	<1	<1
		Soft	0	1	<1	0
	hardwood	Hard	2	0	0	0
		Soft	0	<1	0	0
Winema	conifer	Hard	3	<1	<1	0
		Soft	0	<1	<1	0

Because no other portions of the pipeline route have been similarly examined, there is no information to suggest that snag density on National Forests is similar to snag densities on lands under different management and ownership. Nevertheless, loss of snags regardless of decay class is expected to be a long-term impact because recruitment of new snags within the affected areas would take much longer than five years.

4.6.2 Aquatic Resources

4.6.2.1 Waterway for LNG Vessel Traffic

The waterway for LNG vessel traffic to Jordan Cove's terminal contains a diverse collection of anadromous, estuarine, and marine organisms and associated habitats. The marine environment along the transit route outside of Coos Bay consists of varied habitats used by aquatic organisms including commercial and recreational fish and shellfish such as salmon, crabs, shrimp, and marine mammals including whales, seals, and California sea lions. This habitat includes gently sloping nearshore intertidal and subtidal sand area near the Coos Bay mouth and rocky shoreline to the south. Habitats near the mouth of the bay range from sand beaches to rocky shorelines. Offshore, deeper soft bottom habitats extend over 100 feet deep with main pelagic surface water along the ship transit route.

The Coos Bay estuary is described in section 4.4.2.1. Several freshwater streams and sloughs enter the bay, so that its habitats range from marine to estuarine. The bay contains shellfish resources, as well as marine fish. It is a migration corridor for salmon and steelhead that spawn and rear in the streams that drain into Coos Bay. The bay along the transit route for LNG vessel marine traffic contains mostly sloping beaches with algae and eelgrass beds that supply important habitat for the estuarine organisms. A total of over 14,000 acres of habitat is present in Coos Bay, including some 1,400 acres of eelgrass beds.

Many fish and shellfish species are common within the waterway leading to the Jordan Cove LNG terminal (see appendix O, table O-1). Most of these aquatic species are briefly mentioned below, and are discussed in more detail in our EFH Assessment attached with our BA (FERC 2015), submitted to the NMFS concurrently with the issuance of the DEIS.

Marine Fish

Species of groundfish, pelagic, anadromous, and marine species would be present in the waterway for LNG vessel traffic to the terminal, in the nearshore and marine waters outside of the Coos Bay estuary. This includes a variety of rockfish, flatfish, shark, skates, sturgeon, sablefish, cod, and migratory fish such as anchovy and sardine and in the outer regions may rarely include some highly migratory species such as thresher shark and tuna.

Marine fish communities within Coos Bay consist of species found in estuarine and marine waters. Their distribution and abundance varies with physical factors such as bottom conditions, slope, current, salinity, and temperature, as well as season, which can affect migration and spawning timing. Some of the more commonly abundant fish include Pacific herring, and the non-native American shad. Most fish species are migratory or seasonal, spending only part of their life in these waters. Other common seasonal marine fish species include surfperch, lingcod, rock greenling, sculpin, surf smelt, Pacific herring, English sole, black rockfish, northern anchovy, eulachon, longfin smelt, Pacific tomcod, sandsole, and topsmelt. California halibut is also present in the bay near Jordan Cove. A few common species like kelp greenling and starry flounder reside in the bay year-round. The bay from just beyond the LNG terminal site to its mouth is a prime feeding area for many local and seasonal fish species.

Fish abundance varies with salinity. Near NCM 1.5, the sloughs are mostly of high salinity, while farther up the bay, near NCM 15.5, sloughs are generally brackish, of lower salinity. Toward the mouth of the bay, the salinity is higher, especially in the summer, which is when the number of fish increase.

Anadromous Fish

A common group of anadromous fish species found in the waterway for LNG vessel traffic to the terminal includes Chinook salmon, coho salmon, chum salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, white and green sturgeon, and American shad. Anadromous is a term describing fish that return from the ocean to the rivers where they were born in order to spawn. Adult anadromous fish spend a portion of their adult life in the ocean; the amount of time varies among the species. Sexually mature adults migrate or “run” from the ocean and estuaries upstream to fresh water streams to spawn in shallow gravel stretches. The fertilized eggs drop into the intergravel spaces. Hatched fry remain in these spaces for a time and then emerge to occupy rearing areas of quiet waters, usually pools or backwaters. After a period of time, which varies with the species, juveniles migrate downstream to estuaries typically late winter to summer depending on race and species. There they undergo smolting (physiological maturation to adjust from fresh to salt water) before entering marine waters as juveniles. They typically rear in the ocean for one to five years before returning as adults to their natal streams to spawn. Salmon typically return to streams in late summer through fall. Steelhead and sea-run cutthroat trout may return to streams in the summer, fall, winter, or spring depending on species and race. Salmon species die after spawning but some steelhead and anadromous coastal cutthroat survive to return to the ocean, and can spawn again. Steelhead typically remain in

freshwater streams after emergence for two to three years before migrating to the ocean, with adults returning to spawn in their fourth or fifth year. Sea-run cutthroat usually remain in fresh water for two to four years before smolting and migrating to saltwater, usually staying in the estuaries or near shore (Behnke 1992).

There are eight species of coldwater anadromous fisheries in the project area: Chinook salmon, coho salmon, chum salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, and green sturgeon. The Oregon Coastal Coho Salmon Evolutionarily Significant Unit (ESU) is present in the project area and is listed under the ESA. The North American Green Sturgeon – Southern Distinct Population Segment (DPS), which is listed as Threatened under the ESA, may be present or migrate through Coos Bay. The Project effects to the listed species are discussed in section 4.7.

Shellfish

A large and diverse population of benthic and epibenthic invertebrates is present beyond the entrance to Coos Bay. Clams, crabs, oysters, and shrimp make up important components of these invertebrates in the bay. Some of the most abundant and commercially important of these species include bentnose clams, Pacific oyster (which is grown commercially), Dungeness crab, and ghost shrimp. Distribution varies along the route from the LNG terminal to the bay mouth. Principal subtidal clam beds are found in the lower bay and South Slough. Clam Island, located at the mouth of Coos Bay, has an abundance of recreationally important clams. Some of the highest recreational harvest of clams and crabs occurs at the mouth of Coos Bay. Razor clams are an important commercial and recreational species. Within Jordan Cove, ghost shrimp, a commonly harvested bait shrimp, are found in the fine sediment and eel grass beds. Mud shrimp are also harvested in this region.

Coos Bay contains one of only three known native Oregon coastal populations of the Olympia oyster. Within its native range, this species has significantly diminished from historical levels (National Fish and Wildlife Federation et al. 2010). Efforts have been taken in the bay to restore this species and improvements in bay water quality and sediment have resulted in self-sustaining populations over the last two decades (Groth and Rumrill 2009; Rumrill 2007). A pilot restoration project began in 2010 that resulted in stocking 4 million juvenile Olympic oysters in South Slough. Because of its low abundance and efforts to improve the quality of the Coos Bay environment and its survival, the Olympia oyster is not harvested.

Status of Fish in the Project Area

The status of federally listed fish species and other commercial fish species that are managed under the MSA is presented in our EFH Assessment attached with our BA (FERC 2015), submitted to the NMFS concurrently with the issuance of the DEIS; this information is summarized in section 4.7 and in the EFH sections below.

ODFW has evaluated the status of salmon and steelhead, trout, and other selected species of interest. The status, or risk, is based on the threat to the conservation of a unique group of populations in the near term (5 to 10 years). The criteria used for evaluating the status of these species included consideration of six varied factors including: as status of existing population, habitat use, abundance, productivity, reproductive independence and hybridization. The details of the methods are presented in ODFW (2005).

ODFW used these factors to determine the status of what they designate Species Management Units (SMUs). SMUs are groups of populations from a common geographic area with similar genetic and life history characteristics. ODFW classified each SMU into one of five status categories: (1) not at risk, (2) potentially at risk, (3) at risk, (4) extinct, and (5) not assessed. This rating system was only directly applied to the SMUs, not individual populations. The Coos River system has populations in 10 SMUs. Of these, three of the SMUs were rated as "not at risk," one "potentially at risk," four "at risk," and two "not assessed." Two of the four SMUs rated "at risk" (spring Chinook and chum salmon) are actually extinct within the Coos basin. The species and SMU ratings of the Coos River system populations are:

- coastal spring Chinook salmon – At Risk (extinct in the Coos River system);
- coastal chum salmon – At Risk (extinct in the Coos River system);
- Pacific lamprey – At Risk;
- coastal winter steelhead – Potentially at Risk;
- coastal cutthroat trout – Not at Risk;
- coastal coho salmon – Not at Risk;
- coastal fall Chinook salmon – Not at Risk;
- western brook lamprey – Not Assessed;
- southern green sturgeon – Not Assessed; and
- white sturgeon – Not Assessed.

Marine Mammals

Thirty-seven species of marine mammals occur in Oregon, including 7 species of baleen whales, 7 species of toothed whales, 17 species of dolphins and porpoises, 5 species of pinnipeds (seals and sea lions), and sea otters (NMFS 2008).

Steller sea lions, California sea lions, northern elephant seals, and Pacific harbor seals use haulout sites in the vicinity at Cape Arago, Three Arch Rocks, and Shell Island, along the southwest Oregon Coast. Eight species of whales are federally and state-listed. All marine mammals are protected under the MMPA and were included in Jordan Cove and Pacific Connector's IHA application to NMFS on October 8, 2014 (Jordan Cove and Pacific Connector 2014). Threatened and endangered marine mammals are discussed in more detail in section 4.7.

Sea Turtles

Four species of sea turtles have been documented off the coast of Oregon: the green, olive ridley, leatherback, and loggerhead sea turtles. Sea turtles potentially occurring in the transit route are protected under the ESA and are discussed in detail in section 4.7.

Operational Impacts and Mitigation Measures To Be Implemented Along the Waterway for LNG Vessel Transit

Vessel Strikes

Jordan Cove anticipates that as many as 90 LNG vessels each year would use the waterway to reach its terminal. In addition, in accordance with the WSR and LOR, there must be three tugboats and additional security ships that assist each LNG vessel in transit along the Coos Bay navigation channel. These vessels have the potential to strike aquatic species, including sea

turtles and marine mammals, and seabirds and shorebirds during their transit to and from the Jordan Cove terminal.

In the open ocean prior to entering the Coos Bay navigation channel, it is estimated that LNG vessels would travel at speeds of about 12 knots. Jordan Cove has proposed to provide measures supplied by NMFS to minimize potential ship strikes to cetaceans, and possibly other listed (sea turtles) and non-listed marine species by LNG vessels in a *Ship-Strike Reduction Plan*. Jordan Cove would provide operators of LNG vessels that would visit the terminal with copies of this plan for avoidance of marine mammals or sea turtles while in transit at sea. Some of the suggested measures could include the following:

- train LNG vessel crews to watch out for and avoid marine mammals and sea turtles;
- keep on board vessels copies of marine species reference guides, such as *Marine Mammals of the Pacific Northwest, including Oregon, Washington, British Columbia and South Alaska* by Pieter Folkens (2001);
- request LNG vessels to establish navigation policies when marine mammals or sea turtles are sighted, including:
  - maintain a distance of 90 meters or greater.
  - attempt to maintain a parallel course to the animal and avoid abrupt changes in direction until the animal has left the area.
  - reduce speed when pods or assemblages of marine mammals or sea turtles are observed nearby; and
- report sightings of any injured or dead marine mammal or sea turtles to the NMFS, regardless of whether the injury or death was caused by the LNG vessel. If the injury or death were caused by collision with an LNG vessel heading to or from the Jordan Cove terminal, the FERC would be notified within 24 hours of the incident. Information to be provided would include the date and location (latitude/longitude) of the strike, the ship name, and the species, if possible.

LNG vessels would enter the waterway at speeds between 8 and 10 knots, and slow between 4 to 6 knots as they proceed up the Coos Bay navigation channel to the Jordan Cove terminal. As required by the WSR, two tugs would escort each LNG vessel within the navigation channel, and another tug would assist in docking the vessel at the terminal. Use of tugs would allow the LNG vessels to maintain steerage even at these slow speeds.

Most sea turtles, marine mammals, and seabirds and shorebirds would be able to avoid LNG vessels traveling at slow speed through the waterway. Even with the additional LNG vessels in the waterway, the number of ships would still be below historic levels for deep-draft traffic to the Port. Effects on aquatic resources from LNG vessels would be not much greater than the effects of current deep-draft cargo ships visiting the Port. Based on the reduced speed of the LNG vessels and the efforts by Jordan Cove to increase the awareness of vessel operators, we conclude that the incidence of accidental strikes of aquatic species by LNG vessels in transit to and from the Jordan Cove terminal would be low.

Ship Grounding

Some commenters raised the possibility that an LNG vessel waiting offshore to enter Coos Bay, either to avoid another ship coming out of the Port or seeking proper tidal conditions, could lose

anchorage or steerage and run aground on the North Spit, like the *New Carrisa* incident of 1999. A ship grounding would have the potential to impact aquatic resources, as oil and fuel could leak from a grounded vessel. However, a Coast Guard investigation found that the *New Carrisa* grounding was caused by the captain's error in not having the ship well anchored.

We conclude that it would be highly unlikely that an LNG vessel transiting in the waterway would become grounded. All LNG vessels visiting the Jordan Cove terminal would have to adhere to Coast Guard regulations, including anchoring procedures offshore, in addition to the measures outlined in the WSA, WSR, and LOR. A pilot would board the LNG vessel to guide it through the Coos Bay navigation channel, and the vessel would be accompanied by tugs and security escort boats to keep it on course. In addition, the geometry of the navigation channel would keep the LNG vessel within its confines, away from the shore.

Shoreline Erosion from Waves and Propeller Wash

Propeller wash from LNG vessels and tugboats transiting the waterway to and from Jordan Cove's terminal could cause shoreline and bottom erosion, and displace bottom organisms due to scour. Wakes and waves caused by vessels in the waterway could increase erosion along the shoreline and resuspend loose sediments in the bay. Increased erosion and suspended sediment levels can adversely affect fish eggs and fish survival, benthic community diversity and health, and spawning habitat. At high concentrations, suspended sediments can affect oxygen exchange over the gills, resulting in weakened individuals or mortality. Waves from vessels breaking on the shoreline can also cause fish stranding. The possible magnitude and effects of the Jordan Cove Project on shoreline erosion were approximated by Jordan Cove through model studies, the results of which are discussed below.

Model Parameters

To estimate the effects of waves and propeller wash from LNG vessels in Coos Bay, Jordan Cove developed two separate model approaches. One was developed by Moffat & Nichol (2008) and another by CHE (2011b). Both used similar baseline information but different approaches to determine likely effects on shoreline erosion. These models assumed that upon entering Coos Bay, LNG vessels would travel at approximately 8 to 10 knots (9.2 to 11.5 miles per hour [mph]) within the first mile of the Coos Bay entrance. For the remainder of the route to the Jordan Cove Terminal, LNG vessel speed would be approximately 6 knots (6.9 mph) or less. Both models considered the effect of waves at varied locations from near the mouth of Coos Bay to Jordan Cove's marine slip. The Moffat & Nichol model assumed about 200 vessel transits per year (combined inbound and outbound; about 180 combined vessel transits are proposed) of a 934-foot-long vessel traveling at about 6 knots (6.9 mph).

The CHE (2011b) model, however, used the wake generated by the tugboats traveling at the same speed as the LNG vessel, which would actually generate larger waves. CHE (2011b) also compared the effect of LNG vessel waves to that generated by existing large vessel traffic in the Coos Bay route and compared that to existing large vessel induced waves and natural wind wave's energy and size. CHE selected model points that were considered "sensitive" areas. Their model assumed 113 round trips (i.e., 226 vessel channel transits) of LNG vessels annually traveling at about 6 knots (6.9 mph) along most of the navigation channel but 4 knots (4.6 mph) near Jordan Cove's terminal.

Wave Model Results

The Moffat & Nichol (2008) model found that the maximum wave height generated would be about 1.1 feet. Although waves of this size occur throughout much of the bay, they only occur about 2 percent or less of the time annually based on the locations modeled. Among the seven locations chosen by Moffat & Nichol, the model predicted that the waves generated would equal from 0.0 to 3.1 percent of the annual wave energy at these locations above the current wave energy level.

The CHE (2011b) model compared the two measures of potential changes of shoreline waves from LNG vessel activity. The first was a comparison of single event (one vessel passage) shoreline wave energy (as measure by wave velocity) to that of existing large Coos Bay vessels already occurring. The other comparison was the overall cumulative yearly effect of LNG passage to that of existing vessels and that generated by natural wind waves. Their model results showed that the single passage events of LNG vessels would have slightly less shoreline wave impact (as measured by average wave velocity at the shore) per event than that of large existing vessel passage. This model estimated example direct shore wave height to be less than about 0.6 foot for the assumed mean higher high water tidal conditions for LNG vessel passage.

The CHE model simulated varied natural wind and tidal conditions (1,080 total combination conditions) to estimate wave effects on the shore sediment transport. One example of data results for high wind conditions indicated a maximum wave height near 0.9 foot high at some shore locations (assuming a 22 knot [25.3 mph] west wind). The model results indicated that nearly all of the annual shoreline wave-generated sediment transport would be generated by natural wind waves (greater than about 90 percent at all locations modeled). Overall, the model estimated that additional waves generated by the new LNG vessel traffic could increase shoreline sediment transport at the modeled point by 5 to 8 percent over existing conditions (wind-generated waves plus existing large vessel–generated waves).

While both of the models indicated some additional shore sediment movement could occur from the waves generated by the passage of LNG vessels through Coos Bay, the effects would be small because increased waves would occur infrequently, contribute a very small portion of total annual wave energy and sediment transport, and be within the normal magnitude of waves that naturally occur within the bay. Therefore, the total effect is likely to be within the range of natural annual variability of wave conditions.

Additionally, the analysis indicates that the outer mile of the entrance, where LNG vessels would be traveling at 8 to 10 knots (9.2 to 11.5 mph), may have higher vessel-generated waves because of the greater speed. However, this area is already less protected from naturally occurring ocean-generated waves (this region directly faces the ocean entrance) and likely has higher background naturally generated waves than the regions farther in the bay. Overall, increased sedimentation and disruption of aquatic nearshore habitat from additional tugboat- and LNG vessel–generated waves would be unlikely because of the factors noted above.

Propeller Wash Model Results

Effects of propeller wash on bank and bed erosion were estimated by the two reports noted above. The two models estimated the likely bottom velocity and effects to sediment along the entire route. These models considered boat and bottom sediment characteristics in the area of interest and tidal levels when transport and docking would occur.

The Moffat & Nichol (2008) report indicated that along most of the route (approximately from NCM 1 to the new access channel for the Jordan Cove terminal) bottom disturbance would be slight within the navigation channel. The bottom velocity caused by the propeller would be similar to the maximum velocity of peak tides (about 4 fps). However, near the docking location, they estimated bottom velocity would be roughly double, or about 7 to 8 fps. The report noted that along most of this route the main channel bottom is considered coarse (sand and sandstone). This type of substrate is hard to suspend and rapidly settles. Generally, along most of the route no marked bottom disturbance or sediment suspension would occur, as the increased velocity would be similar to maximum tidal currents. Within about the last half- to quarter-mile before reaching the slip (based on the point selected for modeling) is where bottom velocity is increased. Some increased bottom scour and locally elevated turbidity may occur in this area but the effects would be limited in dimension. Disturbance would be limited, partly due to the coarse (mostly sand) bottom substrate that is relatively resistant to resuspension and rapidly settles.

The CHE (2011b) report found slightly different results using a different model. It reported that maximum bottom velocity in a narrow band along the route would be 13 fps, higher than the previous report. This report also noted that maximum velocity diminished rapidly from directly below the propeller to along the edge of the navigation channel (150 feet from mid-channel), where finer more easily suspended sediment would occur less than 0.6 fps, which is below levels that would suspend fine sediment. Based on model results, bottom velocity greater than about 4 fps would occur only in an approximately 80-foot-wide band. Therefore, velocity generated by the propeller in excess of tidal flow velocity would be limited to a narrow band in the mid-channel, limiting the area where sediment may be suspended from propeller actions of the LNG vessel. However, as noted by Moffat & Nichol (2008), this region is generally of coarser sediment that is less prone to suspension.

The CHE (2011b) report also modeled likely bottom disturbance from existing large vessel transit (assumed 106 trips annually) in the bay and found that bottom velocity from these would be slightly greater than that of the LNG vessels (projected 113 trips annually). Therefore, during LNG transit, where these high bottom velocities occur, some benthic organisms would be disrupted and some sediment would be moved during arrival and departure. This would occur below the intertidal area. Mobile organisms would be able to return to the region, while some benthic organisms could be permanently displaced. Turbidity would likely be slight due to the coarse characteristics of the navigation channel sediment that is resistant to current induced suspension. Overall, some loss of benthic organisms could occur from LNG vessel propeller wash during each transport trip near the slip approach, but the magnitude would be small and likely less than currently occurs under each existing large vessel trip.

The CHE (2011b) report also modeled velocities and likely effects on sediment scour at the access channel and marine slip from the tugboats pushing of LNG vessels into the dock. Assuming very high power use by the tug to dock the LNG vessel, the model estimated maximum velocity on the far bank (about 275 feet from the propeller) would be mostly less than 2.0 fps, which would be unlikely to erode the bank. Furthermore, this area would be armored so no erosion would occur. Near the bottom, maximum velocity in the channel would be about 2.16 fps. Sediment analysis suggests that over 95 percent of the bottom material (mostly silt/clay size) in the access channel would be susceptible to suspension at this velocity. The report also

estimated that bottom scour would be limited to about 2 inches over a limited bottom area (approximately 100 by 50 feet) in the access channel. Some bottom disturbance would likely occur during docking. In most cases, this disturbance is likely to be much less than estimated because of the conservative assumptions used for this model. While some sessile benthic organisms may be displaced during LNG vessel docking, the limited occurrence and magnitude of bottom disturbance and sediment suspension would result in unsubstantial effects on organisms in the slip.

Fish Stranding

Fish stranding can occur when fish become caught in a vessel's wake and are deposited on shore by the wave generated by the vessel's passing. Stranding typically results in mortality unless another wave carries the fish back into the water. A recent study of strandings (Pearson et al. 2006) suggests that a series of interlinked factors act together to produce stranding during a ship passage. These factors include:

- Water-surface elevation—Low tides are generally more likely to result in strandings than high tides.
- Beach slope—Low-gradient beaches are generally more likely stranding locations than high-gradient ones.
- Wake characteristics—Ship wakes that result in both the greatest drawn-down and run-up on the beach are generally most likely to result in strandings. Wake characteristics are influenced by a number of dynamics including vessel size and hull form ("short and fat" vessels have a greater displacement effect and generate larger wakes than "long and thin" vessels); vessel draught (the smaller the under-keel clearance, the larger the wakes; thus, loaded vessels are more likely to result in strandings than unloaded vessels); vessel speed (fast moving vessels generate larger wakes than slow vessels); and the distance between the passing vessel and the beach (strandings are generally more likely at beaches close to the shipping channel than more distant beaches). Fish strandings were observed because of four types of vessel passages including oil tankers, container ships, car carriers, and bulk carriers (in order of the vessels observed to cause the highest to lowest stranding frequency).
- Various biological factors—For example, the larger the number of subyearling salmon that are present near the shoreline, the more fish that are likely to be stranded; salmon that are larger and relatively strong swimmers are generally less prone to stranding.
- Vessel speed—No stranding has been observed on the Columbia River at speeds less than 8 to 9 knots (about 10 mph).

All of these factors can vary simultaneously, making it difficult to predict the location and to what degree strandings may occur. A few areas may have the potential to strand fish in Coos Bay. One is the mud flats on the west side of the navigation channel along the Coos Bay and Empire Range that have beach morphology that has been shown to have potential for stranding, especially at low tide. Jordan Cove (Moffat & Nichol 2008) modeled the potential wave height and overall energy from 200 LNG vessel transits a year (combined inbound and outbound). As noted above, the wave's height would not exceed that of normal conditions in Coos Bay and vessel-induced waves contribute a small portion of total waves in the bay. In addition, the LNG vessels would be arriving and leaving at high tide, which is a period when gently sloping beaches

are mostly covered, and less likely to be dewatered from waves. The maximum vessel speed once within the navigation channel, about 6 knots, is less than that observed to cause stranding in the Pearson et al. (2006) study. The one exception is near the Coos Bay entrance (first mile), when vessels may be traveling 8 to 10 knots. While waves generated in this portion of the waterway may be larger than farther in the bay, this is an area likely already receiving larger ocean-generated waves, so the vessel-generated waves would be little different than current conditions in this region. Additionally, the presence in Coos Bay of subyearling Chinook salmon, which are the outmigrating fish most likely to be stranded, is limited to the summer months, approximately mid-June through the end of August. Considering the conditions, including LNG vessels entering and leaving at high slack tide, low velocity in most areas, wave height within normal range, and infrequent occurrence of susceptible fish, it appears unlikely that LNG vessel traffic in the waterway would substantially contribute to fish stranding.

LNG Spills

In a highly unlikely scenario, there could be an accidental spill of LNG from a vessel transiting in the waterway. As more fully discussed in section 4.13 of this EIS, spilled LNG would vaporize as warmed by ambient temperature and, if the LNG ignited, a fire could result. The greatest threat to aquatic organisms near an LNG spill would be from changes in water temperature. A spill of LNG would float on the water surface and not mix, but in the process of changing state from solid to liquid would rapidly cool off the upper water layers closest to the LNG spill. As the LNG would vaporize and turn to natural gas, it would be less dense than air and would rise above the water. Aquatic species in the waterway would not be directly affected unless individuals come in direct contact with the LNG. Should an aquatic species directly contact the LNG when it is first released, it could have its flesh frozen because the temperature is very low. The chance of this occurring would be remote because it would require the individual to be near the water surface at the direct point of the LNG spill, before it warms. If an LNG spill from a vessel in the waterway were to ignite, it would cause localized heating of the surface water. Neither the cooling nor heating would likely cause the overall water column to change temperature to the point of affecting aquatic organism beyond the surface layer at the time of initial spill or ignition. Aquatic species, other than possibly the smallest planktonic stages and shellfish, near this spill would be able to detect undesirable temperatures and avoid the LNG spill by swimming away.

As explained in section 4.13, in the entire history of LNG vessel transport worldwide, there has never been a major incident resulting in a large LNG spill or fire on water. The mitigation measures outlined in the WSA, WSR, and LOR would protect public safety and the environment, and ensure that aquatic resources would not be adversely affected by LNG vessel traffic in the waterway to Jordan Cove's terminal.

Fuel or Oil Spills

Fuel (e.g., diesel) used for LNG vessel propulsion could possibly leak or be spilled while en route in the waterway; likewise, oil could be spilled. LNG vessels would have measures aboard to contain fuel or oil spills should they occur, as required under the Coast Guard required hazardous spill response plan for vessels in U.S. waters of 2013 (78 FR 60099). Additionally, LNG vessels are double hulled, which should prevent the escape of fuel or oil. The chance of a spill is low, and any quantities leaked are likely to be small. As reported by Pacific

States/British Columbia annual reports (http://oilspilltaskforce.org/documents/), the number of oil spills reported from fishing, recreational, and other harbor marine vessels in Oregon ranged from about 9 to 65 per year, which is infrequent considering that thousands of marine vessels, both recreational and commercial, use Oregon coastal marine waters. We conclude that fuel or oil leaks from LNG vessels transiting in the waterway to and from the Jordan Cove terminal are not likely to have adverse effects on aquatic resources.

Introduction of Nuisance Species

Exotic or nuisance organisms are unlikely to be transported to Coos Bay by LNG vessels. LNG vessel origin locations are unknown at this time; they could originate from ports across the Pacific. Operators of commercial vessels have a significant economic interest in maintaining underwater body hull platings in a clean condition. Fouling of bottom platings would result in increased fuel costs for voyages and could reduce the vessel's maximum transit speed. To prevent fouling and the associated economic costs, operators aggressively and conscientiously implement hull plating preservation and maintenance programs. Failure to preserve and maintain hull plating not only raises short-term operation costs but also sets the stage for increased long-term hull maintenance costs. There is a particular sensitivity to this engineering and economic reality regarding commercial vessels operating at the higher end of the sailing rates schedule, as is the case for LNG vessels.

In addition to the antifouling program measures, fluid dynamics plays a practical role as a barrier to the introduction of invasive species. The amount of water that passes over the hull and through the sea chest is a massively large volume. (A sea chest is an opening with associated piping in the hull below the waterline to provide seawater to condensers, pumps, and other associated equipment.) The velocity of the seawater, abrasive by nature, along the hull would be expected to "waterblast" off anything that is not affixed to the hull (e.g., a barnacle). The sea chest would have the equivalent of untold multiples of seawater exchange such that an organism would be flushed out with much more velocity and volume of water than the accepted international ballast exchange procedure.

Ballast water may be another source of non-native organisms. Water is held in the ballast tanks and cargo holds of LNG vessels to provide stability and maneuverability during a voyage when vessels are not carrying cargo. Normal ballast exchange requires only three changes of water through the ballast tanks to purge any loading port organisms before arrival at the unloading port. These exchanges are done at sea and the exchanges occur at relatively low velocity. LNG vessels would discharge ship-ballast water as they load LNG at the receiving terminal.

All vessels would be required to comply with ballast water management requirements promulgated by U.S. law (e.g., Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990; 1996 National Invasive Species Act) and agency programs (Department of Defense/EPA regulations at 40 CFR 1700, which implement §312(n) of the CWA), and establish discharge standards for vessel ballast water. Additionally, Coast Guard regulations, Mandatory Practices for All Vessels with Ballast Tanks on All Waters of the United States, require proper cleaning of fouling organisms on the boat exterior, anchor, and anchor lines in manner to prevent the likelihood of exotic species being transferred between ports. In addition, ships must adhere to a Ballast Water Management Plan, which is to be kept onboard, and must maintain a Ballast Water Record Book to record the intake and discharge of ballast water. On September 2006, a federal district court ruled that by September 30, 2008, the EPA needed to take specific action to ensure that shipping companies comply with the intent of the CWA and restrict the discharge of ballast water into United States waters (Buck 2006).

EPA developed specific requirements for ballast water treatment under the Vessel General Permit requirement under the CWA NPDES program to reduce the chance of releasing invasive organisms in U.S. waters in 2013 (78[7] FR 121938 [April 12, 2013]). This regulation requires that beginning December 19, 2013, all newly built large vessels will be required to treat ballast water to kill potential invasive organisms, with older vessels of the size that would be used for the Project having some delay in implementation of this requirement (first scheduled dry dock date after January 1, 2016). Prior to implementing treatment of ballast water, all large vessels that would discharge ballast water within 200 miles of the U.S. coast will be required to exchange ballast water outside of this 200-mile area. The required treatment of water would ultimately be an improvement over the requirement to just exchange ballast water to "flush" potential invasive organisms outside of the 200-mile territorial waters of the U.S., which was reported to reduce organisms by 88 to 99 percent (National Research Council 2011). The new requirement for treatment level is to reduce most organism types to less than 10 living organisms per cubic meter of ballast water. While this requirement may not eliminate all risk of invasive species entering waters, it is a substantial measure that would reduce the risk of project actions introducing invasive organisms into waters of the project area. Several other regulations apply to ballast water management and discharge that would be followed by all LNG vessels; these regulations would also aid in both ensuring reduction of discharge of potentially invasive species and, through vessel inspections, that procedures are followed, as noted in Jordan Cove's Resource Report 3. The FERC has assumed that these provisions apply both to the import and export of nuisance species, and by compliance with this Act and other regulations, the LNG vessels would not likely cause exotic nuisance species to be introduced into Coos Bay, U.S. waters, or the ports of destination of the LNG cargos.

Essential Fish Habitat

The MSA was established to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSA as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

Federal agencies that authorize, fund, or undertake activities that may adversely affect EFH must consult with the NMFS. Although absolute criteria have not been established for conducting EFH consultations, the NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as NEPA, the Fish and Wildlife Coordination Act, the ESA, and the Federal Power Act in order to reduce duplication and improve efficiency (50 CFR 600.920(e)). Generally, the EFH consultation process includes the following steps:

1. Notification – The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into an EIS, Section 10 permit).
2. EFH Assessment – The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH should include:
    - a description of the proposed action;
    - an analysis of the effects (including cumulative effects) of the proposed action on EFH, the managed fish species, and major prey species;
    - the federal agency's views regarding the effects of the action on EFH; and
    - proposed mitigation, if applicable.

3. EFH Conservation Recommendations – After reviewing the EFH Assessment, the NMFS should provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.
4. Agency Response – Within 30 days of receiving the recommendations, the action agency must respond to the NMFS. The action agency may notify the NMFS that a full response to the conservation recommendations would be provided by a specified completion date agreeable to all parties. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH.

The FERC, as the action agency, is consolidating the EFH and the ESA process for all portions of the Project. This includes development of an EFH assessment and BA together for submittal to the NMFS and FWS with a request to initiate formal consultation.

Section 302 of the MSA established regional fishery management councils. Among other responsibilities, these councils develop management plans for each fishery that requires conservation and management. Section 303(a) (7) of the MSA requires that these fishery management plans describe and identify EFH. The Project would be constructed and operated within the region of the Pacific Fishery Management Council (PFMC). The PFMC has developed four fishery management plans for species in Oregon marine, estuarine and freshwater areas: Pacific Groundfish, Coastal Pelagic Species, Salmon and Highly Migratory Species. EFH is described and identified as everywhere that species managed by the PFMC occur.

EFH occurs both in the Pacific Ocean off the southwestern Oregon coast, and within Coos Bay. The locations of EFH within the waterway for LNG vessel transit to the Jordan Cove terminal are illustrated in figure 4.6-1. The area in this figure generally of greatest concern for potential impacts to EFH from LNG vessel–related actions is that shown as the "wetted area." Additional EFH habitat of concern would occur along the potential LNG vessel transit route extending out to the 200-mile EEZ (not shown in the figure). Species with EFH in the project area are summarized below.

Groundfish EFH

The groundfish group includes 82 species. For the Pacific coast groundfish fishery, the EFH determination is based on habitat use by life stage for all 82 species within each composite EFH shown in Appendices B-1 and B-3 of the Pacific Coast Groundfish Management Plan (PFMC 2008). The life history descriptions and maps showing species distributions are also available in Appendices B-2 and B-4, respectively, of the Management Plan (PFMC 2008). The EFH of groundfish species is listed and effects assessed in the EFH assessment as part of our BA (FERC 2015).

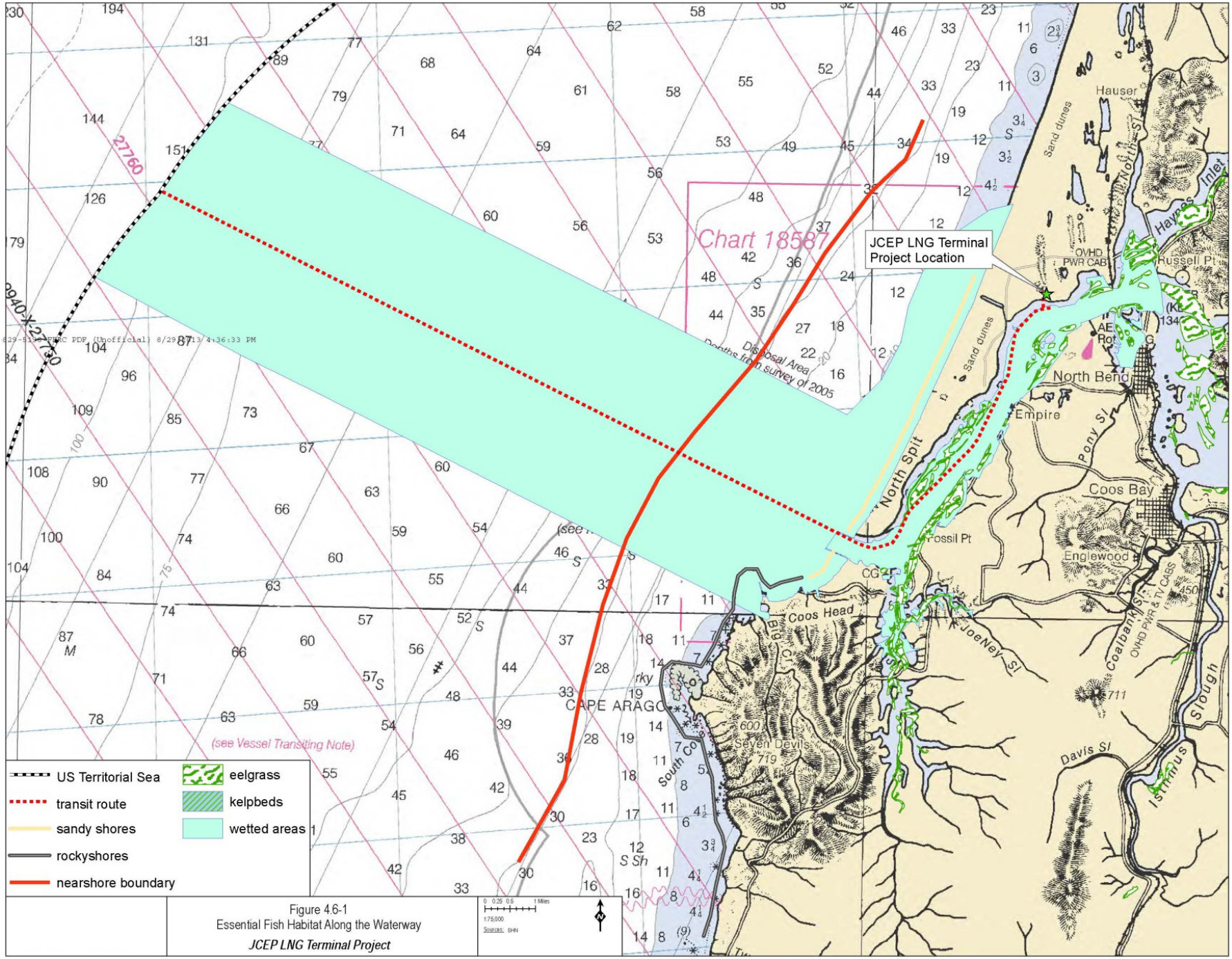


Figure 4.6-1
Essential Fish Habitat Along the Waterway
JCEP LNG Terminal Project

Coastal Pelagic Species EFH

The EFH for coastal pelagic species is defined by the species' temperature and geographic range during all life stages in the past, present, and where they could occur in the future. In addition to all marine and estuarine waters off the Pacific Coast to the limits of the EEZ, EFH for coastal pelagic species also includes portions of the water column where sea surface temperatures range between 50°F (near the U.S./Mexico maritime boundary) and 79°F (seasonally and annually variable) (PFMC 2006). The coastal pelagic species fishery management plans includes five species: Northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel, and market squid. Of these, two species (market squid and Pacific sardine) are known to occur in estuaries (PFMC 1998). The others would be found in the marine waters off the Oregon Coast along the shipping route. The EFH of coastal pelagic species is listed and effects assessed in the EFH assessment as part of our BA (FERC 2015).

Pacific Coast Salmon EFH

For the Pacific salmon fishery, the PFMC identified EFH using USGS hydrologic units as well as habitat association tables and life history descriptions for each life stage (PFMC 1999, Appendix A, Amendment 14 to the Pacific Coast Salmon Plan). These areas encompass all streams, lakes, ponds, wetlands, and other currently viable waterbodies and most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California. In estuarine and marine areas, EFH for Pacific salmon extends from the nearshore and tidal submerged environments within state waters out to the full extent of the EEZ (200 nautical miles). Three species are included in the PFMC management plan: coho, Chinook, and pink salmon. The EFH of salmon is listed and effects assessed in the EFH assessment as part of our BA (FERC 2015).

Highly Migratory Species EFH

Highly migratory fish EFH may exist along the outer portion of the transit route for LNG marine traffic. This EFH is found in temperate waters within the Pacific Council's region. Variations in the distribution and abundance of these species are affected by ever-changing oceanic environmental conditions including water temperature, current patterns and the availability of food. Sea surface temperatures and habitat boundaries vary seasonally and from year to year, with some of the species are much more abundant from northern California to Washington waters during the summer and warm waters years than during winter and cold water years, due to increased habitat availability within the EEZ. The species include five species of shark, tuna, striped marlin, swordfish, and dolphinfish. Based on the EFH habitat defined for these species, few if any, of these species are off the Coos Bay at coastal depths less than 100 fathoms (100 fathoms is the approximate edge of the shipping route defined area in Oregon coastal waters to 3 miles offshore). However, in waters farther offshore some habitat is available for some of these species and life stages out to the 200-mile EEZ. Overall, little EFH for these managed species would be present along the shipping route to the EEZ near Coos Bay. However, depending on the shipping route traveled, additional EFH of the highly migratory species may occur in southern west coast waters where more of these species' habitat may be present. The EFH of highly migratory species is listed and effects assessed in the EFH assessment as part of our BA (FERC 2015).

Project Area Specific EFH Species Characteristics

Within Coos Bay, a subset of these managed species are present including 2 salmon (Chinook and coho salmon), 3 pelagic (northern anchovy, Pacific sardine, and Pacific mackerel), and 29 groundfish species may be in or near Coos Bay, based on typical habitat use of these species. The general life history and expected habitat use within and near the project area are shown in our BA and EFH assessment (tables 5.1.1-1, 5.2.1-1, and 5.3.1-1; FERC 2015).

Based on sampling (e.g., ODFW data from 1996 to 2000), 13 groundfish, 2 salmon, and 1 pelagic species would be considered common. The information below provides details on most of these fish species use within the Bay, relative to the Project site.

Managed groundfish and coastal pelagic species are not estuarine resident species and therefore utilize Coos Bay on a seasonal basis, primarily in summer months. During the summer, the estuary may be utilized as a forage area for juveniles and adults and as a nursery area for larvae and juveniles. Starry flounder spawn near river mouths and sloughs. Juvenile starry flounder are found exclusively in estuaries. Sampling in upper Coos Bay from 1979 to 1990 showed that young-of-the-year flounder are present at least in the spring and summer months (Wagoner et al. 1990). Flounder and sole are found in sandy or muddy substrate and juveniles are found in shallow water near rivers and in estuaries in eelgrass beds. Adults generally are found in deeper waters in the winter and migrate to shallower water in the spring. English sole juveniles depend heavily on inter-tidal areas, estuaries, and shallow nearshore waters for food and shelter.

Adult Chinook and coho salmon may utilize habitat in the transit route in Coos Bay for migration and offshore for migration and feeding. Adults would return to the rivers in late summer and fall. Juveniles and smolts may use the transit route in Coos Bay for resting and foraging during emigration in the spring and summer, and offshore for migration and feeding. ODFW (2005) has captured coho and Chinook salmon, starry flounder, northern anchovy, and sand sole in the Jordan Cove area adjacent to the Project site.

The black rockfish is the only member of the rockfish family that is consistently caught in Coos Bay (Wagoner et al. 1990). The copper, blue, grass, canary rockfishes, and bocaccio are occasionally caught. The rockfishes are in the lower areas of Coos Bay, mainly during the late spring and summer months (Wagoner et al. 1990). Black rockfish are not known to spawn in estuaries. Rockfish recruit to seagrass beds in shallow, soft bottom embayments (Love et al. 1991). Johnson et al. (2003) reported that juveniles of many commercially important species utilize eelgrass habitat in Southeastern Alaska. Rockfish juveniles settle into shallow, vegetated habitats for rearing. Vegetated habitats (eelgrass and kelp) provide refuge from predators and access to prey. Juvenile rockfish may also be closely associated with seagrass drift for both feeding and refugia while they move between pelagic and near shore habitat (Nightingale and Simenstad 2001a). Rockfish have not been seined by ODFW in or near the immediate Project slip area, indicating that this area is not likely utilized by rockfish.

Black rockfish and cabazon were the most abundant juvenile rockfish species captured within Coos Bay (near the entrance) between June 2003 and December 2005 (Schlosser and Bloeser 2006). Trap sites were located in eelgrass beds, along dock pilings and in sandy bottom habitat near the entrance to Coos Bay. Juvenile chilipepper, copper, grass, yellowtail, and kelp greenling were also captured near the entrance.

Lingcod begin life in near-surface marine waters and estuarine areas. Juvenile lingcod primarily use estuaries, entering to feed, while adults are usually found in marine waters of 100 to 150 meters deep. Lingcod lay eggs in rocky, marine subtidal areas. Larvae are found in the near-surface marine waters and estuarine areas. In this life stage, lingcod feed primarily on copepods, eggs, and other crustaceans. As it matures, lingcod are commonly found in shallow, inter-tidal areas of bays near algae and seagrass beds.

Phillips (1984) described northern anchovy to be transient users of eelgrass. Eelgrass provides indirect benefits to these species as well through contributions to productivity in the estuary, and eelgrass drift may provide cover for coastal pelagic species (Nightengale and Simenstad 2001).

Other species managed by the PFMC that occur in Coos Bay include sand sole and big skate. Sand sole require a sand-mud-eelgrass type of habitat; however, they have not been captured in or near the project area. Big skate occur nearshore and occasionally in the bay (Wagoner et al. 1990).

In offshore waters, along the shipping route out to the 200-mile EEZ, additional species and life stages of groundfish, coastal pelagic species, Pacific Coast salmon and highly migratory species would be present. The details of the species and life stages and likelihood of being present within the EEZ analysis area are presented in our BA (FERC 2015).

Food Web Importance to EFH

Prey species that are important for local EFH fish species rely on many of the same habitat conditions as the EFH fish species. The food web components including phytoplankton, zooplankton, detritus, epiphyton, and submerged aquatic vegetation (e.g., eelgrass, macrophytic algae, referred to as submerged aquatic vegetation [SAV]) are all important in supplying the habitat and food base for EFH species within Coos Bay. For example, submerged grasses or SAV are important habitat for small prey species of adult lingcod (in Appendix B-2 of PFMC 2008). Forage items that are habitat components for the managed species do depend to some extent on estuarine systems. Many species of groundfish and salmonids occupy inshore areas of the lower bay during juvenile stages (e.g., Chinook salmon, coho salmon, English sole) where they feed on estuarine-dependent prey, including shrimp, small fishes, and crabs. As they mature and move offshore, their diets in many cases change to include fish, although estuarine-dependent species (e.g., shrimp, crabs) can still constitute an important dietary component.

A variety of habitats of importance occurs along the transit route for LNG marine traffic. They include fresh, estuarine, and marine waters. Within Coos Bay are estuarine environments with freshwater streams and slough. The habitat in the marine environment includes shallow sandy shorelines, and nearshore and offshore rocky environments. Also up and down the coast are rocky reefs and kelp forest regions but pelagic and deep ocean waters with soft bottoms habitats are most common directly along the route outside of the bay (ODFW 2005). The fish and other aquatic organisms along this route are highly diverse and abundant containing very important EFH habitat for many species.

Impacts on EFH Along the Waterway for LNG Vessel Transit and Measures to be Implemented to Avoid or Reduce Effects on Aquatic Resources

A summary of potential impacts to EFH is shown in table 4.6.2.1-1. The details of the effects on EFH and aquatic species that occupy that habitat from ship grounding, propeller wash, wake waves, fish strandings, introduction of non-native species, and cargo, fuel, and oil spills related to LNG vessel transit in the waterway, as well as measures that would be implemented to minimize these impacts, are discussed above.

TABLE 4.6.2.1-1

Potential Impacts to EFH due to LNG Vessel Traffic Along the Transit Route

EFH	Description of EFH a/	Project Actions and Potential Impacts	Determination of Effects
Groundfish	All waters from the extent of the high tide line (and parts of estuaries) to offshore to the 3,500 meter (1,914 fathom) depth.	Accidental spills of hazardous substances, entrainment	Minimal adverse effects or less than substantial effects to multiple groundfish species EFH (see section 4.6.2.2 for impacts and mitigation)
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50°F and 79°F.	Accidental spills of hazardous substances, entrainment	Minimal adverse effects or less than substantial effects to coastal pelagic species (northern anchovy, Pacific sardine) EFH (see section 4.6.2.2 for impacts and mitigation)
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon. Estuaries and marine areas extending to the EEZ and beyond.	Accidental spills of hazardous substances, entrainment	Minimal adverse effects or less than substantial effects to Pacific coastal salmon species (coho and Chinook salmon) EFH (see section 4.6.2.2 for impacts and mitigation)
Highly Migratory Species	EFH is defined by temperature ranges, salinity, oxygen levels, currents, shelf edges, and sea mounts. Based on species characteristics closest EFH would be beyond the 40-fathom depth off of Coos Bay. b/	Accidental spills of hazardous substances	Minimal adverse effects or less than substantial effects to highly migratory species EFH (see section 4.6.2.2 for impacts and mitigation)

a/ PFMC (2006; fact sheet, update version, July 24, 2006)
b/ PFMC (2007)

4.6.2.2 Jordan Cove LNG Terminal

Jordan Cove's LNG terminal and related facilities would be located on the bay side of the North Spit, along the shoreline from Henderson Marsh north to geographic Jordan Cove. The access channel would be located on the north side of the existing Coos Bay navigation channel, beginning at the confluence between the Jarvis Turn and the Upper Jarvis Range at about NCM 7.3. The site is near the transition zone between fresh and marine waters in the bay.

Coos Bay contains a variety of habitat for anadromous, marine, and estuarine fish species. A large diverse invertebrate population exists in Coos Bay. Shellfish (predominantly clams, crabs, and shrimp) are of significant economic importance to the Coos Bay area. Of marine mammals in Coos Bay, only the harbor seal has been observed during field surveys at the proposed location of the Jordan Cove access channel. No turtles have been observed or would be expected in the bay. Fish, shellfish, and marine mammals that may occupy Coos Bay are more fully discussed in the section 4.6.2.1.

Juvenile and larval life stages of vertebrate and invertebrate marine organisms are varied in the bay and near the terminal site. Over 35 species of icthyoplankton have been documented in Coos Bay (Miller and Shanks 2005). There are some seasonal trends, with highest occurrence October through May, but fewer differences by month in the upper bay than near the ocean. The only terminal facility in Coos Bay would be the access channel. Shanks et al. (2010, 2011) sampled zooplankton and icthyoplankton in Coos Bay near the Jordan Cove terminal. The data were collected on incoming and outgoing tides, and included monthly and quarterly sampling over a 24-hour period. The sampling was intended to determine seasonal, tidal, and daily changes in abundance of zooplankton including larval fish, shellfish, potential salmonid prey organisms, and other miscellaneous zooplankton that may occur in the project area. A variety of zooplankton were found to be present within the bay (see table 4.6.2.2-1). Among the potential salmonid forage items, copepod adults, lavaceans, harpacticoid copepods, and Daphnia had the highest peak abundance. Overall, larval fish abundance was generally low, with those that spawn primarily in or near estuaries common (surf smelt, sand lance, and staghorn sculpins). At times, other larval or juvenile fish were relatively abundant including English sole, buffalo sculpin, anchovy, and pipefish. A total of nine fish species were captured. Primary fish species spawn in winter and early spring, and larval fish were most abundant in winter samples (Shanks et al. 2011). Over 12 taxa of crab and shrimp larvae were also collected, including some recreational and commercially important crab and shrimp species, such as Dungeness crab and ghost shrimp larvae.

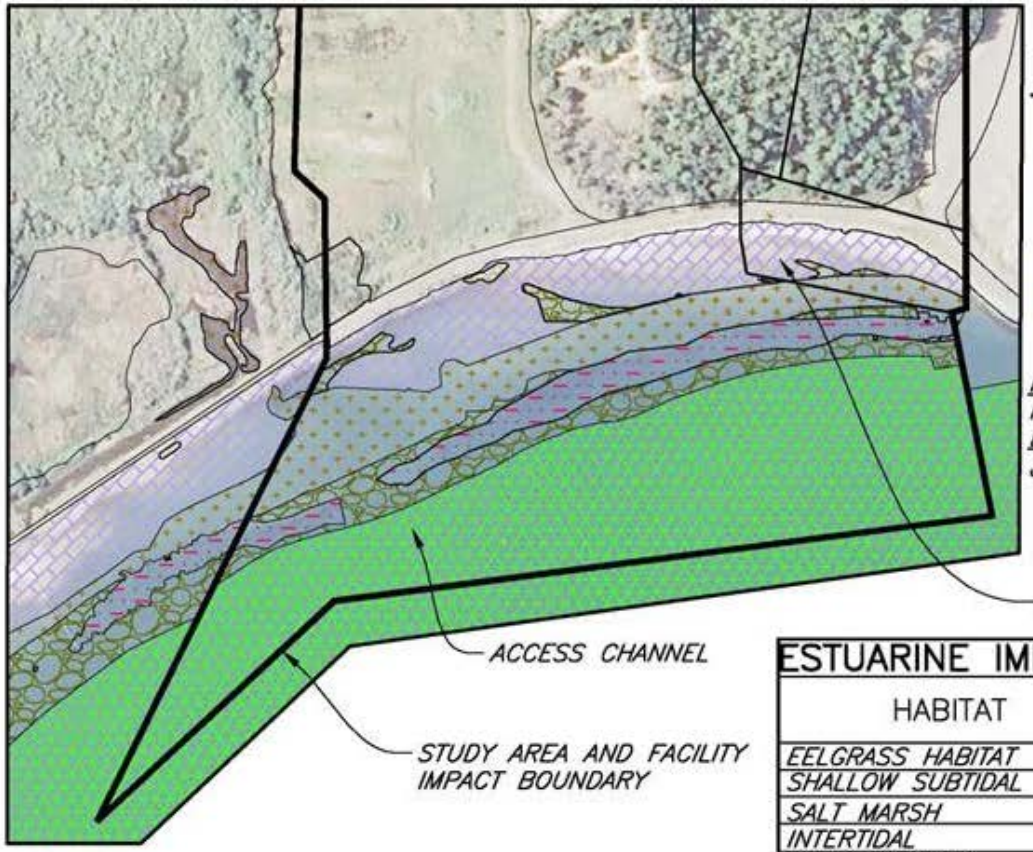
TABLE 4.6.2.2-1

Taxa Groups Collected in Coos Bay Near the Proposed Jordan Cove Terminal During 2009–2011

Categories	Specific Taxa
Fish larvae/juvenile	Surf smelt, sand lance, staghorn sculpin, buffalo sculpin, anchovy, pipefish, English sole, gunnel, pricklefish
Crab/Shrimp larvae	Porcelain crabs, pea crabs, green crab (invasive), xanthid crabs, majid crabs, cancer crabs (e.g., Dungeness, rock crab), Lithodidae, Hippidae, Pagurid (hermit crabs), Callinassa (ghost shrimp), Sergestid shrimp, Pachygrapus crassipes (striped shore crab)
Gastropod and Bivalves larvae	Mytilus (mussels), Clinocardium (cockles), Bivalve juveniles, Gastropod juveniles
Larval Invertebrates	Barnacle nauplii and cyprids, Mytilus larvae, bivalve larvae
Cnidaria/ctenophore	Sea anemone, Hydroids, sea goose berry
Polychaete Worm Larvae	Marine worms
Salmonid Food Prey	Mysids, Amphipods, Isopods, Cumaceans, Copepod adults, Harpacticoid copepods, Calanoid copepods, Daphnia, Larvaceans, larval fish

Source: Shanks et al. (2010, 2011)

The access channel and barge berth facility for Jordan Cove's terminal would cover about 30 acres below the MHHW. This would include less than 1 acre of salt marsh, about 10 acres of intertidal area of unvegetated sand plus algae/mud/sand habitat, about 3 acres of shallow subtidal, about 15 acres of deep subtidal and SAV, and about 3 acres of eelgrass (Evans 2014). The habitat areas affected by the access channel are illustrated on figure 4.6-2 and listed in table 4.6.2.2-2.



EXPLANATION

- INTERTIDAL UNVEGETATED SAND
- ALGAE/MUD/SAND
- EELGRASS
- SHALLOW SUBTIDAL
- DEEP SUBTIDAL

IMAGE SOURCE: 2011 NATIONAL AGRICULTURAL IMAGERY PROGRAM
DATA SOURCE: DAVID EVANS AND ASSOCIATES, INC JCEP ODFW HABITAT (08/2013)

ESTUARINE IMPACT ACREAGE AT LNG TERMINAL

HABITAT	SLIP/ACCESS CHANNEL	BARGE BERTH
EELGRASS HABITAT	2.50	–
SHALLOW SUBTIDAL	3.30	0.07
SALT MARSH	0.06	–
INTERTIDAL	8.08	1.43
DEEP SUBTIDAL	15.40	–

1. INTERTIDAL=INTERTIDAL UNVEGETATED SAND + ALGAE/MUD/SAND
2. BARGE BERTH WAS PREVIOUSLY REFERRED TO AS CONSTRUCTION DOCK

NOTE:

THIS FIGURE HAS BEEN REVISED BASED ON THE 2013 JCEP LNG TERMINAL DESIGN AND HABITAT MAPPING OF THE SUBMERGED AQUATIC VEGETATION (SAV) AND ASSOCIATED ESTUARINE HABITAT IN THE SLIP AND ACCESS CHANNEL.

N

1"=400'

0 400

Figure 4.6-2
Submerged Aquatic Vegetation within the Slip and Navigation Channel

TABLE 4.6.2.2-2

Estuarine Habitat Affected from Construction of Jordan Cove LNG Facilities

	Acres Affected					
Habitat Type	**Slip and Access Channel**	**Barge Berth**	**Gas Processing Facility/Shared**	**North Point Bridge**	**North Point Workforce Housing**	**Trans-Pacific Parkway/Hwy 101 b/**
Eelgrass Habitat	3	0	0	0	0	0
Shallow Subtidal	3	<1	0	0	0	0
Salt Marsh	<1	0	<1	<1 a/	a/	0
Intertidal	8	2	<1	0	0	<1
Deep Subtidal	15	0	0	0	0	0
Total	**29**	**2**	**<1**	**<1**	**0**	**<1** b/

Note: Columns/rows may not sum correctly due to rounding. Acres are rounded to nearest whole acre. Acreages less than 1 acre are shown as "<1".
a/ Shared locations, bridge is located in workforce area
b/ Not shown: two marine wetland areas (J and M) near the LNG site with <1 acre of impact.
Source: Jordan Cove response to data request September 17, 2013 and Evans (2014)

Submerged grasses are one of the important major habitat components in Coos Bay. Recreationally and commercially harvested species such as clams and shrimps, Dungeness crab, English sole, and salmonids use the eelgrass beds extensively. Previous studies (Akins and Jefferson 1973) have reported that Coos Bay has 1,400 acres of lower intertidal and shallow subtidal flats covered by eelgrass meadows. ODFW (1979) conducted habitat mapping in Coos Bay and documented intertidal and subtidal aquatic beds. Submerged grass meadows provide cover and food for a large number of organisms including burrowing, bottom-dwelling invertebrates; diatoms and algae; herring that deposit eggs clusters on leaves; tiny crustaceans and fish that hide and feed among the blades; and, larger fish, crabs and wading birds that forage in the meadows at various tides. Eelgrass provides shelter for a variety of fish and may lower predation, allowing more opportunity for foraging. The protective structure attribute of eelgrass is primarily for smaller organisms and juvenile life history stages of fishes.

The maintenance dredging disposal Site F, located just north (about 300 feet) of the North Jetty at the mouth of Coos Bay, within 2,000 feet of and extending out about 3 miles from the shore (figure 2.1-11), has many of the same anadromous and marine species found in Coos Bay and discussed in section 4.6.2.1. Trawl sampling in the site has identified 28 species including herring, anchovy, sculpin, flatfish, rockfish, greenling, skate, and others (Hinton and Emmett 1994). A flatfish, speckled sanddab, was the most abundant. Chinook and coho salmon migrate through and may feed in this area, both as juveniles and adults. Shellfish were not common here, but include some Dungeness and red rock crab and *Cragon* shrimp and smooth bay shrimp.

Project activities associated with the LNG terminal that could potentially impact aquatic resources include in-water construction activities, habitat modification, water appropriations, artificial lighting, and accidental spills of hazardous materials. Measures that would be implemented by Jordan Cove to avoid or reduce impacts on aquatic resources are discussed below.

Construction of Jordan Cove's LNG Terminal Facilities and Potential Impacts on Aquatic Resources

The Jordan Cove LNG terminal would include an access channel and marine slip. The entire access channel would be located within Coos Bay, while the majority of the marine slip would

be excavated or dredged from an existing upland on the North Spit. Many of the construction supplies for the facility would be provided through transport by marine barge and break bulk ships.

Dredging Activities

About 1.3 mcy would be removed by marine dredging during creation of the access channel in the bay. The creation of the access channel would result in the modification of about 31 acres of present-day subtidal and intertidal habitat to deeper water habitat in the bay. The dredging operation to create the access channel would change physical conditions of the bay bottom in this area, locally altering the bathymetry and potentially altering the morphology and water currents. About 16 acres of intertidal to shallow subtidal habitat, including approximately 3 acres of SAV eelgrass habitat and less than 1 acre of salt marsh, would be modified to primarily deep subtidal habitat during the dredging process of the deepened channel. Increasing depth and removal of vegetation would reduce the quality of habitat for juvenile salmonids and other juvenile marine species.

The construction of the access channel would impact local aquatic resources by removal or conversion of some habitats. There would also be short-term turbidity from dredging in the bay, and additional erosion of the shoreline during construction activities could result in sedimentation. To control upland soil erosion and potential sedimentation, Jordan Cove would follow the measures outlined in its ESCP; for marine waters, measures in the *Excavated and Dredged Material Management Plan* (Moffatt and Nichol 2013) would be followed.

There is also the potential for an accidental oil or fuel leak from dredging equipment to affect aquatic resources in the bay. To avoid or reduce impacts from oil or fuel leaks, Jordan Cove developed a preliminary draft SPCCP.[94]

About 37 acres of current upland habitat excavated and dredged to create the marine slip would be converted to open water, primarily deep subtidal habitat. While this area would have little intertidal habitat due to steep banks, it would supply some subtidal habitat that would not have been present without the Project. This habitat, however, would be highly disturbed due to large vessel arrivals and departures, and would generally be of low quality habitat for most species.

Jordan Cove has identified two specific sites in Coos Bay that would be set aside and/or developed as compensatory mitigation[95] for loss of tidal and subtidal habitat from dredging. The loss of 3 acres of eelgrass would be mitigated by development and planting of about 8 acres of off-site new eelgrass habitat in bay south of the west end of the Southern Oregon Regional Airport runway. The area proposed has been used successfully for eelgrass mitigation in the past. The details of the plan, measures of success, and contingencies are provided in the *Compensatory Wetland Mitigation Plan, Part B: Estuarine Impacts*.[96] This plan is similar to that approved by the ODSL under permit #37712-RF.

[94] This plan was attached as appendix K.2 to Resource Report 2 of Jordan Cove's application to the FERC filed in May 2013.
[95] Jordan Cove included in its application to the FERC the *Oregon Gateway Marine Terminal Draft Estuarine Resource Mitigation Plan*, attached as Appendix B.3 of environmental Resource Report 3.
[96] See *Jordan Cove Energy Project Compensatory Wetland Mitigation Plan* (Federal Permitting) filed with the FERC in April 2015, as part of supplemental information for their 404/10 permit application.

The impact on the other estuarine habitats (non-eelgrass) would be mitigated with reestablishment of tidal flow on about 47 acres of unvegetated mudflats in Kentuck Slough, just less than three times the affected acreage, at the site of a former golf course. Kentuck Slough is located on the east shore adjacent to the main inner bay between the project area and Coos River mouth. This area is close to the main Coos Bay river channel, which would benefit early marine-rearing juvenile salmonids. However, some details have changed and final acceptance of the adequacy of the plan to replace lost habitat by ODSL or other resource agencies is pending. Therefore, we have recommended that Jordan Cove continue to consult with the COE, NMFS, ODSL, and ODFW and other appropriate resource agencies to develop a final wetland mitigation plan for permanent impacts on eelgrass and other estuarine habitats (see section 4.4).

Following mitigation efforts, Jordan Cove would monitor the sites to ensure that all criteria for successful mitigation (e.g., acreage amount, condition of vegetation, function) have been met. Monitoring would occur for at least five years and up to eight years for the eelgrass site and five years for the intertidal sites, unless different periods are specified by agencies. Should eelgrass sites not be successful, the condition(s) causing lack of success would be evaluated. If failure resulted from errors in planting, the sites would be replanted. If there were other problems and the site was not viable, discussion would occur between Jordan Cove and the agencies to determine alternative mitigation strategies. For the intertidal flat, if the mitigation site does not meet performance standards, including the identification of potential concerns for the surrounding infrastructures, the potential causes of the deficiencies or concerns would be evaluated and solutions offered to the agencies. Considering the mitigation measures proposed, and the implementation of mitigation plans, construction and operation of the LNG terminal would have only short-term impacts on marine aquatic resources in Coos Bay.

The major impacts on marine and estuarine organisms would result from increased turbidity and sediment during dredging operations. A large quantity of suspended sediment can reduce light penetration, which in turn reduces primary production of both pelagic and benthic algae and grasses. Increased suspended sediment can affect feeding of benthic and pelagic filter feeding organisms (Brehmer 1965; Parr et al. 1998), and the settling of the suspended particles can cause local burial, affect egg attachment, and modify benthic substrate. High enough levels can have direct adverse effects to fish ranging from avoidance to direct mortality. Use of pumps to convey the material from the cutter heads in a hydraulic dredging operation would serve to contain most of the siltation caused by the dredging. The siltation would be conveyed with the material removed to the disposal area where it would settle out before being discharged back to the waterbody. The suspended sediment and turbidity levels would decline to ambient levels following completion of dredging activities. Jordan Cove included with its application to the FERC a study produced by Moffatt and Nichol entitled *Report on Turbidity Due to Dredging*.[97]

Dredging of the access channel would result in temporary siltation and sedimentation impacts similar to those that currently occur during COE maintenance dredging of the Coos Bay navigation channel. On average, the COE removes approximately 550,000 cy from the bar, 200,000 cy from NCM 2 to 12 and 150,000 cy from NCM 12 to 15 each year.

The ambient turbidity levels in the water (generated by flows, waves and ship traffic) create a background level of turbidity. Within Coos Bay, turbidity measurements taken at the Charleston

[97] This report was filed as Appendix F.2 of Resource Report 2.

Bridge over a two-year period show an average summer turbidity level of 10 mg/l and an average winter level of 27.3 mg/l. Some individual events (e.g., winter storms) measured at the Charleston Bridge were recorded between 100 and 500 mg/l. Aquatic organisms in Coos Bay are adapted to and exposed to periods of high to moderate turbidity during the winter months. Dredge operations are expected to result in similar effects, with higher concentrations of TSS in the immediate area of dredging.

Within the access channel, dredging would be conducted using a hydraulic (suction) dredge with a cutterhead or mechanical (clamshell) dredge. While the hydraulic dredge is preferred, the mechanical dredge may be needed in portions of the nearshore area due to buried woody debris. Cutterhead dredges use a rotating cutter to loosen soil particles, while mechanical dredges have closing scoop bucket to remove sediment. A model commissioned by Jordan Cove (Moffatt and Nichol 2006a) provides a range of turbidity from dredging activities by dredge type with consideration of likely velocity of the tidal current. The highest resultant turbidity for a hydraulic dredge was modeled to be approximately 500 mg/l at the cutterhead with a current velocity of 0.2 meters/second with maximum spread of turbidity decreasing to approximately 14 mg/l at 200 feet from the cutterhead under high water velocity (1.0 meters/second). For a mechanical dredge, the maximum concentration would be 6,000 mg/1 at the dredge site, decreasing to 50 mg/l within 660 feet under high water velocity (1.0 meter/second). Maximum spread of elevated sediment from the actual dredge location only occur during brief periods (less than two hours) of elevated tidal velocity. For both dredge types at lower tidal velocities, turbidity values would be at or below average seasonal background levels within 660 feet or less. Other than at the actual dredge location, average daily (24-hour) turbidity levels would not exceed background levels of 10 to 30 mg/l for the mechanical dredge and would be even less for the hydraulic dredge.

During the dredging process, some small fish, larvae, and fish eggs could be entrained. Larger fish would be able to avoid this process and would likely actively avoid the area during the dredging disturbance process. In a review of many maintenance dredge studies through 1998, Reine et al. (1998) concluded that "much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging." Based on this review, it appears that entrainment of marine fish and shellfish species would not be a substantial impact to the local marine resources. Impacts would be minimized by the current in-water work windows (October 1 to February 15) and by maintaining the cutterhead near the bottom if a hydraulic dredge is used.

If salmonids are exposed to moderate to high levels of turbidity (suspended sediment) for prolonged periods, a number of adverse effects could occur including behavioral changes, sub-lethal effects, and increased mortality from predators. Dredging is expected to create spikes of high to moderate turbidity in a localized area. Effects to salmonids are expected to be slight and not measurable due to the limited area affected and the short duration of dredging operations, and limitations on construction periods. Rearing and migrating salmonids including ESA listed salmon, which should be uncommon in Coos Bay during the in-water work window, would likely avoid active work areas.

In Coos Bay, suspended sediment from dredging activity could affect shellfish, including clams and other filter feeders within the immediate vicinity and downstream of the access channel. The major commercial oyster-growing areas in the bay are upstream of the access channel.

Therefore, dredging conducted by Jordan Cove should not adversely affect those commercial oyster beds.

Jordan Cove's dredging would also directly remove benthic organisms (e.g., worms, clams, benthic shrimp, starfish, and vegetation) from the bay bottom within the access channel. Mobile organisms such as crabs, many shrimp, and fish could move away from the region during the process, although some could be entrained during dredging so that direct mortally or injury could occur. Based on 1978 maps of shellfish (Gaumer et al. 1978), shrimp, soft shell calms, bentnose clams, and cockles are located within the intertidal areas near the slip and within dredge areas (west of the Roseburg Forest Products Company site). ODFW captured Dungeness crab and red rock crab in this area during 2005 seining efforts. Varied species could be injured or killed during dredging operations. Dungeness crabs and sand shrimp (*Crangon* spp.) can be especially susceptible to entrainment, although many survive dredging (Reine et al. 1998). Reine et al. (1998) reviewed dredging studies and concluded that "much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging." Dredge entrainment studies over a four-year period in the Columbia River found no juvenile or adult salmonids entrained during dredging, although some other pelagic fish were entrained (Larson and Moehl 1990).

It is reported that benthic communities on mud substrates in Coos Bay, when disturbed by dredging, recovered to pre-dredging conditions in 4 weeks (McCauley et al. 1977). However, recovery in estuarine channel muds has been reported in a review paper of dredging to be typically six to eight months (Newell et al. 1998). In the lower Columbia River, McCabe et al. (1997, 1998) noted benthic organism recovery in three months. Because of the large quantity being dredged, it may take a longer than four-week period relative to typical dredging and thus the benthic communities in the areas to be dredged may take a more varied length of time to recover. In addition, because the shallow area would be converted to deeper water habitat than what is currently there, some long-term reduction in benthic production would occur. Some of this net loss would be offset by added annual benthic production from the newly formed 37-acre slip habitat, even though it would likely be of poor quality. We would also expect increased organic matter production to the Coos Bay system from Jordan Cove's proposed eelgrass and wetland mitigation sites, which would be provided at 3:1 habitat replacement for shallow water and intertidal habitat removed by slip dredging and development.

Additionally, high oxygen demand sediment could be encountered during dredging. This could remove oxygen from the local water areas, putting local organisms at risk from insufficient oxygen. This effect would be temporary, and tidal exchange would be expected to replenish oxygen. In most cases, where dredging and disposal occurs in open coastal waters, estuaries, and bays, localized removal of oxygen has little, if any, effect on aquatic organisms (Bray et al. 1997). Also, Nightingale and Simenstad (2001b) reviewed literature in a summary document on effects of dredging and could find no empirical data indicating reduction in oxygen was an issue of concern for estuarine and marine organisms for dredging actions.

Dredging may also resuspend nutrients to the water column and could affect primary production. At low levels, this could be of benefit, increasing phytoplankton production, which could benefit prey species eaten by fish. However, in estuaries, this production is limited by turbidity and flushing, so any effects would be slight and local.

Maintenance dredging, which would occur every three to five years, would keep the navigation channel depth as it is currently and the LNG slip depth as originally developed. Thus, the current habitat structure of the navigation channel would remain unchanged and slip area would be as originally developed following each maintenance dredging cycle.

Construction windows for in-water dredging, developed by the state, are intended to reduce the likelihood of salmonid presence during their critical life stages in the region where effects may be greatest. The in-water work window (October 1 through February 15) would minimize the exposure of juvenile salmonids to increased turbidity during outmigration but would occur during much of the adult salmonids' upstream migration. Resident estuarine species, however, would be present during the in-water work window.

New Deepwater Habitat

The construction of the slip and berth would add a new region of deeper water habitat in Coos Bay. The area would have steep riprap sides which would likely have reduced biological diversity in shoreline habitat. The deeper areas may have slightly different fish composition than the main bay but overall the change in depth would be slight relative to the main adjacent navigation channel. Based on COE surveys, the navigation channel adjacent to the proposed site is -44 feet deep, with proposed slip depth -45 feet similar to the local deep bay areas, although to the side of the channel. While future composition of the channel species cannot be predicted, it appears conditions are not substantially different than the adjacent navigation channel area. This may, however, result in some species composition differences locally. It will remain a relatively disturbed area for organisms, with the frequency of LNG vessel traffic likely reducing its overall benefit to fish and invertebrate resources. However, the final use of this new environment and changes in use from the existing conditions cannot be completely estimated at this time and conditions may take time to fully develop. Aquatic resources, such as fish, shellfish, and marine mammals that may use Coos Bay, are under the management of ODFW and NMFS. In its response to the FERC staff's BA and EFH Assessment (see section 4.7 of this EIS), the NMFS can impose conditions through its BO to protect aquatic resources in the new deepwater habitat created by the Jordan Cove terminal slip.

Pile Driving

Jordan Cove would install 112 steel piles for the LNG vessel berth and loading platform on the east side of the marine slip. These piles would all be driven land-side adjacent to the berth. Ninety-eight steel piles would be driven to support the tugboat dock on the north side of the slip. These piles would be installed while the upland portions of the marine berth are still isolated from the bay by the berm. Pile driving and other terminal construction-related noise could cause adverse effect to fish in the area of the activity. However, no in-water pile driving would occur, eliminating potential adverse effects on aquatic resources from underwater noise waves. All new pilings will be fitted with devices to prevent perching of piscivorous birds, as a measure to avoid impacts to fish species such as fall Chinook salmon, coho salmon, and steelhead juveniles.

Noise in air produced by pile driving was modeled by Jordan Cove and it was found that the noise contour for sound levels greater than 65 dB extended less than 0.25 mile from pile driving operations. It can be assumed that the distance to noise greater than 100 dB root mean squared (RMS) - the in-air disturbance threshold for pinnipeds - would be much less than that, although it was not modeled by Jordan Cove. Laughlin (2007) found that the maximum noise in air 300 feet

from a 36-inch hollow concrete pile was 98.3 dBA while the noise 300 feet from a 36-inch-diameter steel pile as 96.7 dBA. Therefore, it is unlikely that sound levels of 100 dB RMS or greater in air would be experienced within 300 feet of the piles at the LNG terminal site.

Jordan Cove would consult with NMFS to design a monitoring and adaptive management plan including the development of a pinniped safety zone. Should exceedances of the NMFS noise criteria be measured during pile driving, pile driving would cease and additional mitigation measures would be implemented. These measures could include the use of a different type of pile cap or hammer cushion, re-design of the bubble curtain, or other measures identified through consultation with NMFS. Following completion of the pile driving, Jordan Cove would provide a written report on hydroacoustic monitoring to NMFS. While these are the designated plans, Jordan Cove would need to obtain concurrence from NMFS on the adequacy of the plans and provide these to FERC. Therefore, **we recommend that:**

- **<u>Prior to construction,</u> Jordan Cove should file with the Secretary, for review and approval by the Director of OEP, a *Monitoring and Adaptive Management Plan* to ensure compliance during construction with NMFS underwater noise criteria for the protection of pinnipeds, and documentation that the plan was formulated in consultation with the NMFS.**

<u>Erosion and Runoff from Upland Facilities</u>

Impacts on marine resources could occur from the clearing of vegetation at the terminal, erosion and sediment runoff, and potential hazardous substance spills during construction. While no streams are present in the upland portion of the terminal, the removal of current vegetation could modify the character and amount of water runoff into the bay.

Nearshore vegetation clearing could indirectly affect aquatic resources in the bay; however, the amount of nearshore vegetation that would be removed for this Project is small. Other than an existing disturbed shoreline near the South Dunes Power Plant area that would be used as a temporary laydown area, no planned nearshore disturbance would occur outside of the upland and shoreline excavated and dredged to create the marine slip for the terminal. Jordan Cove would prevent uncontrolled releases of sediment runoff during construction by implementing erosion control and revegetation measures from its ESCP.

During construction of the LNG terminal facilities, stormwater runoff could erode disturbed soils, creating sediment in nearby surface waters, and impact local aquatic resources. Stormwater runoff from the disturbed portions of the site would be managed in accordance with Jordan Cove's ESCP. Following appropriate treatment, such as electro-coagulation, chemical flocculation, or filtration, if needed, all construction stormwater from the LNG terminal site would be directed toward the slip.

Additionally, accidental spills of hazardous materials (e.g., equipment fuel, oils, and paints) during construction could have effects on aquatic resources in the bay. Jordan Cove prepared a preliminary draft site-specific SPCCP to minimize the potential for accidental releases of hazardous materials.

Hydrostatic Testing

Approximately 28 million gallons of water would be used for hydrostatic testing of the LNG storage tanks prior to placing them in service. The source of water would be local untreated potable supply from the CBNBWB. After completion of the test, the water would be discharged to the on-site firewater pond. Permits would be obtained for all wastewater discharges as required by ODEQ. Water discharges would be treated, if necessary, to comply with discharge permits. If treatment were required, treatment procedures would be developed prior to discharge. Approximately 5 million gallons of the hydrostatic test water would be retained in the firewater pond, reducing the need for additional water to fill the pond. The remaining water would be discharged through the existing industrial wastewater discharge pipeline, which connects to the previously existing ocean discharge diffuser location at a rate of about 1.8 million gallons per day. Given that the water would be used inside the LNG storage tanks, chemicals would not be added, the water would be tested for quality and treated if necessary prior to discharge, and would enter the ocean through a diffuser allowing rapid dissipation and mixing, the release of hydrostatic test water would not likely affect the ocean aquatic environment.

Construction Supply Vessel Transit

The applicant has estimated that much of the supplies needed for construction of the terminal and related facilities would be transported by break bulk ships and barges. They indicated that over a two-year period about 82 break bulk vessel and 18 barge trips would transport supplies to the proposed barge berth site. These vessels would likely be similar to those used for typical transport of materials that currently occur into Coos Bay. Currently, about 60 deep-draft commercial cargo ships and 50 barges arrive in Coos Bay per year; while the frequency of vessel traffic would increase during the two-year period, effects to marine resources would likely be similar to those that would normally occur from standard commercial vessel traffic. The types of effects would be similar to those described for LNG vessel traffic but likely less due to a reduced number of trips and smaller vessel size. See section 4.6.2.1 for details of analysis of LNG transport effects.

Vessel Strikes

These vessels have the potential to strike aquatic species, including sea turtles, marine mammals, seabirds, and shorebirds during their transit to and from the proposed Jordan Cove barge berth. Like LNG vessels, equipment supply vessels would be required to follow a *Ship-Strike Reduction Plan* and would likely be restricted to a reduced speed within Coos Bay. This would limit overall risk of vessel strikes for these vessels. However, the barge transport would have higher risk of marine mammal strikes than break bulk vessels as they would be paralleling migration routes along the coast area north and south of Coos Bay. Compared to current deep draft and barge transport to Coos Bay, there would be about a 50 percent increased risk of vessel strikes relative to current conditions for those two years of equipment transport. However, due to the small number of trips (about 18 round trips total over a two-year period), we conclude that the increased risk is not significant.

Ship Grounding

A ship grounding would have the potential to impact aquatic resources, as oil and fuel could leak from a grounded vessel. We conclude that it would be highly unlikely that a commercial equipment vessel transiting in the waterway would become grounded. All large commercial

vessels visiting the Jordan Cove barge berth would have to adhere to Coast Guard regulations, including anchoring procedures offshore, in addition to the measures outlined in the WSA, WSR, and LOR. In most cases, a local pilot would be on board to guide vessels through the channel including accompanying tugs. Channel geometry of the navigation channel would also keep the vessel away from the shore.

Shoreline Erosion Waves and Propeller Wash

Shoreline erosion and effect of propeller wash would be slight from the increased number of marine vessel transport. The shoreline sediment transport model for LNG vessels projected an increase by 5 to 8 percent over existing conditions (wind-generated waves plus existing large vessel–generated waves). The effect of the barge vessels would be much less. Wave height generated on the shore from LNG vessels would be less than 0.3 foot compared to normal wind waves up to about 1 foot, with normal transport vessels about the same. The smaller vessel sizes of the barges should reduce the proportional effects of these barges on shoreline waves and erosion, making shoreline erosional effects inconsequential.

Propeller wash from docking vessels may disturb some local benthic organisms with scour based on models for the LNG vessels with a bottom area of likely less than 100 by 50 feet. The effect of the equipment supply vessels again would likely be less because of the smaller vessel size of the transport vessels. In addition, there would likely be no main channel effects due to shallower boat depth maintaining propeller wash well above the channel bottom. While some sessile benthic organisms may be displaced during transport vessel docking, the limited occurrence and magnitude of bottom disturbance and sediment suspension would result in unsubstantial effects on organisms in the slip.

Fish Stranding

Fish stranding from increased shipping is unlikely. Wave height generated on the shore from LNG vessels was estimated to be less than 0.3 foot with normal commercial transport vessels compared to normal wind waves up to about 1 foot. However, commercial vessel traffic may not have the channel speed restrictions that would be in place for LNG vessels. The lower speed has been found to reduce the chance of wave stranding events as was noted in studies on the Columbia River where events were only observed with vessel velocities greater than 8-9 knots, which commercial vessels may exceed in Coos Bay. While the chance of stranding events occurring from transport vessels may be greater than those from LNG vessels due to higher speed, the projected wave height, as noted and assuming effects would be the same as for LNG vessels, is still predicted to be low, likely much less than naturally occurring waves in the bay. While the vessel speed may be higher, the vessels are expected to be smaller; thereby minimizing wave height even at greater speeds. With wave height being low, and occurrence of susceptible fish (primarily young of the year juvenile Chinook salmon in the summer) infrequent, it is unlikely that increased equipment supply vessel traffic in the waterway would substantially contribute to fish stranding during the two years of supply transport.

Fuel Oil Spills

While increased vessel traffic would statisticall increase the risk of fuel oil spills, the overall change is unlikely to be a substantial increase in risk to Coos Bay estuary or marine aquatic organisms from the increased commercial vessel traffic. As noted in fuel oil spills for LNG

transport, the rate of reported oil spills from vessels in the Oregon Coast area is very low, about 9 to 65 per year for the whole area where thousands of vessels travel annually. We conclude that fuel or oil leaks from additional commercial vessels transiting in the waterway to and from the Jordan Cove terminal during the two years of equipment transport are not likely to have adverse effects on aquatic resources.

Introduction of Nuisance Species

Some of the equipment supply vessels will originate in and return to foreign waters potentially increasing the chance of transporting exotic non-native species to coastal Oregon and Coos Bay waters and return ports. Current and future U.S. laws and Coast Guard and EPA regulations and economic considerations by the transport operators (see section 4.6.2.1) would reduce the risk of transport and discharge of nuisance species to local waters from both the hull and ballast water. As well, because equipment supply vessels will be arriving to unload equipment, ballast water would be most likely added from Coos Bay as the vessels unload, not discharged to local waters, further reducing the risk of potentially adding nuisance species. We have assumed that by compliance with these laws and regulations the commercial equipment supply vessels would not likely cause exotic nuisance species to be introduced into Coos Bay, U.S. waters, or the ports of destination of the returning cargo vessels.

Operation of the Jordan Cove Terminal and Potential Impacts on Aquatic Resources

Water Use by LNG Vessels at Berth

Jordan Cove estimates that about 90 LNG vessels would visit its terminal each year. While at the terminal dock for a period of about 17.5 to 24.5 hours, these LNG vessels would release ballast water while taking on LNG cargo. They also would take in water from the marine slip to cool their engines, and would slightly affect the temperature of the water in the slip due to either the release of warm water after engine cooling or contact with the cool hull after taking on LNG cargo. All of these activities could have effects on aquatic resources in the slip.

Ballast Water

LNG vessels would discharge ballast water into the slip after arriving at the terminal berth and taking on cargo. As explained in section 4.4.2.1, Jordan Cove estimated that an LNG vessel taking on cargo at its berth would discharge about 9.2 million gallons of ballast water into the marine slip during the 17.5 hours it would be hotelled at the terminal. Because the ballast water would have been taken on at sea, it might have slightly higher salinity than the water in Coos Bay that is feed from upstream fresh water sources. The tidal cycling of water in Coos Bay would reduce the impact of more saline seawater from ballast release in the slip on local aquatic resources. We estimate the total slip area to cover about 4.8 mcy (3.7 million m^3) of water. Therefore, the ballast water release would only amount to 1 percent of the entire size of the marine slip. By following Coast Guard and EPA procedures for ballast water, Jordan Cove and the LNG vessels visiting its terminal would probably not introduce exotic non-native organisms from a foreign port into Coos Bay.

Entrainment and Impingement from Vessel Cooling Water Intake

During operation of the terminal, LNG vessels at berth may entrain marine organisms through water taken from the slip to cool engines. Jordan Cove estimates that a 148,000 m^3 LNG vessel would take in about 6.1 million gallons (23,000 cubic meters) of water from the slip for engine cooling while at the terminal dock.

Currently, no additional screening system other than that already employed on the LNG vessels, is proposed for water intakes. The current screen bar spacing on most LNG vessels is about 24 millimeters (mm; about 1 inch) and the total open area (considering screen open area is about 80 to 90 percent of total intake size) of the cooling water intake is about 4 m^2 or 43 ft^2. Additional finer mesh screens are located internally on the vessels to prevent larger items from entering the system. These screens would not meet NMFS (1997a) screening criteria for juvenile salmonids. The estimated velocity at the opening of the cooling water intake would range from 0.3 to 1.44 fps (0.09 to 0.44 meters/second), depending on the intake rate of cooling water used. NMFS recommends an approach velocity for screening systems for salmonids of less than 60 mm is 0.33 fps, and 0.8 fps for larger juvenile salmonids. These guidelines also include other requirements such as sweeping velocity and type and size of openings that are not present on these screens. The result is likely to be that fish at least up to fry and possibly larger juvenile size salmonids near the intakes may be entrained or impinged during cooling water intake.

In addition, smaller marine and estuarine fish, juvenile stages of crab and shrimp, as well as other zooplankton and eggs and larvae fish could also be entrained. Some estuarine organisms potentially including juvenile salmonids would be removed from Coos Bay with this process during every loading cycle. It is expected that a high portion of juvenile larval stages of fish and invertebrates entrained or impinges would suffer mortality. Nevertheless, natural mortality of these early life stages is extremely high. The result would be less than 1 percent of earliest life stages reaching adult size, with natural mortality over 20 to 30 percent per day during earliest growth periods (Comyns et al. 2003). For example, data from an estuarine cooling water intake site determined that intake water larval stage entrainment, had very low natural survival (Marine Research Inc. 2004, as cited in FERC 2005). On a typical LNG vessel, the location of the water intake would be near the inner portion of the slip at depth of about 30 feet, which would likely reduce overall abundance of organisms in the intake area. Salmonids migrating in Coos Bay would more likely be swimming in the main channel, away from the shoreline and the inset slip, reducing their chance of encountering the LNG vessel intakes. Therefore, the off-channel artificially created marine slip at the Jordan Cove terminal would probably have a lower presence of fish than the rest of Coos Bay.

To make a reasonable estimate of potential loss from cooling water intake, we compared the relative amount of water used by an LNG vessel while at dock at the terminal to the amount of water carried by the tide in Coos Bay past the Project vicinity. There are several assumptions with this method; the three major ones are: (1) organism distribution would be similar in water used to that in the bay as a whole, (2) all organisms entrained would be lost to the system, and (3) no avoidance to entrainment would occur. In addition, the estimate of entrainment loss was compared to what typical natural mortality loss would be for invertebrate and vertebrate life stages that are common in zooplankton as potential salmonid food sources. This information provides a perspective of how entrainment loss may influence food supply relative to natural conditions. This approach was developed in the Shanks et al. (2010, 2011) documents.

The period at the dock would span approximately two tidal cycles (each tidal cycle takes approximately 12 hours). An approximation of spring high tide water exchange in the Project vicinity over one complete high and low tide cycle is 122.5 million m^3 based on data from the SHN Consulting Engineers and Geologist, Inc., technical memo (see Shanks et al. 2010, 2011). Neap tides (tides that occur when the difference between high and low tide is least) are less; however, these were not directly measured. Shanks et al. (2010, 2011) estimated the volume of water passing through Coos Bay in the vicinity of the Jordan Cove terminal during lower tidal levels to be 106 million m^3. Assuming tidal values would mostly vary between two ranges the average volume passing the LNG terminal would be about 2 times 114.25 million m^3. Using the conservative figure of 114.24 million m^3 for water in Coos Bay, we estimate that from 0.02 to 0.03 percent of the water near the marine slip would be taken in for engine cooling while an LNG vessel is at dock at the terminal, based on average tidal exchanges. Theoretically, organisms in this entrained water would be lost to the Coos Bay system and therefore not available as a food source.

The loss of these organisms from entrainment can also be compared to loss from natural mortality in the bay environment. Instantaneous natural mortality rate (per day) can be defined by the function: $M = \ln (N_0/N_t)/-t$, where M is instantaneous mortality rate, and N_0 and N_t are the initial and final abundance of larval after time t (Rumrill 1990). The comparison between entrainment and natural mortality loss of potential larval food organisms was made assuming 100 percent mortality of all organisms entrained during water intake and all mortality occurred during a single day. Additionally, it was assumed that all pelagic zooplankton in the project area during water exchange on an average day (i.e., 114.25 million m^3) suffered one day's natural mortality at the rate determined in the literature.

Rumrill (1990) provides estimates of mortality rates for a variety of marine invertebrate larval and in some cases through juvenile stages. McGurk (1986) supplies similar information for a variety of larval stages of marine fish. These values provide the bases for comparison of potential Project entrainment loss to that from natural mortality. Rumrill (1990) supplied estimates of morality rate using two methods with different data sets. One set is based on the contrast between larval production and subsequent recruitment, and the other is based on the monitoring of larval cohort in the plankton. The lowest and average mortality rates from Rumrill (1990) and McGurk (1986) are shown in table 4.6.2.2-3 for invertebrates and fish larvae. Invertebrate 1 and 2 in this table refer to the two respective rate groups from Rumrill (1990). Average and lowest mortality rates data for larval invertebrates and larval fish from these two sources were similar. Average loss of organisms from entrainment during one LNG vessel loading event would be low, ranging from 0.1 to 0.2 percent of what would occur from natural morality in one day. For the lowest literature mortality rate of larval taxa among those reported, daily entrainment loss would be much higher ranging from 0.7 to 1.8 percent depending on what water volume was used during one vessel loading cycle and which taxa group data are used. These values are conservative estimates when compared to natural mortality that would occur in the Coos Bay system overall because entrainment would not occur daily whereas natural mortality would.

TABLE 4.6.2.2-3

Comparison of Relative Loss of Larval Invertebrates and Larval Fish from Entrainment to Natural Mortality During Cooling Water Intake for One LNG Vessel Docked at the Jordan Cove Terminal

Mortality Category in Literature Source	Taxa Group b/	Sample size	Natural Mortality Rate M (daily)(M=ln(S)/-t) c/	Estimated Percent Loss from Entrainment Relative to Daily Loss from Natural Mortality a/	
				Low Intake	High Intake
Lowest	Larval Invertebrate 1	14	0.0305	0.7%	0.9%
Lowest	Larval Invertebrate 2	28	0.0161	1.0%	1.8%
Lowest	Larval Fish	29	0.0200	1.0%	1.4%
Average	Larval Invertebrate 1	14	0.1450	0.2%	0.2%
Average	Larval Invertebrate 2	28	0.2470	0.1%	0.1%
Average	Larval Fish	29	0.1969	0.2%	0.2%

a/ Values based on average daily Coos Bay tidal water exchange rate of 114,250,000 m^3, and one LNG vessel water intake of 22,800 m^3 (low) and 31,900 m^3 (high). Assumes 100% mortality of entrained organisms.
b/ Sources: Invertebrates from Rumrill (1990), and fish from McGurk (1986).
c/ S= Survival, t=days, ln=natural log base e

Because about 90 LNG vessel trips a year would occur, LNG loading and water intake use would occur on average every 4 or 5 days. Therefore, relative fish food organism loss from entrainment annually would be considerably less than that estimated. Overall reduction in food sources for marine predators from entrainment of planktonic organisms appears to be slight, considering various factors. On average, water intake would be less than 0.03 percent of the water in Coos Bay passing by the terminal location on a daily tidal cycle, so relatively few organisms would be subject to entrainment assuming similar planktonic organism distribution at the intake. Typical "loss" on average would be about 0.2 percent or less of loss from natural mortality of invertebrate and fish larvae during the day of LNG cargo loading. Even though the number of fish individuals lost is not expected to be large, some mortality would occur. It is expected that the greatest portion of organism and fish that would be entrained would likely be early life stages, as these are unable to avoid entrainment. As noted above, natural mortality is high for these early stages.

We also considered what effect the direct loss of young stages may have on production of older individuals. EPA (2004) examined the effects of entrainment by California power plants on marine fish and shellfish. The document developed natural mortality information by life stage of common marine and estuarine species or groups of species present in the California coastal region. Many of the species groups are common to Coos Bay. This information supplies an additional indication that loss of early life stages because of high natural mortality would not markedly reduce later life stages. Table 4.6.2.2-4 shows the relative survival percent from one life stage to the next up to age 2, and overall percent survival from larval to age 1 and 2, based on the EPA (2004) document. For most taxa, less than 1 percent of larvae would be expected to survive to age 1, as the highest rate of mortality occurs in early life stages. Adult or harvestable populations of a fish species are also affected by many factors (e.g., currents, food, temperature, usable habitat) that are generally independent of numbers or survival of early life stages. Overall, the loss of marine fish and their prey resources from entrainment, relative to numbers in Coos Bay, would be small based on the information discussed.

TABLE 4.6.2.2-4

Selected Survival Values by Life Stage of Marine Species That May Be Entrained or Impinged

	Percent Survival by Life Stages a/				
Taxa Group/Species b/	**Larvae to Juvenile**	**Juvenile to Age 1**	**Age 1 to Age 2**	**Larvae to Age 1**	**Larvae to Age 2**
Anchovies	0.03%	12.00%	49.66%	<0.01%	<0.01%
Longfin Smelt	0.17%	40.01%	51.17%	0.07%	0.03%
Pacific Herring	0.90%	50.01%	62.31%	0.45%	0.28%
Other Forage Fish	0.05%	27.53%	19.79%	0.01%	0.00%
Flounder	0.19%	31.98%	69.56%	0.06%	0.04%
Rockfish	36.79%	36.79%	80.65%	13.53%	10.92%
Cabazon	1.87%	40.01%	26.18%	0.75%	0.20%
Sculpins	2.26%	40.01%	65.70%	0.90%	0.59%
Dungeness Crab	30.12%	30.12%	60.65%	9.07%	5.50%
Commercial Shrimp	4.98%	11.53%	11.53%	0.57%	0.07%
Forage Shrimp	0.31%	41.85%	33.29%	0.13%	0.04%
Average	**7.06%**	**32.90%**	**48.23%**	**2.32%**	**1.607%**
Median	**0.90%**	**36.79%**	**51.17%**	**0.45%**	**0.07%**

a/ Values based on natural mortality rates by life stage.
b/ Groups include multiple species defined in Appendix B1 of EPA (2004).

Loss of juvenile salmonids from entrainment or impingements could also reduce adult returns. Survival from smolt stage is highly variable among salmonid size, species, and year and easily can range from less than one to more than 10 percent. NMFS (2008) in their assessment of effects of the Coos Bay airport expansions used a value of 4 percent survival for coho salmon smolts to returning adults. Even so, due to the extremely small portion of total water intake relative to the volume of Coos Bay, likely intake locations (30 feet deep, in the back of the isolated slip) likely away from concentrations of juvenile salmonids, the relative portion of juvenile salmonids that would be entrained and suffer direct mortality would be small.

Overall, the extremely small portion of total water intake relative to the volume of Coos Bay suggests that the loss of zooplankton and icthyoplankton, other marine invertebrates, eggs, larvae, shellfish, and fish including juvenile salmonids due to operation of the Jordan Cove Project would be low in comparison to total available entrainable size organisms in the bay and occurring from natural mortality. Therefore, we conclude that entrainment and impingement from water intake of an LNG vessel at berth at the Jordan Cove terminal would not have substantial adverse effects on marine phase of aquatic resources or their food sources.

Water Temperature in the Slip and Bay

LNG vessels at berth at Jordan Cove's terminal have the potential to both warm the temperature of the marine slip while discharging engine cooling water, and to cool the temperature of the marine slip while loading LNG cargo. Moderate to large temperature increases have the potential to reduce fish and invertebrate growth, reproductive success, and if high enough cause direct mortality. Fish of the north Pacific, including those found in Coos Bay, are adapted to cool water conditions and could be adversely affected by sharp increases in water temperature. Coos Bay temperatures historically remain less than 20°C (McAlister and Blanton 1963).

To cool engines while at dock, LNG vessels may take on about 6.1 million gallons of water from the marine slip. After running this water around its engines, the cooling water would discharged back into the slip at a higher temperature than when first removed. The estimated water temperature of the discharged water would be about 3°C (5.4°F) warmer than ambient water

temperature at the discharge port and would be reduced through dilution within a narrow plume to 0.3°C (0.6°F) warmer than ambient within 50 feet of the vessel. Based on an estimated volume of the slip area of 4.8 mcy (3.7 million cubic meters), the average water increase for the total slip volume during one day when an LNG vessel is at dock would range from 0.03 to 0.06°F.

We expect the actual average increase in water temperature in the slip would be less than the higher value estimated. First, tides would be continually exchanging the water, about 25 percent each tidal cycle. Second, LNG cargo loading would cool the temperature of the water around the vessel (possibly in the range of 20 percent reduction of temperature increase). The cooling would be a result of actual vessel hull cooling from the addition of LNG into the vessel at -260°F (-162°C). The cooling vessel hull would absorb heat from the water. Thus, based on estimates of total quantity of heat (in BTUs) in cooling water discharged, it was estimated that the cooling hull would absorb an equivalent of 20 percent of the total quantity of heat gained to the slip.

The modified water temperature would be well below levels that would be considered lethal in the short term (a few days) for salmonids, which would be over about 24 to 26°C (WDOE 2002). While optimum temperatures are much lower for salmonids, short-term local temperature increase would remain well below short-term adverse levels, and any small concentrated changes in temperature including within 50 feet of the discharge port would be easily avoided by fish. Therefore, the cooling water discharge should result in no adverse effect on fish resources from temperature changes. Considering the total volume of water in Coos Bay in comparison to the small volume of heated water discharged, virtually no change in bay temperature would occur from operation the terminal.

Water Runoff and Spills of Hazardous Materials

After construction of the terminal, about 34 acres would be covered by impervious surfaces. There is the potential for stormwater to run off these hard surfaces into the marine slip or bay, carrying sediment or hazardous materials, which may harm aquatic resources. As mentioned in section 2.1.1.10, Jordan Cove would design and construct a stormwater drainage and collection system for its terminal. Stormwater from areas that have no potential for contamination would be allowed to flow into the slip. Stormwater collected in areas that are potentially contaminated with oil or grease would be directed to sumps and then processed through an oily water separator before discharge to the industrial wastewater pipeline.

All areas where LNG may be present would be curbed and graded so that any spill would flow to containment trenches leading to impoundment basins. The two LNG storage tanks would be surrounded by a 65-foot-high barrier.

Any spills of hazardous materials would be handled in accordance with Jordan Cove's SPCCP. We conclude that Jordan Cove has measures in-place to prevent contaminated stormwater and hazardous materials from entering the bay and adversely affecting aquatic resources.

Terminal Lighting

Localized changes in light regime have been shown to affect fish species behavior in a variety of ways (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004; Nightingale and Simenstad 2001a). Disorientation may cause delays in migration, while avoidance responses

may cause diversion of migratory routes into deeper, less protected waters. In some cases, increased light may attract both predators and potential prey species (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004). Juvenile coho salmon show no response to moderately high light intensity, but become inactive in very low light (Hoar et al. 1957). In contrast, schools of juvenile chum salmon show marked preference for light, while juvenile sockeye prefer the dark. Depending on their reaction, fish may have migration delayed, be moved into less protected deepwater habitat, or they may become more susceptible to predation, as light increases predators' ability to see fish and also may be attracted to the area. Some adverse modification in fish behavior could occur from the lighting present at the terminal, possibly delaying migration, moving fish to less desirable habitat conditions, or subjecting juvenile fish to greater nighttime predation.

Lighting at the LNG terminal would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting that would primarily be located on shore, in and adjacent to the slip. The facility would have its highest intensity lighting on shore away from the water, although some lower level lighting would be present near the water. Lighting on the tug dock would be low intensity lighting adequate for safety. No high intensity lighting would be present near the water except possibly during vessel docking. When an LNG vessel is not in the berth, the lighting would be reduced to that required for security and would be focused upon the structures and not be in proximity to the water; therefore, the lighting would not serve as an attractant or deterrent to fish species. When an LNG vessel is at the berth, it would physically block the lighting on the berth from the slip waters and, due to its proximity to the slip wall, would block the fish from getting too close to the lighting on the berth. Lighting used would be similar to that already in place at other Coos Bay facilities.

The location of the facility, set back from the main channel of Coos Bay, would reduce fish encountering any shoreline lighting effects. The reduced lighting levels near the water should reduce any behavioral effects to fish near the terminal. As mentioned above, we have recommended that Jordan Cove develop the details of its final lighting plan in consultations with the FWS, NMFS, and ODFW to minimize potential impacts on aquatic resources.

Maintenance Dredging

Jordan Cove has estimated that the volume and frequency of maintenance-dredged material from the slip and access channel would be approximately 115,000 cy every 3 years for the first 9 to 12 years, and 115,000 to 160,000 cy every 5 years thereafter. This equals a removal rate of about 36,000 cy per year for the first 10 years and 33,000 cy per year for the next 10 years. This rate is much less than the annual amount that the COE removes from NCM 2 to 12 (200,000 cy per year). This dredged material may be placed at disposal Site F outside the mouth of Coos Bay (see section 2.1.4 and figure 2.1-11).

Modeling conducted by Jordan Cove and the Port (Moffat & Nichol 2006a) suggests a very narrow range of elevated suspended sediment (greater than 100 mg/l) during low tidal velocity extending out a few hundred feet from where the maintenance dredging would occur in Coos Bay using a mechanical (clamshell) dredge. The highest concentration levels would occur at lowest tidal velocity when dispersion of suspended sediment would be the least. Peak value at the lowest modeled tidal velocity—the point of clamshell dredging—is estimated to be 830 mg/l, with decreasing values away from the actual dredging site to about 125 mg/l at 200 m (660 feet)

from the site. During typical tidal cycles, turbidity would be up to 75 mg/l out about 0.2 to 0.4 mile from the dredging site. Moderately low values of 25 to 50 mg/l may extend out to about 3.5 miles depending on flow, sediment composition, and equipment used, for brief peak periods (about 2 hours daily). During high current velocity, peak values at the point of dredging would be about 90 mg/l, decreasing to 25 mg/l in 100 m (330 feet). Average daily (24-hour) values outside of the direct area being dredged would remain in the range of seasonal background levels of 25 to 50 mg/l during the ODFW-allowed dredging window. The number of days dredging would occur would depend on details of equipment used but would likely range from a few days to about a month of dredging to remove about 115,000 cy every three years (COE 2011).

Fish are likely to move from this narrow band of elevated suspended sediments during peak occurrences for short durations during dredging (likely several hours over the largest area affected). Additionally, some benthic organisms (e.g., clams, shrimp, and tubeworms) would be removed during this dredging. Maintenance dredging would occur in October to correspond to the Coos Bay in-water work window and the EPA recommended disposal period for Site F (June 1 through October), which would also avoid major juvenile salmonid presence in the region.

The distribution and location of dredge material deposited at Site F are planned by the COE and EPA, including Coos Bay maintenance channel dredging, to meet anticipated needs and to help extend the effective useful life of Site F. The COE develops annual disposal plans, based on the anticipated volume to be disposed of that year. These annual plans are developed in accordance with the EPA and COE's *Site Material Management Plan*, which is updated every 10 years, based on current bathymetric and environmental characteristics. If additional non-COE disposal is proposed, the COE will produce a disposal plan for that event.

However, the size and characteristics of Site F would allow additional disposal beyond that currently planned (EPA 2006a). Due to non-redistributed mounding in the past at this site, there is some concern about adding additional unplanned dredge materials at Site F that may mound to less than 50 feet deep, a depth consider minimum for safe ship passage (EPA 2009). The planning process and management has been developed and defined in the site management and monitoring plan for Site F. Current average annual disposal at Site F is about 858,000 cy, so maintenance-dredge discharge during the year it occurs would be about a 13 to 19 percent increase every three to five years, or the equivalent of about 4 percent per year over existing disposal.

Changing of the habitat conditions at Site F resulting from "mounding" is also a concern. Should this occur, it may alter normal habitat conditions found in this area, and as noted above may be a shipping hazard. However, bathymetric and photographic surveys would be used to select disposal sites to ensure this does not occur as a result of project site maintenance dredging. The large size of Site F would allow disposal locations to be selected to eliminate or greatly reduce mounding. Maintenance dredge materials, if evenly distributed, would equal about 0.3 inches (0.8 cm) additional sediment to the total area of Site F every three to five years, a relatively small sediment depth change.

The placement of the maintenance-dredged material at Site F would result in periodic impacts to primarily benthic marine organisms, but these impacts would be short term due to rapid recolonization on a small bottom area. Some direct mortality would occur to benthic and slow-moving organisms from burial during disposal at Site F. This may include very early juvenile

stages of the locally abundant flatfish, sanddab. Thus, some turbidity would occur from disposal, possibly causing temporary fish avoidance of the region and inhibiting primary production. However, the high energy of the region would rapidly dissipate turbidity plumes generated from discharge, reducing these effects to short term and temporary. Testing of sediment for contaminants occurred under an approved SAP in October 2006, and the sediment has been found to be suitable for clean disposal based on the DMEF of the EPA and COE.

Operational Acoustic Effects

LNG vessel and tug operations along the waterway, operational noise at the terminal, and maintenance dredging would generate underwater sounds pressure levels that could elicit responses in aquatic organisms. The intensity of the sound pressure levels from vessel traffic and dredging activities can vary considerably. However, sound pressure levels are generally in the range of 112 to 160 dB, intensities that may influence organism behaviors or perceptions but are not great enough to cause physiological damage (Richardson 1995; Hastings and Popper 2005; Fisheries Hydroacoustic Working Group 2008). State agencies in Washington, Oregon, and California along with federal agencies have developed interim noise exposure threshold criteria for pile-driving effects on fish (WSDOT 2011; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006). These threshold criteria are considered to be levels below which injury effects would not occur to fish from in water noise. These thresholds should be thus suitable for all forms of in-water noise. Interim noise exposure threshold criteria for pile driving effects on fish include: 1) a cumulative sound exposure level (SEL_{cum}) of 187 dB re 1 μPa^2 s for fishes more than two grams, 2) a SEL_{cum} of 183 dB re 1 μPa^2 s for fishes less than two grams, and 3) a single-strike peak level (SPL_{peak}) of 206 dB re 1 μPa for all sizes of fishes (WSDOT 2011). The LNG tanker in the Hatch et al. (2008) study produced sound levels (with one standard error) of 182 ± 2 dB re: 1 μPa @ 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359 meters (Hatch et al. 2008). These vessel noise levels are therefore generally less than threshold levels considered to cause direct harm to fish. Upland operational noise may also travel over water, but is not likely to affect fish, although there may be impacts on marine mammals close to the terminal.

Generally, response to noise impacts would be behavioral and perceptual, and not physiological in nature, as fish and marine mammals would tend to avoid the area during periods of high noise output. We conclude that operational noise would not have significant adverse effects on aquatic resources.

Essential Fish Habitat and Impacts at the Proposed LNG Terminal

EFH and species present in Coos Bay, including near the LNG terminal, are described in detail in section 4.6.2.1, and additionally for Site F above. EFH effects from construction and operation of the LNG terminal and maintenance dredging are summarized in table 4.6.2.2-5. Three habitat types occur within the slip site that would be affected by the slip and access channel that are tidally influenced and function as EFH: the shoreline habitat, SAV, and the open water of Coos Bay. The effects of the LNG terminal and Site F disposal on aquatic resources as described above also apply to EFH species.

TABLE 4.6.2.2-5

Potential Impacts to EFH due to LNG Terminal Construction and Operations

EFH	Description of EFH a/	Project Actions and Potential impacts	Determination of Effects
Groundfish	All waters from the extent of the high tide line (and parts of estuaries) to offshore to the 3,500-meter (1,914-fathom) depth.	• Dredging of 29 acres of estuarine habitat in Coos Bay • Potential food and larval organism impingement/entrainment • Periodic channel dredging and disposal • Accidental spills of hazardous substances	Substantial adverse effects to multiple groundfish species (e.g., rockfish, English soul, Starry flounder) EFH (see section 4.6.2.2 for impacts and mitigation)
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50°F and 79°F.	• Dredging of 31 acres of estuarine habitat in Coos Bay • Accidental spills of hazardous substances • Periodic channel dredging and disposal • Potential food and larval organism impingement/entrainment	Substantial adverse effects to coastal pelagic species (northern anchovy, Pacific sardine) EFH (see section 4.6.2.2 for impacts and mitigation)
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon. Estuaries and marine areas extending to the EEZ and beyond.	• Dredging of 31 acres of estuarine habitat in Coos Bay • Accidental spills of hazardous substances • Periodic channel dredging and disposal • Potential food organism impingement and entrainment • Potential impingement and entrainment	Substantial adverse effects to Pacific coastal salmon species (coho and Chinook salmon) EFH (see section 4.6.2.2 for impacts and mitigation)

a/ PFMC (2006; updated version July 24, 2006)

Approximately 31 acres of EFH within Coos Bay would be affected by the dredging of the access channel and barge berth. This includes approximately 4 acres of intertidal unvegetated habitats, about 4 acres of algae/mud/sand flats, about 3 acres of eelgrass, and 15 acres of deep subtidal habitat. Other than the deep subtidal habitat, the remaining 16 acres of shallow water habitat including 3 acres of SAV eelgrass beds (figure 4.6-2) would be lost as a result of the dredging. Less than an acre of additional estuarine habitat would be lost due to other project-related construction in the bay. While the construction of the access channel and slip would adversely impact EFH through loss of this narrow band of SAV, the potential adverse impacts on EFH would not be substantial.

Several of the EFH species known for Coos Bay are not present in the vicinity of the Jordan Cove terminal. Rockfish and lingcod have not been seined by ODFW near the terminal location; however, they are known to be present in the bay. Juvenile chilipepper, copper, grass, yellowtail, and kelp greenling were captured near the mouth of Coos Bay only, so habitat they utilize within the bay would be unlikely to be disturbed by the terminal.

During operation of the terminal, LNG vessels at the berth could entrain or impinge aquatic species while taking in engine cooling water. This could result in mortality to early life stages and juvenile species and their local food organisms. However, this impact would not be substantial for EFH species.

A small portion of the 2,700-acre sand/fine sediment bottom nearshore ocean benthic habitat at Site F just off the mouth of Coos Bay would be affected every three to five years from disposal of maintenance dredge material. While some of each of the three management groups have been documented near the Site F dredge disposal site (18 groundfish, 2 coastal pelagic, and 2 Pacific

salmon), abundance appears low for many of these species in this area. The uniform high-energy bottom area may restrict high benthic species abundance as well, as indicated by surveys of the region. Impacts to this region are expected to be low from the additional deposition because of the limited use of this region and overall small contribution of sediment amount and frequency relative to total available site area, and plans to distribute sediment to avoid mounding, and maintenance of clean sediment quality added. In addition, the site has been approved as a standard dredge disposal site by EPA partly because impacts to EFH would be limited at this site.

All associated activities, including construction and operation of the LNG terminal, dredging of the slip, maintenance dredging of the channel, and docking and loading of marine vessels, carry the risk of accidentals spill or leaks of hazardous substances occurring. Should these occur, they could have minimal adverse effects to coastal pelagic, groundfish, or Pacific Coast salmon species that may be present near the spill. Effects would be slight because of the procedures that would be in place in Jordan Cove's SPCCP to reduce the chance of spills occurring and magnitude of a spill should one occur.

EFH Conservation and Mitigation Measures for LNG Terminal Construction and Operation

The following measures would be implemented to minimize impacts on EFH from construction and operation of the Jordan Cove terminal:

- the bulk of the slip construction would take place in isolation from Coos Bay by maintaining a portion of the existing shoreline as a berm;
- all dredging in Coos Bay during construction of the marine slip and access channel would occur during the ODFW preferred work windows (October 1 through February 15) to minimize effects on vulnerable life stages of important fish species;
- an SPCCP would be implemented;
- Jordan Cove would develop about 8 acres of new eelgrass habitat at a site in Coos Bay near the Southwestern Oregon Regional Airport to mitigate for the loss of 3 acres of eelgrass removed during construction of the access channel to the terminal;
- about 47 acres of subtidal and intertidal habitats would be restored at the Kentuck Slough site, to mitigate for about 10 acres of intertidal mudflats, about 3 acres of shallow subtidal habitat, less than 1 acre of salt marsh, and other Coos Bay sites affected by construction of the access channel, marine slip, barge berth, and other Coos Bay areas;
- primarily sand and clean materials from maintenance dredging of the access channel and marine slip would be disposed at ocean Site F and nearshore areas to augment North Jetty and Coos Bay-Umpqua beach/dune system;
- disposal locations with ocean Site F would be staggered to allow maximum recovery of sites and dilute impacts, and bathymetric and photographic surveys would be used to select disposal sites; and
- routine bathymetric and photometric monitoring of dredge discharge sites would be conducted to properly locate disposal sites.

4.6.2.3 Pacific Connector Pipeline

The Pacific Connector pipeline would cross or affect 263[98] waterbodies (excluding ditches): 106 perennial streams, 151 intermittent streams, 5 ponds (i.e., 3 stock ponds, 1 excavated pond, 1 natural pond), and Coos Bay (1 crossing). Available data indicate that about 88 of these waterbodies are known or assumed to be inhabited by fish. Appendix O, table O-2, lists information on waterbodies crossed or potentially affected, other than ditches and ponds, and known fish distribution and classification relative to the crossing.

Aquatic Habitat in the Coos Bay Estuary

The pipeline would cross about 2.5 miles of Coos Bay, the largest estuary completely within Oregon. Coos Bay consists of about 14,000 acres of varied intertidal and subtidal substrate habitat conditions including algae beds, eelgrass sites, marsh lands, and mostly unconsolidated substrate. The upper Coos Bay estuarine habitat contains important rearing habitat supplied by estuarine wetlands, algae, and eelgrass beds, which are important conditions for estuarine fish and migratory salmon, as well as commercial oyster beds. The estuarine habitat of the Coos Bay estuary along the pipeline route is located in mostly shallow regions of the Haynes Inlet part of the bay (see figure 4.6-1). Most of the route and associated work areas are in about equal amounts of shallow intertidal and subtidal fine bottom and unconsolidated bottom habitat, with a few regions of mixed seabed of eelgrass, attached algae, and tidal marsh. The fisheries in these habitats include a mix of anadromous and marine species, as well as shellfish, and are described above in section 4.6.2.1.

Aquatic Habitat in Inland Waterways

The freshwater streams crossed by pipeline route include six major subbasins of rivers in southern Oregon. The aquatic habitat crossed by the pipeline outside of Coos Bay is primarily coldwater streams, but with a few warmwater ponds adjacent to the pipeline. Most stream riparian areas crossed are heavily forested, and are therefore shaded by conifer trees, providing typical salmon and/or trout habitat. Several waterbodies crossed are large (over 100 feet wide), but the majority are small waterbodies with generally low flow. Most of the major streams and many of the minor streams crossed contain salmon and steelhead, some of which are federally listed as threatened fish species.

Fishery Types

Fish species present in the pipeline area can be classified as warmwater, coolwater, coldwater resident, anadromous, and estuarine. Coldwater resident and anadromous streams are the most common along the pipeline route and associated facilities other than in Coos Bay estuary, while warm water species are typically associated with ponds in southeast Oregon.

<u>Warmwater, Coolwater, and Coldwater Fish</u>

Typical warmwater species in the pipeline area include black and white crappie, and brown bullhead, which are not native to the region. Warmwater species are present in several lakes near

[98] This number includes waterbodies adjacent to but not crossed by the pipeline that may be affected by construction activities. The pipeline would actually cross 211 waterbodies. Number of waterbodies affected differs from that in section 4.4 because that section includes ditches.

the route and are present at pipeline crossing areas, and are likely in some Klamath Basin streams crossed by the pipeline.

Coolwater fish present in the project area include both non-native and native species. Some important non-native species include smallmouth bass and yellow perch. These fish are often present in lakes, and smallmouth bass may be found in some larger rivers. Other native coolwater species of note include the Lost River sucker, shortnose and Klamath largescale suckers, and blue chub. These latter species occur primarily in the Klamath Basin, in Upper Klamath Lake and its tributaries. Umpqua chub are a species of concern, as this fish species has declined precipitously in the last decade. The pipeline would cross habitat occupied by Umpqua chub. Lost River and shortnose suckers that are listed under the ESA are discussed in section 4.7.

Resident coldwater fish species spend their entire lives in fresh water. Various waterbodies crossed by the Pacific Connector pipeline provide year-long habitat for several resident coldwater fish species. Resident cutthroat trout, rainbow trout, and redband trout are the most common resident coldwater game species along the route. Non-game fish species, some of which migrate between freshwater and marine habitats (e.g., threespine stickleback), and others that are freshwater residents (e.g., speckled and longnose dace, sculpins, chiselmouth, sucker) also may occur in waterbodies in the pipeline area.

Anadromous Fish

Anadromous fisheries in the pipeline area comprise eight species: Chinook salmon, coho salmon, chum salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, and green sturgeon (see section 4.6.2.1). Additionally, the Oregon Coastal Coho Salmon ESU listed under the ESA is present in the Coos River Basin and federally listed Southern Oregon/Northern California Coastal Coho Salmon ESU is present in the Rogue River system of the pipeline route (see section 4.7). On July 18, 2008, the Oregon Fish and Wildlife Commission approved the State plan to initiate an effort to re-establish anadromous fish into the Oregon portion of the Klamath River Basin. Although there is no definite timetable, this could result in the ESA-listed Southern Oregon/Northern California coho salmon ESU being present in the Klamath River system upstream of currently impassible Iron Gate Dam at some point in the future. Additionally, a settlement agreement was signed by 45 organizations on February 18, 2010, that includes agreement to restore anadromous fish to this basin, which is currently blocked by dams and diversions. Section 4.6.2.1 summarizes most of the major runs of anadromous salmon, steelhead, and trout species within the pipeline project area and their general timing of life phases.

Marine (Estuarine) Fish

The marine species that may be present along about 2.4 miles of the pipeline route where it would cross Haynes Inlet between about MPs 1.7 and 4.1 are the same as those discussed above for the Coos Bay portion of the waterway for LNG vessel marine traffic to and from the terminal (section 4.6.2.1). However, only fish adapted to tolerance of lower salinity conditions would normally be present because of the influence of freshwater in this region.

Marine (Estuarine) Shellfish

Major invertebrate taxa present in Coos Bay are described in section 4.6.2.1. Invertebrate groups include pelagic (in the water column), epibenthic (residing on sediment surface), and benthic (residing within the sediment) organisms. Pelagic invertebrates include juvenile and larval stages of many species, such as crab, shrimp, clams, worms (polychaetes) as well as adult and juvenile crustacean zooplankton (e.g., copepods). Epibenthic organisms including harpacticoid copepods, snails, amphipods, mussels, oysters are all present to varying degrees. Benthic organisms include clams and the most abundant polychaetes and amphipods, the latter an important food for juvenile salmonids.

Estuarine Oysters

There are two different types of oysters identified along the pipeline route across Haynes Inlet between MPs 1.7 and 4.1: 1) commercially grown non-native Pacific oysters (*Crassostrea gigas*); and 2) native Olympia oysters (*Ostrea lurida*). Neither species can be legally harvested for recreational purposes. Native oyster populations are state-protected to encourage their recovery. Pacific oysters are the private property of their commercial growers.

Four companies lease state lands within Coos Bay to raise Pacific oysters commercially. They seed their beds with juvenile oysters (spat) and later harvest adults. These commercial beds are located on the north and east side of Coos Bay from Glasgow Point (north) to Crawford Point (south). Another commercial oyster operation is in South Slough.

Olympia oysters can be found in the subtidal and intertidal zones of Coos Bay from Haynes Inlet south to Isthmus Slough. Pacific Connector surveyed nearly 7,000 feet of relatively shallow intertidal habitat for Olympia oysters along the pipeline route in Haynes Inlet during late June 2011. Olympia oysters were found growing on riprap at the mouth of Haynes Inlet and on substrates within the pipeline right-of-way. Forty-seven oysters were documented within the right-of-way in addition to oysters present in a 1,400 square foot reef. An overall estimate of oysters that may occur within the pipeline right-of-way is between 100 and 1,000 oysters (Ellis Ecological Services 2011).

Both commercial Pacific oysters and native Olympia oysters could be affected by pipeline construction. There could be oil or fuel leaks from construction equipment. Pacific Connector would implement the measures outlined in its SPCCP to avoid or reduce impacts from an equipment oil or fuel leak. Pacific Connector has routed the pipeline in Haynes Inlet to avoid direct impacts on commercial oyster beds, and the route is not in or near commercial beds except between MPs 2.9 to 3.2 where commercial beds are adjacent to the route. The pipeline would be installed across Haynes Inlet using an open cut, as described in section 4.4.2.2 above in this EIS. Oysters may be affected by turbidity and sedimentation caused by pipeline construction in the bay. Impacts on commercial oyster beds are discussed in section 4.9.2.8 below in this EIS.

Marine Mammals

The marine mammals that may be present along the pipeline route within Haynes Inlet are the same as those discussed for the Coos Bay portion of the waterway for LNG vessel transit to and from the terminal (see section 4.6.2.1), with the exception of large whale species that only inhabit the deep, open ocean. It is possible that killer whales and pinnipeds could be found in Coos Bay. The potentially present marine mammals are protected under the MMPA and were

included in Jordan Cove and Pacific Connector's IHA application to NMFS on October 8, 2014 (Jordan Cove and Pacific Connector 2014).

Freshwater Mussels

Limited native freshwater mussels may be present in some streams along the route. Only eight native mussels are present west of the Continental Divide, most of which belong to the genus *Anadonta* (Nedeau et al. 2009). This genera tends to be more often in lakes and pond and quiet pools but may found in swifter waters in protected areas without current sheer. Another species, the Western pearlshell (*Margaritifer falcate*), while most common in large streams can be found in cold small streams only a few feet wide (Nedeau et al. 2009). The distribution relative to the project crossing for mussels species in not known; however, it is possible that some may be present near crossings, especially in larger, low-gradient streams. Two sensitive species (see appendix O) may be present in streams along the route: California floater mussel (*Anadonta californiensis*) and Western ridged mussel (*Gonidea angulata*). The second species is also addressed in the Forest Service's Biological Evaluation (BE; appendix L of this EIS).

Status of Fish in the Pipeline Project Area

The status of federally listed fish species and other commercial fish species that are managed under the MSA is presented in our BA and EFH Assessment (FERC 2015) submitted to the FWS and NMFS. Effects to EFH along the Pacific Connector pipeline route are summarized below. Endangered and threatened species and other special status species are addressed in section 4.7. The status of other state-listed fish species and fisheries of concern are also discussed in section 4.7.

ODFW (2005) has evaluated the status of salmon and steelhead, trout and other selected species of interest. This document did not address all species that may be of concern along the route. The assessed status or risk of these stocks is based on the threat to the conservation of unique groups of populations in the near-term (5 to 10 years) period (see section 4.6.2.1 for criteria details). The species categorized as to status by ODFW are called SMUs. The pipeline route crosses six major subbasins (i.e., USGS hydrologic units). Each of these subbasins include from 1 to 10 SMUs. The ratings of each of the SMUs that correspond to these subbasins are shown in table 4.6.2.3-1. The pipeline would cross a total of 20 SMUs distributed among the six subbasins. The number ranges from 10 SMUs in the Coos hydrological unit to one SMU in the Lost River hydrological unit. A specific SMU population that may be present near an individual crossing area varies within these subbasins.

TABLE 4.6.2.3-1

Status Rating of Fish Populations by Major Subbasins Areas Crossed by the Proposed Pipeline

Group	Species Management Units (SMU)	Risk Category by SMU	Risk Criteria by Subbasin Populations					
			Coos	Coquille	South Umpqua	Upper Rogue	Upper Klamath River	Lost River
Coho Salmon	Coastal	Not at Risk	None	None	None			
	Rogue	Not at Risk				None		
	Klamath	Extinct					Extinct	
Fall Chinook Salmon	Coastal	Not at Risk	Reproductive Independence	None	None			
	Rogue	Not At Risk				None		
Spring Chinook Salmon	Coastal	At Risk	Extinct	Abundance and Production	Abundance and Production			
	Rogue	Potentially At Risk				Reproductive Independence		
	Upper Klamath	Extinct					Extinct	
Chum Salmon	Coastal	At Risk	Extinct					
Winter Steelhead	Coastal	Potentially at Risk	Reproductive Independence	Reproductive Independence	None			
	Rogue	Not at Risk				None		
Summer Steelhead	Rogue	Not at Risk				None		
	Klamath	At Risk					a/	
Redband Trout	Upper Klamath Basin	At Risk					b/	Distribution and Abundance and Production
Cutthroat	Oregon Coastal	Not at Risk	None	None	None			
	Southern Oregon Coastal	Not at Risk				None		
Other Species of Interest d/	Pacific Lamprey	At Risk	Abundance and Production	Abundance and Production	Abundance and Production	Abundance and Production		
	Western Brook Lamprey	At Risk	Abundance and Production	Abundance and Production	Abundance and Production	Abundance and Production		
	Northern Green Sturgeon	Not Assessed	Abundance					
	Oregon White Sturgeon	Not Assessed	None					
	Lost River Sucker c/	ESA listed					Multiple	Multiple
	Shortnose Sucker d/	ESA listed					Multiple	Multiple

Source: ODFW (2005 and 2014b) for South Umpqua Spring Chinook salmon

a/ Insufficient data for three of six categories for Upper Klamath population

b/ Two Populations: Jenny=Risk: Distribution and Reproductive Independence; Klamath River=Risk: Production

c/ These species not evaluated under the ODFW (2005) document, but are ESA-listed species found in the basins indicated. Risk criteria not assessed but include: passage, reproductive independence, water quality and quantity, distribution and abundance, and others

d/ Species of special concern that were not assessed by ODFW (2005) are not included in this table. See section 4.7 for special species assessments.

Among salmon and steelhead species SMUs, six are rated by the ODFW as "Not at Risk," two "Potentially at Risk," three "At Risk," and two "Extinct." For trout SMUs, two are "Not at Risk," and one is "At Risk." Regarding other species of interest, two are rated "At Risk," and two are "Not Assessed." Additionally, two ESA-listed species, the Lost River sucker and shortnose sucker, are present in the Klamath and Lost River basins. These two species were not included in the ODFW (2005) evaluation. The life history of federal, state, BLM, and Forest Service species of special concern including those with state-designated risk status in all subbasins crossed by the pipeline is provided in appendix O.

The reasons for the "At Risk" rating vary by subbasin and species but include hatchery interaction; exotic species introduction that causes predation, competition or genetic interaction; low abundance and production of the stocks; irrigation diversions and water withdrawals; grazing and forestry practices; and habitat loss, pollution, and fish passage barriers. Non-native fish species may pose an equivalent, if not greater, threat than habitat degradation to native freshwater fish since non-native fish are more widespread in western streams (50 percent) than habitat degradation (18 percent) (Schade and Bonar 2005).

General Impacts and Measures to Reduce or Mitigate Impacts

The pipeline route would cross 2.4 miles of estuarine habitat in Coos Bay and cross or pass near an additional 263 waterbodies (not including ditches), of which about 87 are known or presumed to be inhabited by fish. In addition, 4 new stream crossings would occur along the 14 temporary or 13 permanent roads, 2 of which are known to have fish. Existing roads used by the pipeline project for construction would use existing stream crossings although final design may include new or modified structures at some locations (see below), with a total of 23 streams crossed, 7 of which are perennial streams with 4 known to have fish. Two new temporary construction roads would also cross known fish-bearing streams (TAR 88.63 crossing Days Creek and TAR 128.69 crossing a tributary of Indian Creek).

The entire estuarine habitat and many of the freshwater streams contain EFH habitat. Additionally, many crossings contain ESA listed fish resources as well as other species of concern. Because of the numerous fish waterbody disturbance actions and project actions in watersheds containing special status fish, there is the potential for many special status fish resources to be affected by the pipeline project.

Pacific Connector proposes to cross the Coos Bay estuary using wet open cut dredging. At three large river crossings, HDD methods would be used (Coos, Rogue, and Klamath Rivers), and at two crossings of the South Umpqua River Pacific Connector would use a diverted open-cut method at one and a DP method at the other. Pacific Connector proposes to cross three waterbodies (Kentuck Slough, Catching Slough, and Medford Canal) using conventional bores. All other stream crossings would employ a dry, open-cut method. General stream crossing methods for each of these are described in section 2.4.2.2, and specific crossing methods are listed in appendix O, table O-2. General Project activities potentially impacting aquatic resources include estuarine in-water construction, freshwater in-water construction activities, terrestrial/riparian habitat modification, accidental spills or leaks of hazardous materials, and periodic maintenance of the pipeline. Much of the discussion on types of impact below applies to the salmonids protected under the ESA and other special status species (see section 4.7).

Construction of the Pacific Connector pipeline (early spring through late fall) would coincide with juvenile out-migration and upstream adult migration for most anadromous fish species in most river basins. However, following ODFW recommended in-water construction windows, in consultation with NMFS on suitability relative to listed fish species, should minimize the coincidence of pipeline construction with upstream adult salmonid migration and minimize impact during sensitive spawning periods in the streams. Resident salmonids, which would be primarily cutthroat and/or rainbow trout, spawn in the spring outside of the state approved in-water work windows. During construction within the Coos Bay estuary (October 1 through February 15), adult anadromous salmonids would be present (ODFW 2007b).

The extent of impact on aquatic resources from pipeline construction would depend on the waterbody crossing method, adjacent clearing methods, erosion control, the existing conditions at each crossing location, and the timing of construction. Short-term impacts are likely to last from the initiation of construction up to three years afterward. Potential short-term impacts that degrade habitat could occur with trenching and laying of the pipe at waterbody crossing sites and sometimes adjacent slope runoff. The installation of the pipeline across a waterbody may result in temporary deposit of a limited amount of sediment in that stream, with associated short-term turbidity affecting aquatic species. Pacific Connector would install erosion control devices during construction to reduce sedimentation and in-stream turbidity at waterbody crossings. We expect the pipeline right-of-way to be restored and revegetated immediately after pipeline installation. Except for forested areas, vegetation would reestablished in the area within three years.

Long-term degradation of habitats can occur if flow or sediment regimes are modified in a manner that results in morphological changes to the bed and banks of the channel. Also, in forested areas, shade would be reduced at waterbody crossings for the time it would take trees to grow after restoration and revegetation and future LWD. In streams that have very small flows, lack of shade may raise stream water temperatures and reduce LWD supply, which could in turn affect aquatic species. However, streams with low or intermittent flow generally support smaller fish populations and less diverse species composition.

Pacific Connector developed its project-specific ECRP which includes specifications for waterbody crossing techniques and associated sediment and erosion controls to be implemented during waterbody crossings. A detailed description of construction and mitigation measures that Pacific Connector would implement at waterbody crossings is included in section 4.4.2.5.

In addition to actual waterbody crossings by the pipeline, several of the project-related construction activities, such as improving existing access roads, could indirectly affect aquatic resources by increasing erosion and runoff to nearby streams. The approximate relevant characteristics of these activities and potential effects to aquatic resources are summarized in table 4.6.2.3-2.

TABLE 4.6.2.3-2

Pacific Connector Pipeline Approximate Associated Construction Disturbance and Aboveground Facilities and Their Potential Effects to Aquatic Resources

Category	Facility	Location	Notes	Effects to Aquatic Resources
Pipeline-related facilities	Hydrostatic testing	75 potential sites, 6 sites located outside of construction right- of- way.	A *Hydrostatic Testing Plan* addressing protection procedures has been developed.	Potential erosion to streams and invasive species introduction if not properly managed. Potential flow reduction during withdrawal. Measures from ECRP and *Hydrostatic Testing Plan* (part of the POD) would avoid adverse effects.
	Temporary extra work areas (TEWAs)	574 TEWAs, would impact 239 acres of wetland and 237 waterbodies	81 are known fish bearing	Potential for erosion or hazardous spills. Slight LWD and shade reduction Measures from ECRP and SPCC and other measures in the POD would avoid adverse effects.
	Uncleared storage areas (UCSAs)	65 UCSAs within riparian zones 12 assumed fish, 13 unknown, and 5 non-fish bearing streams	11 waterbodies directly affected (note: unknown 2013)	Some potential for sedimentation effects to aquatic resources. Slight LWD and shade reduction. Measures from ECRP would avoid or reduce adverse effects.
Pipeline-related facilities	Contractor and pipe storage yards.	Of 38 sites, 31 surveyed, 19 no wetlands	12 have wetland or drainage ditches	Potential modification of flow, sediment runoff. Measures from ECRP and SPCCP would avoid adverse effects.
	Rock sources, and permanent disposal sites	Of 42 rock sources, 12 are in riparian areas	Willis Creek and tributary (fish bearing) within 50 feet of disposal site(note: unknown 2013)	Potential sediment runoff to stream. Measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.
Construction access roads	13 new Temporary Access Roads (TARs) segments to be constructed, some near streams	6 near likely fish streams (riparian zone), including 4 crossing fish streams	One TAR on federal Riparian Reserves (*Middle* Creek)	Potential sediment effects and loss of riparian shade. Measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.
	17 new Permanent Access Road (PAR)	Two new PAR near small streams of unknown fish status, no stream crossings	No new PAR on federal Riparian Reserve	Slight effect as measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.
	Improved Existing Access Roads	66 access roads would cross 23 streams, including 3 known fish streams	No riparian clearing expected as road width changes near streams would be absent or slight	Potential sediment effects. Measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.

Fish passage is a potential issue relating to streams crossing by roads that would be used by the project. The final locations of all road-stream crossing and road use levels would not be determined until a construction contractor can assess what final road use would be needed and final designs are developed. However, Pacific Connector, in consultation with ODFW, has developed general plans and designs for methods to be use for road-stream crossings to ensure fish passage is maintained and other impacts are minimized (Pacific Connector Gas Pipeline LP 2015). For temporary and permanent roads, designs may include use of existing instream structures, which could include the protection, repair or replacement of these stream-crossing structures. New culverts may be needed in some areas. Where applicable, fish passage would be ensured for any new structure. However, Pacific Connector may not modify fish passability of existing structures that they use if they are already fish barriers. Pacific Connector would submit a fish passage plan to ODFW and would not construct the crossing until approval is received. Temporary bridges may be used before culverts are installed. These bridges would span above the ordinary water level and be maintained to stay above water levels during use. All new or

temporary structures would meet state fish passage requirements, any culvert installation would occur during state designated in water work windows unless otherwise approved by ODFW, and fish passage would be maintained during construction. If temporary bridges are used, they may be installed outside of the in-water work window. In-water activities would meet state turbidity standards reducing turbidity impacts. Riparian disturbance would be kept to that needed for construction. These actions would maintain adequate fish passage and minimized stream disturbance from the use and installation of road-stream crossing structures.

Construction in Estuarine Habitats

During in-water pipeline installation within Coos Bay, fish and other aquatic resources could be affected. Construction of the pipeline across the Coos Bay estuary would utilize a wet-open cut method. The current pipeline route in the bay would span 2.4 miles and disturb approximately 73 acres of subtidal (33 acres) and intertidal (36 acres) habitats (table 4.6.2.3-3).

TABLE 4.6.2.3-3

Areas of Subtidal and Intertidal Habitats within the Coos Bay Estuary Directly Affected by Construction of the Pacific Connector Pipeline

Project Component	Intertidal and Subtidal Habitats Affected a/				Total
	Low Eelgrass	Medium Eelgrass	Mud Flat	Subtidal	
Distance Crossed (mile)	<0.1	<0.1	1.3	1.0	2.5
Area Disturbed 2008 (acre) a/					
Right of Way	1	<1	38	32	72
Temporary Work Areas	0	0	1	0	1
Total	**1**	**<1**	**39**	**32**	**73**
Area Disturbed 2013 (acre) b/	**Low/Medium Eelgrass**				
Right of Way	5 c/		35	33	72
Temporary Work Areas	0		1	0	1
Total	**5**		**36**	**33**	**73**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre, miles to nearest tenth of a mile (values below 1 or 0.1, respectively, are shown as "<1"/ "<0.1").
a/ Eelgrass area based on 2008 survey by Ellis Ecological Services (2008).
b/ Eelgrass area bases on 2013 survey by Ellis Ecological Services (2013).
c/ The increase in eelgrass impact is due largely to a natural expansion of one eelgrass bed within the pipeline right of way in Haynes Inlet that occurred since the 2008 survey.

Pacific Connector conducted a survey of eelgrass beds within Coos Bay along the pipeline route in 2008. Based on the survey of the route in 2008, there was about 1.0 acre of eelgrass beds that would be directly affected by the construction right-of-way (including TEWAs). A more recent survey found 5 acres of eelgrass scattered along the route, with total acres of estuarine habitat that would be affected little changed from earlier assessments (Ellis Ecological Services 2013).[99] Eelgrass beds were placed into three categories based on density: low, medium, and high. From the 2008 survey, most of the area affected would be low density, and no areas were categorized as high-density eelgrass. A total of 1,400 acres of eelgrass beds are present in Coos Bay (Ellis Ecological Services 2008), so less than 0.1 percent of this important habitat would be directly disturbed from construction with the new route. Overall, since the Coos Bay estuary is about 12,000 acres, construction disturbance would be less than 1 percent of the entire estuarine area.

Trench excavation to install the pipeline in the bay would bury, displace, or injure benthic organisms (e.g., worms, clams starfish and vegetation). Mobile organisms like crabs, shrimp, and fish would

[99] Attachment 7 of Pacific Connector's *Compensatory Mitigation Plan* filed with the FERC in September 2013.

move away from the trenching activities. Short-term impacts would occur to other benthic taxa in Coos Bay that include ribbon worms (*Nemertinea*), various burrowing segmented worms (*Polychaeta*), small crustaceans including amphipods, Dungeness crab, echinoderms, clams (i.e., *Macoma* sp.), and coral/anemone polyps (*Anthoszoa*) (Miller et al. 1990). However, benthic communities on mud substrates in Coos Bay that were disturbed by previous dredging activities recovered to pre-dredging levels in four weeks (Newell et al. 1998). Some impacts may be long-term if important habitat elements are affected, such as the effects of turbidity on eelgrass growth (Martin and Tyrrel 2002).

In addition, oyster beds near the construction right-of-way would be affected by turbidity (Couch and Hassler 1989) similar to potential effects to eelgrass. Pacific Connector has sited the pipeline route to be outside of all commercial oyster beds, so impacts on commercial beds would be limited to possibly short-term turbidity near the route (about 0.3 mile of the route where commercial beds are adjacent).

An overall estimate within the pipeline route is between 100 and 1,000 Olympia oysters along about 0.3 mile of the pipeline route based on surveys conducted in 2011 (Ellis Ecological Services 2011). Olympia oysters along the crossing of Haynes Inlet would be directly affected by construction activities. Additionally, some Olympia oyster spat would be settling to substrate to form their attached life stage during part of the allowed in-water construction window (October 1-February 15), with spat settling occurring from August through December, peaking in October (Sawyer 2011). The highest concentrations of Olympia oysters found during project surveys along the proposed route were between approximately MP 2.6 and 3.2. Generally, spat settle on hard substrates (e.g. shells, rock) so some disruption of spat settle success in this area could occur near the dredging area. To reduce this potential impact, the Coos County Planning Department, in their final approval of the land use permit for the construction of the route in Coos County including across Haynes Inlet, conditioned the approval on the applicant not dredging the pipeline route during October between MP 2.6 and 3.2 unless ODFW were to approve construction then (Coos County Planning Department 2012). This restriction would reduce the potential for unsuccessful spawning for Olympia oysters during the year of construction.

Pacific Connector has proposed an *Olympia Oyster Mitigation Plan.*[100] The plan includes moving any oysters present along the pipeline route just prior to construction to local areas that would be unaffected by project actions to prevent direct harm to these individuals. The applicant would also augment the region with suitable substrate for Olympia oysters after construction. The enhanced area would be monitored over several years to determine whether substrate was successfully colonized by Olympic oysters. If not, the applicant would consider other actions that may be proposed through consultation with resource agencies. The Coos County Planning Department (2012) placed additional conditions on the currently developed *Olympia Oyster Mitigation Plan* to meet their permit approval. Overall, this would result in no net substantial adverse effects to commercial or Olympia oysters from project actions.

Sedimentation and Turbidity Resulting from Pipeline Installation Across Haynes Inlet

Turbidity and increased suspended sediments would be generated during pipeline construction across the Haynes Inlet portion of the Coos Bay estuary. While the exact duration of pipeline

[100] Attachment 8 of Pacific Connector's *Compensatory Mitigation Plan* filed with the FERC in September 2013.

construction in the bay is unknown, if the typical construction rate of about 800 feet a day (CHE 2013b) occurs, it would be completed in a 2- to 3-week period.

Construction would occur during one season (i.e., less than the 4.5-month in-water work window). "Wet" crossing construction or open cutting (trench excavation, pipe installation, and backfilling the trench through flowing water) produces the highest downstream (or relative tidal flow direction) sediment loads of any construction technique (Mutrie and Scott 1984; Reid and Anderson 1999; Reid et al. 2004). The amount of sediment produced by open cutting depends on multiple characteristics at the construction site including depth and width of the waterbody (affects mixing of the sediment plume in the water column), current velocity and local turbulence at the site and downstream, concentrations of suspended sediment initially at the site and at some distance downstream, particle diameter, specific weight, and settling velocity of the excavated and backfilled materials (Ritter 1984; Reid et al. 2004). The general effects of increased turbidity and sediment on marine organisms and anadromous salmonids are presented in the earlier LNG impact discussion (section 4.6.2.2).

As discussed above for the LNG terminal (section 4.6.2.2), salmonids exposed to moderate to high levels of suspended sediment for extended periods could be adversely affected (also see the discussion of suspended sediment effects below under Turbidity and Sedimentation – in Freshwater). Salmonids may avoid areas of increased turbidity based on some studies at about 70 mg/l (Lloyd et al. 1987) while some other studies suggest avoidance may occur at 20 mg/l suspended sediment, and possibly lower depending on length of exposure (Newcombe and Jensen 1996). The elevated suspended sediment conditions would be short-term during pipeline installation and would not be continuous at any one location. This would reduce the chances of continuous elevated exposure for fish that may move little. Concentrations as low as 17 mg/l have been noted to potentially have some adverse effects (e.g., gill irritation, respiration) for juvenile coho salmon (Wheeler 2008). Some other studies have found varied effects including lesser effects at these concentrations, with overall effects related to both duration as well as concentration (Newcomb and Jensen 1996). Additionally, estuarine environments often have moderately elevated suspended sediment concentrations (i.e., greater than 15 mg/l) and they are very productive (Gregory et al. 1993). As noted above, concentrations typically exceed this value (i.e., 17 mg/l) in Coos Bay in the winter (Moffat & Nichol 2006a), so fish present in Coos Bay in the winter are commonly present in regions with natural concentrations exceeding this value. The construction time would avoid periods of high abundance of salmonids in the construction area, with the possible exception of migrating coho salmon adults in the fall.

Sediment concentrations from pipeline trenching in the bay would be similar to winter background levels for much of the construction period and few fish would be near the highest plume concentration due to active avoidance. The applicant developed models to predict potential effects of dredging a pipeline route across Haynes Inlet on suspended sediment concentrations (CHE 2013b). Model results suggest that concentrations over 50 mg/l would be limited to a region likely less than 100 feet from actual trenching. Concentrations up to about 10 to 15 mg/l would be limited to likely less than 300 to 500 feet from actual trenching, which are normal for Coos Bay during the fall and winter construction period (Moffat & Nichol 2006a). Model results also indicated that suspended sediment concentrations would not exceed ambient suspended sediment concentrations by more than 10 percent within 350 feet or less of actual trenching. At an assumed construction rate of about 800 feet a day (CHE 2013b), this

construction effect would likely occur over a 2- to 3-week period to traverse the 2.5 miles across Haynes Inlet. Therefore, some local, short-term avoidance of the actual construction area by fish may occur, but long-term or substantial effects on fish in the bay would be unlikely.

The composition of invertebrates inhabiting estuarine and tidal flats is likely to change seasonally (Higley and Holton 1981), and those invertebrate taxa most predominant at the time of construction would be affected. Estuarine benthic invertebrates including shellfish are likely to be affected by disturbed substrate and turbidity generated by pipeline construction. Construction within the estuary is scheduled from October 1 through mid-February to occur during the recommended in-water construction windows established by ODFW (2000b). Abundance of benthic invertebrates (except for shellfish) is expected to be minimal (Higley and Holton 1981). Similarly, impact from turbidity to local low salt marsh and high salt marsh would be during vegetation dormancy and low abundance of invertebrate inhabitants. Consequently, impact to those resources is expected to be limited.

Suspended sediment and turbidity resulting from construction may adversely affect filter feeding commercially and recreationally harvested clams and oysters near the pipeline route in Haynes Inlet. Adverse Project-related effects on clams and oysters from higher levels of TSS would be restricted to the short-term period of active construction across Haynes Inlet (maximum of 3 weeks).

Pacific Connector would minimize impacts by following the BMPs of its Haynes Inlet Water Route Construction Plan. These measures include:

- developing a turbidity monitoring and management plan;
- deploying turbidity curtains as practicable;
- where depth of water allows, keeping the excavation bucket below the water surface;
- placing the excavated spoil immediately adjacent to the trench;
- conducting fueling and maintenance of equipment more than 150 feet away from the pipeline trench, where practicable, and inspecting equipment for leaks; and
- backfilling the trench as quickly as possible after the pipeline is installed.

Intertidal and Subtidal Habitat Removal and Modifications in Haynes Inlet

During construction of the Pacific Connector pipeline across the Haynes Inlet portion of Coos Bay, various intertidal and subtidal habitats would be disturbed by trenching. Approximately 39 acres of intertidal mud flats and 32 acres of subtidal habitat would be affected by the construction right-of-way and TEWAs (table 4.6.2.3-3). Based on the distribution mapping of eelgrass, construction along the pipeline route could temporarily disturb about 5 acres of eelgrass (Ellis Ecological Services 2013).

Eelgrass can be adversely affected by turbidity because the depth and distribution of eelgrass is strongly associated with water clarity and depth of light penetration (Dennison and Orth 1993; Thom et al. 1998) as well as nutrient availability (Short et al. 1995), salinity, and water temperatures (Thom et al. 2003). Effects to eelgrass from turbidity generated during trenching would, in large part, depend on type of equipment utilized and strength and direction of currents within the estuary during construction. As noted above, model results suggest slightly elevated turbidity levels exceeding background would be limited to an area less than 350 feet from the actual dredging site for a period likely less than 3 weeks.

Generated turbidity could affect light penetration potential affecting primary production. This could affect overall production. The timing of the construction based on ODFW in-water work window requirements, October 1 through February 15, which would be reviewed by NMFS relative to listed and EFH fish species, is during most of the period when eelgrass in Coos Bay would be dormant, coinciding with low temperatures and short photoperiods (Fonseca et al. 1998). Therefore, light limitations would have minor effects on local patches of eelgrass beds proximate to construction sites and should not contribute additional indirect source of impact to eelgrass habitats or dependent aquatic species. Following pipeline installation, the pipeline trench would be backfilled with sediments removed during trenching, and the bottom elevation and flow conditions would be restored to pre-construction conditions. It is anticipated that following pipeline backfill, the areas disturbed by construction would be suitable for eelgrass to regrow. Pacific Connector has proposed a plan, its EWMP, to replant the disturbed areas with eelgrass.[101]

Construction within Coos Bay would also affect mud/sand flats, shallow subtidal, low and high salt marsh, and undifferentiated tidal marsh areas. Pacific Connector has prepared a plan to mitigate for a disturbance that would include, for marsh habitat, primarily retaining the rooted plants and top foot of soil, and planting them back after the pipeline has been backfilled and the pre-construction contours restored. For other habitat types, restoration would involve replacing excavated soils and recontouring sites. All areas of the estuary habitat, including the eelgrass restoration and marsh plant restoration, have monitoring and contingency plans to ensure habitat is restored along the route (see the EWMP). The plan includes details of how habitat would be restored, schedules, measures of success, monitoring, and contingency plans and schedule. Some of the main factors include:

- goal of 1:1 restoration of habitat with standard meeting or better than pre-project conditions specifically for eel grass bed, mud/sand flats, and salt marsh;
- on-site mitigation (restoring the habitat in place where it was disturbed);
- recontouring of pipeline route to pre-project conditions returning original covering substrate;
- pre-construction survey, physical and some biological, including references methods to resurvey same location;
- success criteria for eel grass is same acreage at equal or greater density;
- take no more than 10 percent of eel grass donor plants from other areas for replanting;
- contingency is if plants not established to pre-conditions within five years Pacific Connector would consult with agencies on next steps; and
- for mud/sand flats and shallow subtidal, success would be recontouring to pre-construction with natural substrate.

Aquatic Nuisance Species in Coos Bay

Invasive species have the potential to modify the food base and induce other ecological modifications in the estuarine area of Coos Bay. Non-indigenous aquatic species (NAS) are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Within the Coos Bay

[101] Attachment 7 of Pacific Connector's *Compensatory Mitigation Plan* filed with the FERC in September 2013.

estuary, over 67 NAS have been identified (Aquatic Nuisance Species Taskforce 2006). All of the invertebrate NAS in the Coos Bay estuary have been introduced by ship fouling or discharge from ballast water of ocean-going vessels.

Pacific Connector identified two NAS that may occur within the Coos Bay estuary: New Zealand mud snails (*Potamopyrgus antipodarum)* and brackish water snail *(Assiminea parasitologica)*. Pacific Connector did not specifically address how it would deal with encounters with NAS while crossing Haynes Inlet. The company did state that it would not obtain hydrostatic test water from either Coos Bay or the Coos River, to prevent the spread of NAS from the estuary to inland watersheds.

Construction Across Inland Stream Habitats

Construction of the pipeline would affect 106 perennial stream sites, 151 intermittent stream sites, five ponds, and one estuary channel[102] (table 4.6.2.3-4; Haynes Inlet crossing discussed above not included in the table). A total of 229 locations would be direct channel crossings, while 34 would be locations where the water body is in the right-of-way clearing area. Direct impacts to six perennial streams would be avoided by placing the pipeline beneath them by HDD, DP, or conventional boring.

TABLE 4.6.2.3-4

Number of Streams and Ponds (excluding Haynes Inlet) Crossed or Adjacent to the Pacific Connector Pipeline, by Fish Status Category and Fifth-Field Watershed

Fifth-Field Watershed (Fifth-Field HUC)	Ponds a/	Perennial Streams	Intermittent Streams	Fish-bearing Streams/channel with: Anadromous Species (assumed) b/	Fish-bearing Streams/channel with: Resident Species (assumed) b/, c/	EFH Species and Habitat Present (assumed) b/	ESA Species or Habitat Present (assumed) b/
Coos County							
Coos Bay Frontal (1710030403)	1	41	20	15(2)	6(8)	12(7)	12(7)
Coquille River (1710030505)	0	5	1	2	1	0(2)	0(2)
North Fork Coquille River (1710030504)	0	3	9	2(1)	3	2(1)	2(1)
East Fork Coquille River (1710030503)	0	8	5	2(6)	5(2)	2(6)	2(6)
Middle Fork Coquille River (1710030501)	0	3	6	0(1)	0(3)	0(1)	0(1)
Douglas County							
Middle Fork Coquille River (1710030501)	0	3	3	0	0(3)	0	0
Olalla Creek-Lookingglass Cr (1710030212)	0	4	11	2(3)	3(1)	2(3)	2(3)
Myrtle Creek (1710030210)	0	5	5	3(2)	4(1)	3(2)	3(2)
Clark Branch-South Umpqua River (1710030211)	0	8	12	4	4	4	4
Days Cr. South Umpqua River (1710030205)	0	5	4	4	4	4	4

[102] Note that the values reported for stream crossings in this section (section 4.6) may differ from those reported in section 4.4 because this section does not include ditches in the analysis.

TABLE 4.6.2.3-4

Number of Streams and Ponds (excluding Haynes Inlet) Crossed or Adjacent to the Pacific Connector Pipeline, by Fish Status Category and Fifth-Field Watershed

Fifth-Field Watershed (Fifth-Field HUC)	Ponds a/	Perennial Streams	Intermittent Streams	Fish-bearing Streams/channel with: Anadromous Species (assumed) b/	Fish-bearing Streams/channel with: Resident Species (assumed) b/, c/	EFH Species and Habitat Present (assumed) b/	ESA Species or Habitat Present (assumed) b/
Upper Cow Creek (1710030206)	0	5	1	0	0(4)	0	0
Jackson County							
Upper Cow Creek (1710030206	0	0	1	0	0	0	0
Trail Creek (1710030706)	0	2	4	3	2	3	3
Rogue River-Shady Cove (1710030707)	0	4	13	1(1)	4	1(1)	1(1)
Big Butte Creek(1710030704)	0	3	6	2	2(1)	2	2
Little Butte Creek (1710030708)	2	4	31	3(3)	7(1)	2(4)	2(4)
Klamath County							
Spencer Creek (1801020601)	0	1	4	0	2(1)	0	0
Klamath R-John C Boyle (1801020602)	0	0	3	0	0	0	0
Lake Ewauna-Upper Klamath (1801020412)	1	1	1	0	1	0	1
Mills Creek-Lost River (1801020409)	2	1	11	0	0	0	1(7)
TOTAL	**6**	**106**	**151**	**43(19)**	**48(25)**	**37(27)**	**39(34)**

a/ All but one stock pond are not directly crossed but in ROW adjacent to direct pipeline locations.
b/ Known and assumed, possible or likely (value in parentheses) crossings or pipeline proximity with indicated fish category designation.
c/ Includes primarily cold water trout, but also estuarine species in lower Coos system, and endemic species in the Klamath Basin.

At one crossing of the South Umpqua River, Pacific Connector would use a diverted open cut. All other waterbody crossings that have flow at the time of construction would be crossed using dry open cut, which is designed to minimize activities directly in flowing water. Of streams that would be crossed using the dry open-cut method, about 36 are known to support anadromous salmon and/or steelhead and another 19 streams are assumed to also have anadromous species. Forty-two streams are known to support primarily coldwater resident fish, or important endemic species in the Klamath River Basin. Resident trout are mostly cutthroat trout. Twenty-three additional streams that would be crossed with dry open cut are assumed to support important resident fish. In all, about 87of the waterbodies that would be crossed by, or adjacent to, the pipeline are known or assumed to have fish. Pipeline construction could adversely affect EFH species in up to 63 streams, as well streams with numerous special status fish species crossings (see section 4.7 for ESA listed species). Our EFH assessment and BA (FERC 2015) describes impacts to those species occupying inland streams, and measures Pacific Connector would implement to avoid, minimize, or mitigate the impacts.

In-stream construction could interfere with essential life processes of aquatic species. The majority of the waterbodies identified as known, presumed, or classified as being fish bearing would be crossed using isolated or “dry” crossing construction techniques including the flume or dam-and-pump method if water is flowing in the waterbody at the time of construction. At one

site on South Umpqua, the diverted open cut method used would require diversion of the flow to one side of the channel at a time. Potential effects of trapping fish from these methods are discussed under Entrainment and Entrapment subsection below.

Timing of Construction

The degree of impacts on aquatic resources associated with construction activities would depend on the timing of in-water construction. Construction during periods of sensitive fish activity (i.e., spawning, juvenile and adult rearing, and migration) can have a greater impact on fish than construction during other periods. Pacific Connector would cross fish-bearing waterways during the in-water work windows specified by the ODFW in consultation with NMFS.

The timing restrictions would prevent construction during periods of sensitive fish use and would typically allow construction only in periods of lower flow rates in streams. In general, construction of the pipeline would be timed to miss periods of major juvenile or adult anadromous salmonid migrations in freshwater based on allowed fishery construction windows, typically July 1 to mid-September for most streams, and some other dates for specific waterbodies. These are tentative dates and timing restrictions would be subject to change by the ODFW. Any modifications to the allowable construction windows would be dictated by stream and fish migration conditions in the year of construction, and would be stated as conditions of state water crossing permits.

Sedimentation and Turbidity Resulting from Pipeline Installation Across Inland Freshwater Streams and Impacts on Aquatic Resources

Pipeline crossings of surface waterbodies would cause some downstream turbidity and sedimentation. The type of crossing and stream sediment characteristics can affect turbidity and suspended sediment in streams. Nearly all streams (96 percent) would be crossed using the dry open-cut method (flume and dam-and-pump) (table 4.6.2.3-5). Both "dry" techniques produce much less sediment in the water than alternative "wet" open cut methods (Reid and Anderson 1999; Reid et al. 2002; Reid et al. 2004). While several factors affect the effectiveness of dry construction methods, dry open-cut construction across waterbodies, if properly installed and maintained during construction and restoration, would produce minor levels of sediment and turbidity. Pacific Connector would minimize impacts on surface waters and aquatic resources by implementing the waterbody crossing and erosion and sediment control measures as described in its project-specific ECRP, which would reduce the risk of sediment releases during construction.

TABLE 4.6.2.3-5

Proposed Waterbody Crossing Methods for All Waterbody Crossings (excluding Haynes Inlet), by Subbasins and Fifth-Field Watersheds

Subbasins and Fifth-Field Watersheds	Number of Waterbodies Crossed, by Construction Method							
	HDD or Direct Pipe	Bore	Wet Open-Cut	Diverted Open-Cut	Dry Open-Cut	Total Crossed	Adjacent Not Crossed a/	Bedrock b/
Coos Subbasin								
Coos Bay-Frontal Pacific Ocean	1	2	1		53	56	6	1
Coquille Subbasin								
Coquille River					6	6		2
North Fork Coquille River					10	10	2	2
East Fork Coquille River					12	12	1	4
Middle Fork Coquille River					14	14	1	6

TABLE 4.6.2.3-5

Proposed Waterbody Crossing Methods for All Waterbody Crossings (excluding Haynes Inlet), by Subbasins and Fifth-Field Watersheds

Subbasins and Fifth-Field Watersheds	Number of Waterbodies Crossed, by Construction Method							
	HDD or Direct Pipe	Bore	Wet Open-Cut	Diverted Open-Cut	Dry Open-Cut	Total Crossed	Adjacent Not Crossed a/	Bedrock b/
South Umpqua Subbasin								
Olalla Creek-Lookingglass Creek					15	15		5
Clark Branch-South Umpqua River	1				14	15	5	3
Myrtle Creek					8	8	2	3
Days Creek-South Umpqua River				1	8	9		5
Upper Cow Creek					6	6	1	1
Upper Rogue Subbasin								
Trail Creek					5	5	1	2
Shady Cove-Rogue River	1				10	11	6	2
Big Butte Creek		1			7	8	1	4
Little Butte Creek					34	34	3	5
Upper Klamath Subbasin								
Spencer Creek					5	5		
J.C. Boyle Reservoir-Klamath River					3	3		
Lost Subbasin								
Lake Ewauna-Klamath River	1				1	2	1	
Mills Creek-Lost River					10	10	4	1
TOTAL	**4**	**3**	**1**	**1**	**221**	**229**	**34**	**46**

a/ Waterbodies within the construction right-of-way that will not be crossed
b/ Bedrock streambeds will be crossed by dry open-cuts but may require special construction techniques to ensure pipeline design depth including rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the contractor and would only be initiated after ODFW blasting permits are obtained. Numbers are not in addition to Total Crossed as they are already included in the Dry-open cut counts shown.

Duration of crossing can ultimately affect downstream impacts of turbidity and suspended sediment to aquatic resources. If channels are dry during construction, small streams (less than 10 feet) are projected to be crossed in less than 24 hours, and intermediate streams (10 to 100 feet) usually in less than 48 hours. Reid et al. (2004) noted that, in flowing streams they monitored, instream work averaged 38 and 64 hours for dam-and-pump and flumed crossings, respectively. However, failure of flow sealing and other instream structures at upstream diversions structures can occur from a variety of malfunctions such as pump failure, dam and flume failure, poor dam seal and others. Reid et al. (2004) noted seal failures of monitored diverted open cut crossing in 1 of 23 dam-and-pump projects and 5 of 12 flumed projects. Should these occur, suspended sediment would be relatively elevated over those without failure, but immediate repair work could reduce magnitude and duration of elevated suspended sediment.

General Effects

Increased sediment loads associated with high turbidity can have effects on fish behavior and physiological processes (e.g., blood chemistry, gill trauma, immune system resistance), and can result in mortality. Salmonids (e.g., trout and salmon) are the most common, abundant, and important species within Project area streams and often the most sensitive of common freshwater fish species to elevated suspended sediment. Approximately 40 percent all streams crossed in the Project area contain salmonids that could be affected if TSS levels are elevated. Salmonids exposed to moderate to high levels of suspended sediment for extended periods could be adversely affected. At high levels, turbidity and suspended sediment directly affects survival and growth of salmonids and other species and interferes with gill function (reviewed and compiled

by Bash et al. 2001). Turbidity can also reduce aquatic plant cover (over the long-term) by limiting photosynthesis (Goldsborough and Kemp 1988), as well as adversely affecting fish vision, which is a requisite for social interactions (Berg and Northcote 1985), feeding (Vogel and Beauchamp 1999; Gregory and Northcote 1993), and predator avoidance (Meager et al. 2006; Miner and Stein 1996).

Sediment stirred into the water column can be redeposited on downstream substrates, which could bury aquatic macroinvertebrates (an important food source for salmonids, and other fish in estuarine areas). Additionally, downstream fine particle sedimentation could affect spawning substrate habitat, spawning activities, eggs, larvae, and juvenile fish survival, as well as benthic community diversity and health (reviewed and compiled by Bash et al. 2001).

Some studies related specifically to pipeline stream crossing have found varied effects from sediment. For example, rapid recolonization of benthic organisms has been documented on 30 pipeline projects post-construction (Gartman 1984). One long-term study (during construction through three years post-construction) of multiple pipeline crossings of a coldwater streams found no measurable effect to fish or benthic resources or their habitat within two months to three years of construction (Blais and Simpson 1997).

Dry open-cut construction methods may have the potential to alter fish abundance over the short term. Reid et al. (2002) found that fish abundance downstream of dam-and-pump or flumed crossings reduced immediately after construction in two of four sampled sites, but concluded these reductions were likely not the result of sediment. Additionally, one year after construction, Reid et al. (2002) found no difference in fish abundance below these two sites from preconstruction levels.

Newcombe and Jensen (1996) compiled research from many sources that demonstrates effects to anadromous and resident salmonids by various levels of suspended sediment concentration and exposure duration. They used this information to develop models that estimated the severity of these effects based on sediment concentration and exposure duration.

Output from the model provides severity-of-ill-effects (SEV) scores that are summarized below. Values range from 0 to 14, where an SEV of 0 indicates no effects, an SEV between 1 and 3 indicates behavioral effects, an SEV from 4 to 8 indicates sublethal effects, and an SEV from 9 through 14 indicates lethal and paralethal effects (see Table 1 in Newcombe and Jensen 1996).

1) <u>Behavioral Effects SEV scores</u>
   - 1 = Alarm reaction
   - 2 = Abandonment of cover
   - 3 = Avoidance response

2) <u>Sublethal Effects SEV scores</u>
   - 4 = Short-term reduction in feeding rates and/or feeding success
   - 5 = Minor physiological stress (increase coughing rate and/or increased respiration rate)
   - 6 = Moderate physiological stress
   - 7 = Moderate habitat degradation; impact on homing

- 8 = Major physiological stress; long term reduction in feeding rate- feeding success; poor condition

3) Lethal and Paralethal Effects SEV scores
   - 9 = Reduced growth rate and/or delayed hatching and/or reduced fish density
   - 10 = 0 to 20 percent mortality and/or increased predation and/or moderate to severe habitat degradation
   - 11= >20 to 40 percent mortality (SEV scores exceeding 11 predict increased mortality rates)

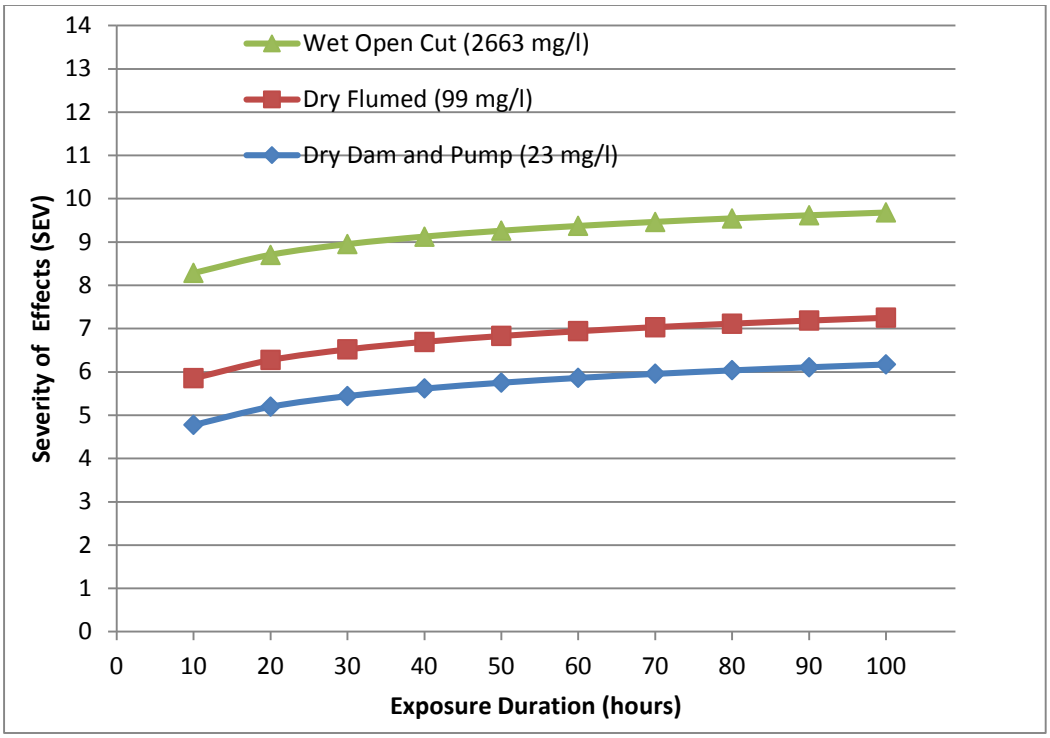
Newcombe and Jensen (1996) developed varied models for this assessment method. The one most relevant for this study is Model 1, which is used to estimate effects to both juvenile and adult salmonids and is based on 171 different study results.

Because of the uncertainty of both available site-specific information and the accuracy of models when applied to varied locations, two approaches were taken to estimate the concentration of suspended sediment and its effect on aquatic resources. One method used literature values from other stream pipeline studies concerning concentrations and durations of the activity to estimate reasonable approximations of likely sediment concentrations and effects to fish. The other was a detailed approach using models to predict sediment concentrations at Project stream pipeline-crossing sites based on known and assumed values, as presented in Pacific Connector's Resource Report 3.

Literature-Based Assessment of Sediment Effects

Application of the Newcombe and Jensen (1996) model to a collection of stream pipeline crossing locations supplies an approximation of what the likely range of effects may be to fish (primarily salmonid) resources in the project area. The Reid et al. (2004) data are the most complete set of literature information available on likely ranges of suspended sediment that may occur from various crossing methods and likely in-stream construction duration. Reid et al. (2004) measured suspended sediment downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings (dry open-cut or isolated pipeline construction crossings) and 11 wet open-cut construction crossings. He noted that average suspended sediment concentrations near these 11 "wet cut" crossing sites were 2,663 mg/l, whereas values were much lower at "dry crossing" sites, which averaged 99 mg/l (12 sites) and 23 mg/l (23 sites) for flumed and dam-and-pump sites, respectively. Using the mean values from Reid et al. (2004) and the Newcombe and Jensen (1996) sensitivity Model 1, the effects to salmonid resources can be approximated (see figure 4.6-3).

Based on the estimate of likely average conditions of construction at a crossing assuming the average of the Reid et al. (2004) suspended sediment values, SEVs for dam-and-pump crossings would be most likely in the range of 5, which could include short-term reduced feeding rate or minor physiological stress, considering the likely construction time of less than 55 hours. Flumed crossing sites would on average have slightly greater effects, with SEVs mostly in the range of 7, which could result in habitat degradation, considering crossings could take up to 92 hours. If some failure occurred in crossing methods, short-term effects would be greater. SEV values would be similar to those of wet open-cuts, likely in the range of SEV 8, implying adverse



Note: Based on the Newcombe and Jensen (1996) effects model based on typical suspended sediment concentrations and duration of elevated levels (data from Reid et al.2004) by crossing type.

Figure 4.6-3. Effects of Pipeline Stream Crossing Suspended Sediment Concentrations on Salmonids

factors such as long-term reduction in feeding success, with wet open cut crossing time closer to 16 hours or less. All levels of impact would remain sublethal even with some short-term failure in crossing methods, based on the literature concentration and duration values.

Active monitoring of pipeline crossing construction of mostly coldwater fish streams in New Hampshire found similar SEV level results to those shown above. Trettel et al. (2002) monitored suspended sediment levels within 50 to 150 meters (160 to 500 feet) downstream of the active pipeline crossing constructions sites and used information from 75 perennial streams consisting 71 dry dam-and-pump or flumed crossings and 4 open-cut wet sites to estimate SEV levels. They found that the average SEV of the dry crossings was 6.5 with no measurable difference between types of dry crossing, while the four wet crossings averaged an SEV of 7.4. The SEV level of 6 corresponds to moderate stress while SEV 7 suggests the lowest level where some habitat impacts would occur. They found that about one-third of the dry crossings equaled or exceeded this SEV level (7) of potential adverse habitat effects. Additionally, 99 percent of all crossings were less than the designated paralethal or lethal range (SEV of 9 or above). The biggest factor affecting elevated SEV levels was the portion of fines in the sediment at the crossing. These results suggest a very low probability of any direct fish mortality from construction, with local crossing area impacts consisting of mostly sublethal effects (e.g., physiological stress, short-term reduction of feeding), and limited habitat degradation.

The distance downstream effects could occur is dependent on many factors (e.g., substrate composition, velocity, flow, channel width). Ritter (1984) estimated that for a minor perennial stream (likely average only half a foot deep, and less than 20 feet wide), suspended sediment

concentrations may be near background levels in the range of 60 meters (200 feet) to 150 meters (500 feet) downstream during open-cut crossings. These stream sizes would be most typical of crossings along the pipeline route. Reid et al. (2002) found that below four separate dam-and-pump crossings, mean suspended sediment was less than 20 mg/l within 30 meters (100 feet) downstream. However, at another crossing where some high suspended sediment concentrations occurred from leakage, values 340 meters (1,100 feet) downstream were reduced to 20 percent of those at 45 meters (150 feet) downstream. Low concentrations during construction of crossings appear to be more common when BMPs are closely followed. For example, according to Pacific Connector, a Williams Northwest pipeline completed in Washington State had only one state turbidity standard exceeded out of 67 waterbodies crossings. Pacific Connector's Resource Report 3 estimated the changes of suspended sediment concentrations based on the Ritter (1984) model downstream of 13 project area subwatersheds using estimates of substrate sediment composition and other physical conditions at the crossing sites (e.g., width, depth, and flow). For the project area streams, based on the models used in Resource Report 3, the average estimate of change in concentration from construction sites downstream was estimated to be reduced to 23 percent of the initial concentration within 10 meters (30 feet), and 17 percent within 100 meters (330 feet) (assuming low summer flow conditions). The results suggest typical suspended sediment concentrations are likely to be less than 20 percent of initial concentration within 100 meters (330 feet) downstream, greatly reducing the effect to aquatic resources.

Based on the Reid et al. (2004) average values, effects to salmonids would be low, other than when sealing failure events occur at the planned dry crossings; the effects would likely range from short-term behavioral to short-term sublethal effects. Trettel et al. (2002) monitoring suggests adverse effects may be somewhat greater but still sublethal, with occasional local habitat degradation.

Model Estimates of Effects of Suspended Sediment

Pacific Connector (Resource Report 3) incorporated site data, regional data, and available literature-based models to provide an estimate of both suspended sediment level and extent of effects to aquatic resources from pipeline stream crossing construction based on their estimates of sediment concentration and exposure duration. The parameters used in this model assessment are variable and are based on a combination of some data and professional judgment. Thus, the results may be considered an approximation, rather than the exact suspended sediment levels that would be observed.

The method for approximating the concentration of suspended sediment at the specific crossing sites and distance downstream that various concentrations travel relies on the use of two separate models and empirical suspended sediment value comparisons from typical crossing sites for each crossing method. The first is a regression model that estimates the concentration at or near the direct installation area (Reid et al. 2004) (see above) based on selected physical stream conditions. The second model estimates the distance various concentrations of suspended sediment travel downstream (Ritter 1984) based on selected physical site data (see Resource Report 3 in Pacific Connector's 2013 application to the FERC).

The Reid et al. (2004) model, which included site-specific physical parameters at crossings, was used to predict sediment concentrations from a wet open-cut crossing at a subset of project

stream crossings. Since all project area crossings would be dry cut, these model estimates were adjusted downward to equal predicted dry cut crossing values based on the average relationship between wet cut and dry cut methods in the Reid et al. (2004) article. Mean suspended sediment concentrations generated during dry open-cut construction for dry fluming construction were 3.7 percent of the wet open-cut concentrations and 0.85 percent of the wet open-cut concentrations for dam-and-pump construction. Pacific Connector assumed in their model that if sealing of the site from stream flow failed during construction, the average suspended sediments levels at the crossing would be equal to wet cut crossing values.

All parameters used in this model (flow, stream width, velocity, percent silt and clay), except for median sediment size (this had an assumed value for all sites), were measured or estimated based on select crossings from fifth field watersheds in the project area. The details of how these values were estimated are presented in Pacific Connector's Resource Report 3.

The model by Ritter (1984) for small stream crossings was used to predict change in concentrations downstream of crossings based on stream characteristics (e.g., flow, depth, roughness). The details of how this model operates are provided in Pacific Connector's Resource Report 3. The distance concentrations would travel downstream at 10, 50, and 100 meters from the crossing site were estimated.

Estimates were made for 98 stream crossings for which sufficient data were available to conduct the analysis. These crossings were representative of the Project regions and ranges of stream width/gradient and would have normal dry open-cut crossings. Streams not modeled included the Upper Klamath River and Lost River subbasins, HDD or boring sites, and bedrock stream crossings (44 identified) that would have low sediment during crossings (see Resource Report 3 for details).

The resulting estimates of potential suspended sediment concentrations (without major crossing area sealing failures) indicate that suspended sediment concentrations would remain low in most project regions (Table 3.2-25 in Pacific Connector's Resource Report 3). Estimates of suspended sediment concentrations produced during pipeline construction under varied summer low-flow conditions may be highest for the six waterbodies crossed within the Coquille River fifth-field watershed, followed by crossings within the Coos Bay-Frontal Pacific Ocean fifth-field watershed, which is the result of assumed high fines concentrations at the crossings (see Table 3.2-21 in Pacific Connector's Resource Report 3). However, even for these streams, nearly all dry crossing estimates would be less than 100 mg/l within 10 meters (33 feet) downstream of the crossing site. For the other fifth-field watershed crossings where estimates could be made, the average suspended sediment concentrations produced during fluming and dam-and pump construction would be near background suspended sediment levels (about 2 mg/l). Nearly all estimates were less than 10 mg/l between 10 and 100 meters (33 and 328 feet, respectively) downstream from construction sites. However, as noted above, levels as low as about 17 mg/l may cause some short-term adverse effects to salmonids such as gill irritation and respiration issues for juvenile coho salmon.

If there is a failure of isolation structures during either type of dry open-cut construction, it is assumed that the suspended sediment generated during the failure would be similar to suspended sediment generated during wet open-cut construction. Suspended sediment concentrations assumed to occur during failure of isolation structures could be substantial. In waterbodies

within the Coos Bay-Frontal Pacific Ocean and Coquille River fifth-field watersheds, peak modeled suspended sediment might be as high as 2,110 mg/l only 10 meters (33 feet) downstream from construction and as high as 1,389 mg/l 100 meters (328 feet) downstream. However, the values are based on a single point estimate without consideration of how precise the model value is or how the variability of input parameters may affect the model output.

As noted above, Newcombe and Jensen (1996) developed models that estimate severity of effects on fish (primarily salmonids) based on the suspended sediment concentration and the amount of exposure time (i.e., assumed in-water construction period length) for various fish life stages. We used the results from Model 1 (effects to juvenile and adults salmonids) for the analysis in this EIS because those are the primary life stages and species of concern.

The duration of exposure to suspended sediment generated during dry open-cut construction at each of the 98 waterbodies is assumed to be similar to the empirical values presented in Reid et al. (2004) for all aspects of in-water construction (e.g., dam-and-flume placement and removal, and channel trenching).

The models were run for the two types of dry crossings (flume and dam-and-pump) that would be used for all stream crossing sites (except the HDD sites and one site on South Umpqua River). An additional set of models were run to estimate higher suspended sediment in water passing downstream if sealing methods used for dry crossings failed.

Exposures of juvenile and adult salmonids to suspended sediment concentrations estimated at flumed crossings range from 5 to 90 mg/l (Table 3.2-25 in Pacific Connector's Resource Report 3). These estimates are based on the range of suspended sediment concentrations during low flows, the period when in-stream construction would occur at 10, 50, or 100 meters (33, 164, or 328 feet) downstream from construction sites. Exposures to suspended sediment concentrations from 10 to 105 mg/l at 10, 50, or 100 meters (33, 164, or 328 feet) downstream from construction sites are expected during peak low flows. All flumed construction is assumed to be completed between 36 and 96 hours.

The highest suspended sediment concentrations would be expected during flume crossings within the Coquille River fifth-field watershed because of assumed high substrate fines (see Pacific Connector's Resource Report 3, Table 3.2-21). Some of the 42 dry open-cut crossings in this watershed would be by fluming. High concentrations would also be expected during flumed construction across waterbodies in the Coos Bay-Frontal Pacific Ocean fifth-field watershed, which is also assumed to have high substrate fines at the crossings. This watershed has 55 dry open-cut crossings, some of which would be by fluming. Results of Model 1 for juvenile and adult salmonids indicate most SEV scores for durations of exposure to the suspended sediment concentrations range from 6 (moderate physiological stress) to 7 (moderate habitat degradation and/or impaired homing) (Table 3.2-26 in Pacific Connector's Resource Report 3). Based on model uncertainties (inclusion of the upper 95 percent confidence intervals from Newcombe and Jensen 1996), SEV scores could be as high as 8 (indications of major physiological stress). All expected responses by adult and juvenile salmonids, to suspended sediment produced during fluming 10 meters or more downstream, would be classified as sublethal. For most waterbodies crossed, estimated suspended sediment concentrations produced by fluming are 5 mg/l or less between 10 and 50 meters downstream from construction during low flows or peak low flows. For that concentration, Model 1 SEV scores range from 4 (short-term reduction in feeding rates

and/or feeding success) to 5 (minor physiological stress), and possibly to 6 (moderate physiological stress). Overall, these effects would be short term, with most lasting less than 3 days. As noted above for value estimates of suspended sediment, the SEV estimates should be considered approximate because the range of accuracy and variability of the input parameters is not directly included in the model estimates. However, the results are reasonable considering that typical dry crossing methods have relatively low concentrations of suspended sediment of short duration (Reid et al. 2004).

Where dam-and-pump crossing methods are used, exposures of fish to modeled average suspended sediment concentrations would range from less than 5 to 22 mg/l during low flows at 10, 50, or 100 meters (33, 164, or 328 feet) downstream from construction sites (Table 3.2-25 in Pacific Connector's Resource Report 3). Exposures to modeled average suspended sediment concentrations may be slightly higher (less than 5 up to 26 mg/l) during peak low flows at 10, 50, or 100 meters (33, 164, or 328 feet) downstream from construction sites. All dam-and-pump construction is assumed to be completed within 20 to 56 hours. Values in this range of suspended sediment and expected exposure periods are used to estimate the SEV values shown in Table 3.2-27 in Pacific Connector's Resource Report 3.

The highest suspended sediment concentrations would be expected during dam-and-pump construction across streams within the Coquille River and Coos Bay-Frontal Pacific Ocean fifth-field watersheds for the same reasons as discussed for fluming. Results of Model 1 for juvenile and adult salmonids indicate most SEV scores for durations of exposure to the suspended sediment concentrations would be 5 (minor physiological stress with increased coughing rate and/or increased respiration rate) or 6 (moderate physiological stress). Similar to flume crossing, overall effects would be very short term, with most less than 2 days.

Failures of isolation dams/structures to exclude streamflow during fluming or dam-and-pump could result in increased suspended sediment entrained downstream, assumed to be the same as concentrations generated during wet open-cut construction (Table 3.2-25 in Pacific Connector Resource Report 3). Scenarios of exposures of 1 hour and 6 hours could occur while work crews repair the failed isolation dam structures. Longer exposures of 12 and 24 hours are assumed to occur if dry open-cut construction (flume or dam-and-pump) is abandoned and the waterbody crossing is completed using wet open-cut construction. The mean time required for wet open-cut crossings was 13.7 hours with standard error of 2.0 hours (Reid et al. 2004). Therefore, durations of 12 and 24 hours are reasonable to complete a crossing if a dry open-cut fails. With the high suspended sediment concentrations expected during wet open cuts of waterbodies in the Coquille River and Coos Bay Frontal fifth-field watersheds, durations of 1 and 6 hours during low flows and peak low flows would generally result in sublethal effects to salmonids, with SEV scores ranging from 5 (minor physiological stress) to 8 (major stress, such as long-term reduced feeding success) (Table 3.2-28 in Pacific Connector's Resource Report 3). Wet open-cut construction lasting from 12 to 24 hours would also result in SEV scores of 8 or lower. The effect under likely scenarios if failure occurred would remain at sublethal levels. The only exception may be in the estimated highest concentrations and longest possible durations for the two high substrate fines watershed where paralethal effects may occur with SEV levels of 9 (e.g., reduced growth/reduced fish density). Even under failure, effects would be very short term, likely a day or less, although some redistribution of sediment may occur over time with these higher concentrations.

No open-cut or dry-cut crossings would occur when any known salmonid resource, including spring Chinook salmon, would be spawning near a crossing during the designated approved construction window, so direct effects to spawning are unlikely. Overall, the potential effect of suspended sediment on spawning activities of spring Chinook salmon would be limited to close proximity to the South Umpqua River diverted open-cut crossing.

Summary of Suspended Sediment Effects

While the modeled results supply a reasonable estimate of likely level of effects to primarily salmonid fish resources, the models rely on multiple input parameters (e.g., substrate composition and size distribution of fines, median substrate size (d_{50}), and water velocity at each crossing) that are predicted. Therefore, overall summary assessment of effects considered both literature results from other pipeline crossings and the modeled results of project area streams. For both modeled and literature-based assessments, effects would be mostly short term (less than 1 to 4 days) and remain near the crossing location (downstream distance a few hundred feet).

Overall model results are based on regional watershed averages; however, some site-specific conditions may vary from these averages. However, the literature-based values of typical project-wide effects provide similar results, suggesting more specific model estimated effects are reasonable. The results for either method are that crossings would cause at least some short-term adverse effects, primarily avoidance, short-term feeding reduction, and likely minor stress. No long-term adverse effect would likely occur unless some major failure occurred during construction. However, if failure occurred under certain conditions, some marked effects could occur including reduced fish density of salmonids in a limited stream area.

Because of the linear nature of the Project, the number of stream crossings and ultimately total area of stream habitat and individual streams that would be affected in any watershed would be extremely small. There would be from zero to 56 crossings per fifth-field watershed, which totals 211 actual stream channel crossings in 231 miles of pipeline route over 19 fifth-field watersheds. Since almost no individual stream would have more than one crossing, effects to each stream would be limited to the crossing location. As an example of the relative portion of streams that may be affected in the short term by stream crossings, we examined the potential stream area affected in the four fifth-field watersheds of the Coquille subbasin, a route area with a high number of stream crossings. Those four watersheds have 3,093 miles of stream (Ecotrust 2015). The Project would cross 42 stream channels in that length. Assuming an effect area from sediment of 400 feet per stream crossing, about 0.1 percent of all stream length in these four watersheds would have some short-term effect from sediment during construction. Overall cumulative effects would be unsubstantial based on the dispersed distribution of crossings and magnitude of effects at each and lengths of stream channel potentially affected.

Inadvertent Release of Drilling Mud from HDDs

Pacific Connector proposes to use the HDD method to cross under the Coos, Rogue, and Klamath Rivers. Generally, an HDD would avoid direct impacts on a river and its associated aquatic resources. However, an HDD requires the use of drilling mud as a lubricant during the process. This fluid is under pressure and there is a possibility of an inadvertent release of drilling mud through a substrata fracture, allowing it to rise to the surface (also referred to as a frac-out).

Drilling mud primarily consists of water mixed with bentonite, which is a naturally occurring clay material. Bentonite by itself is essentially non-toxic (Breteler et al. 1985; Hartman and Martin 1984; Sprague and Logan 1979). However, bentonite, can act like a fine particulate sediment in water, which could affect aquatic resources. The dispersal of drilling mud from a frac-out in a stream could interfere with oxygen exchange by clogging the gills of aquatic organisms (EPA 1986). The degree of interference generally increases with water temperature (Horkel and Pearson 1976). Sediments in high concentrations can clog gills, impair vision, make it difficult to feed, and increase the chance of predation. Drilling mud that accumulates on the stream bottom could cover over food sources and eggs. The majority of highly mobile aquatic organisms, such as fish, would be able to avoid or move away from the affected area. Other less mobile or immobile organisms, such as mussels and other macroinvertebrates, would incur direct mortality if smothered by the drilling mud. Impacts would be localized and short term, limited to species in the immediate vicinity of the frac-out, and ameliorated by river volume.

The effects of an in-stream frac-out on spawning habitat, eggs, and juvenile survival depend on the timing of the release. If spawning habitat is nearby, redds could be affected near a frac-out (Reid and Anderson 1999). During establishment of the spawning bed, the female as part of the normal preparation behavior would likely clean out a minor addition of sediment. However, a heavy sediment load dispersing downstream could settle into spawning beds and clog interstitial spaces, reducing the amount of available spawning habitat, which could be a limiting factor in areas of already reduced habitat. When redds are active, eggs could be buried, disrupting the normal exchange of gases and metabolic wastes between the egg and water (Anderson 1996). The impacts of sediment intrusion into the redd on larval survival are more severe during the earlier embryonic stages than following development of the circulatory system of larvae, possible because of a higher efficiency in oxygen uptake by the older fish (Shaw and Maga 1942; Wickett 1954). Clogging of interstitial spaces also reduces cover and food availability for juvenile salmonids (Cordone and Kelley 1961). Benthic organisms could also be affected by burial. However, bentonite is more likely to stay in suspension and less likely to immediately settle than common bottom sediment so, in flowing water effects on benthic organisms from burial under a release of drilling mud are likely to be low and unsubstantial.

To prevent a frac-out or deal with an occurrence, Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*.[103] As also discussed in section 4.4, the plan outlined measures that would be implemented in the case of a frac-out into an aquatic environment. These measures include, but are not limited to:

- temporarily halting the HDD, and sealing the source of the leak in the fractured zone;
- contacting agencies and developing a site-specific treatment plan;
- deploying containment structures, if feasible;
- monitoring locations downstream of the HDD to identify areas of drilling mud accumulation; and
- removing the drilling mud from substrate and streambanks, if possible.

[103] This plan was attached as Appendix 2H of Resource Report 2, in Pacific Connector's June 2013 application to the FERC.

At the site of any frac-out, the amount of drilling mud released into a waterbody would be low. The HDD locations are all under major rivers, with large volumes of water and swift flows, where the drilling mud would be diluted. We conclude that an inadvertent release of drilling mud from an HDD would have minor short-term adverse effects to aquatic resources.

Streambank Erosion and Stream Bed Stability

The clearing and grading of vegetation during construction could increase erosion along streambanks, resulting in sedimentation and higher turbidity levels in the waterbodies crossed. Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. Erosion, sedimentation, and higher turbidity levels related to the Project could affect aquatic resources, as discussed above. The degree of impact on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbulence, streambank composition, and sediment particle size.

The rootwad network of trees adjacent to stream supplies bank stability. Those within 25 feet of the stream are considered most important at providing the root source aiding in bank stability (WDNR 1997). To aid in maintaining this bank stability, Pacific Connector would cut most trees near the bank, except those in the trench line, at ground level leaving the root systems in place helping to maintain short-term bank stability. Roots would be removed over the trench line or from any steam banks that would need to be cut down or graded to accomplish the pipeline crossing. To minimize these impacts, Pacific Connector would use temporary equipment bridges, mats, and pads to support equipment that must cross the waterbody (perennial, intermittent, and ephemeral if water is present) or work in saturated soils adjacent to the waterbody. Pacific Connector would also install sediment barriers, such as silt fence and straw/hay bales, across the right-of-way at the edge of waterbodies throughout construction except for short periods when the removal of these sediment barriers is necessary to dig the trench, install the pipe, and restore the right-of way.

The pipeline would be designed to ensure it does not become exposed from potential occurrence of bed scour and channel migration, which may include increasing the depth of cover to more than the 5-foot minimum to accommodate the potential for long-term channel changes. At a minimum, Pacific Connector would design all waterbody crossings to meet DOT CFR 49 Part 192 standards. For perennial crossings on federal lands, the site-specific crossing restoration plans (appendix J, 2014 Supplement) would be used in lieu of previously submitted approaches by the applicant. Additional depth would be evaluated and considered based on GeoEngineers (2013f, 2015) channel migration and scour analysis methods or other site-specific investigations, considering the final route alignment. The channel migration and scour analysis rated crossings as to their risk of pipe exposure. The analysis screened sites initially with available data (e.g., aerial photos, LiDAR) and rated them for potential risk. Those sites considered to have potential risk of pipe exposure were evaluated in more detail including site-specific data and, where deemed necessary, would have additional procedures taken to ensure that likelihood of pipe exposure is eliminated. From the results of the channel migration and scour analysis, Pacific Connector would design all crossings that were assessed in detail to bury the pipe below the 100-year scour depth and, for streams likely to have channel migration, outside and below the 50-year channel migration zone. Additional analysis prior to construction would be needed for sites that were not accessible due to property rights. All crossing sites would have pre- and post-

construction surveys conducted in order to document (by post-construction conditions monitoring) that each crossing has been restored to pre-construction conditions (or better) after project construction. Crossing of various risk categories will have additional BMPs as described below.

In addition to a FERC permit, local, state, and federal permits approvals would be sought for final designs and installation procedures before construction would occur. These would help ensure that the pipeline would not become exposed and reduce potential for contribution to bed and bank scour and prevent impedance to fish passage from pipe exposure.

The FWS expressed concerns that more detailed site-specific information on bank material, streambed composition, shoreline vegetation and other information is needed to adequately ensure that actions occurring at a stream crossing do not significantly increase streambank erosion and streambed instability. Pacific Connector, in response to these requests, has conducted an initial assessment of crossing conditions of all streams suitable for analysis based on the FWS risk matrix (GeoEngineers 2013c). GeoEngineers, using a combination of field and GIS data, rated the 215 pipeline stream crossings based on the matrix. The matrix has two axes rating the crossing based on the potential project effects to the crossing and the relative stream response at the crossing. Each crossing was rated as low, medium, or high for each of the two axes (all stream crossings were placed into one of nine categories, such as Low–Low, Low–Medium, Medium–High).

No crossing was rated as having both high risk of project impact potential (i.e., high risk of project impacts and high risk of site response potential) and high risk of stream and site response potential. If any crossing had been in this category, Pacific Connector indicated a site-specific crossing plan, similar to that required by FERC for stream crossings over 100 feet wide, would be developed. Should later assessment of the crossings (see below) find that a crossing is in this category, a site-specific plan would be developed prior to construction.

GeoEngineers (2013c) grouped the nine risk categories into five categories based on generally similar risk of streams being affected, with all but one containing two risk categories, and labeled these as color management categories (Blue, Green, Yellow, Orange, and Red). Those stream crossings with the lowest stream response potential and a low or moderate project impact potential (96 total), designated as the Blue category, would be crossed using project-typical BMPs. These project-typical BMPs would be applied to all streams while additional BMPs would be applied to the other crossings depending on their rated category of risk. The remaining stream crossings, which include 119 crossing (Green 15, Yellow 85, Orange 19, Green 15 categories), were originally designated in the 2013 report to have a variety of additional BMP actions taken to reduce the probability of stream bank and bed erosion or instability from project actions (see pre-construction surveys below). The Green category had streams with high project impact potential but low and moderate stream response. The Yellow category included all other streams with moderate stream response potential and Orange those with high stream response potential. Stream crossings that are unstable can ultimately adversely affect aquatic resources from such factors as loss of local habitat and impacts to downstream habitat from addition of high unstable sediment addition and overall increase in recovery time of the specific site to stable conditions. The Orange category crossing includes crossings with the highest stream response potential and were therefore considered of greatest risk from project actions on bank and bed stability. Those in the Yellow

category contained all of the crossings with moderate stream crossing risk potential and therefore of lower potential risk for channel and bank effects. The Red category had no crossings.

Additional follow-up surveys of selected accessible sites, analysis, and modification of recommended crossing BMPs, and some sited specific crossing designs occurred in 2014 (GeoEngineers 2015). The applicant directly surveyed 60 proposed crossing sites and representative streams of another 11 sites in 2014, including about half of the Orange category sites (access was not available for the other Orange sites) which includes two crossing not included in the original analysis for a total of 217 crossing assessed. These surveys resulted in some changes in categories with final category distribution of Blue (125), Green (14), Yellow (61), Orange (19), and Red (0). GeoEngineers (2015) developed more specific BMPs of bed and bank restoration that would be applied to project-induced disturbed areas of streams on a case-by-case basis (determined at the time of construction). These would be applied to streams in at least the Yellow category. Additionally, for eight surveyed Orange crossings (Middle Creek [MP 27.04], Tributary to East Fork Coquille [MP 29.49], Elk Creek [MP 32.40], Tributary to Big Creek [MP 37.35], Upper Rock Creek [MP 44.21], East Fork Cow Creek [MP 109.47], West Fork Trail Creek [MP 118.89], and South Fork Little Butte Creek [MP 162.45]), GeoEngineers developed specific crossing plans that designate the types of bed and bank restoration that would occur at each of these sites, primarily from the list of those to be used at Yellow category sites. Also there would be eight crossing sites (Middle Creek [MP 27.04], Tributary to Big Creek [MP 37.35], Deep Creek [MP 48.27], Tributary to East Fork Cow Creek [MP 109.17], East Fork Cow Creek [MP 109.47], Tributary to East Fork Cow Creek [MP 109.69], Tributary to East Fork Cow Creek [MP 109.78], and South Fork Little Butte Creek [MP 162.45]) that are on federal lands and at which the BLM and Forest Service have developed specific BMPs they want implemented. GeoEngineers (2015) indicated those specific BMPs would be followed at those sites using the direction included in the appendix J 2014 Supplement.

In addition, substrate characteristics and physical habitat features would be determined through pre-construction surveys, and the upper 1 foot of existing substrate would be replaced and other physical conditions matched during reconstruction after pipe installation. Clean spawning gravel would be top dressed as appropriate and composition would be based on pebble counts or other appropriate methods on a site-specific basis – on federal lands, this would require review and approval by agency staff and line officers prior to implementation. Many of these actions would be determined prior to construction based on results of the pre-construction survey (see below) and determined by a qualified EI specifically trained to determine proper restoration actions to implement based on river channel processes or a suitably trained professional. On non-federal lands, this person would have the authority to select appropriate additional BMP construction methods, bank stability actions, revegetation types and methods to help reduce the risk of instability of the crossing and potential for future erosion (GeoEngineers 2013c, 2015).

A pre-construction survey would be conducted by a technically qualified team on all stream crossings to confirm and clarify conditions developed in the aforementioned matrix analysis. This would include surveys of sites currently not accessible due to property ownership issues. Following these surveys, if significant changes were to occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If any crossing is moved into the “high” project impact and “high” stream response risk matrix category, a site-specific crossing design would be developed for that site. Following the final surveys, special additional BMPs, as described in GeoEngineers (2013c, 2015), would be implemented depending on individual site conditions and may include

such actions as changes in bank material and bank angle modifications, specific substrate composition used, plants used on the bank, artificial stabilizing bank material, rootwad enhancement, type of bed and bank restoration structure and various other actions.

The approach described above, which would include more site-specific information and possibly more site-specific designs based on the pre-construction survey, is expected to be suitable for the protection of aquatic resources at waterbody crossings. The final procedures would ultimately need to obtain state and other federal permit-process approval before construction is conducted (if approved) at specific sites.

As a measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector, as part of their pipeline integrity monitoring, would observe all stream crossings, regardless of risk, annually and note any obvious signs of channel erosion, pipeline exposure, or major shifts in restoration elements. Where any problems were noted during this annual assessment, a follow-up visit by geo-professionals would occur (GeoEngineers 2015). On a quarterly basis, over two years after construction at all perennial crossings on federal lands as well as the highest risk sites identified on non-federal lands (Orange category) monitoring of vegetation success, stability of restoration elements, fish passage status, channel migration, erosion, head cutting, and other channel characteristics would be monitored. Additional forms of monitoring (e.g. vegetation, animal browse, and continued channel/restoration status) would occur at varied sites over varied intermittent periods over a 10-year period, with highest frequency and intensity of monitoring effort at sites of greatest risk of channel and bank instability. Frequency and type of monitoring may be adjusted based on site-specific conditions. In addition, flow and rainfall events would be recorded to understand the response of sites to flow events. Unscheduled monitoring may occur at crossings on BLM and NFS lands following 25-year rainfall events to assess channel, bank, restoration structure, and vegetation conditions including field measurements. Remediation of adverse conditions with channel stability or habitat found during the monitoring would occur. Reports of the monitoring would be developed for years 1, 2, 3, 5, 7, and 10 after construction describing observations made and any remedial actions taken.

Crossing Unstable Slopes

Slope failure near the waterbody during pipeline operation could result in soil and sedimentation falling into the waterbody. Pacific Connector evaluated all likely unstable areas during selection of the proposed pipeline route, and moved the route as necessary to areas considered to have low risk. Only one field-surveyed moderate risk area approximately between MPs 18.14 and 18.20 just upslope from a small (2-foot-wide) stream, a tributary to Cunningham Creek, is known to remain along the route. The known landslide risk areas have thus been all but eliminated from the route.

Resuspension of Potentially Contaminated Sediments

Elevated heavy metals in water and sediment can have adverse effects on aquatic organisms. Fish and other aquatic organisms are sensitive to mercury levels even at very low concentrations. Because of concerns about hazardous waste from historic mining activities in the vicinity of the crossing of the East Fork Cow Creek (approximately MPs 109 to 110), Pacific Connector evaluated the currently proposed route in the area for mercury-contaminated soils and stream sediment. Examination of the underlying rock type (volcanic) of the proposed route indicates it is unlikely to contain elevated mercury in the bedrock (GeoEngineers 2009b). Broeker (2010b) examined this route and sampled soil and stream samples near the proposed stream crossings. Of

the three crossing measurements, one value (0.29 milligram per kilogram [mg/kg]) exceeded the ODEQ Level II screening value for freshwater (0.2 mg/kg). The other two were less than the freshwater value but two of the three were equal to or exceeded the bioaccumulation value of 0.07 mg/kg. The six soils samples were considered low in mercury, although they were slightly higher than the ambient background levels. Two intermittent stream channels occur up slope in this region that theoretically could carry sediment and related mercury downslope. However, Broeker (2010b) concluded that these intermittent streams would stop on upslope benches and not reach the stream. He concluded upslope delivery to streams was not likely unless erosion was not controlled. Special erosion control provisions, in addition to what usually are implemented, were agreed to by Pacific Connector for this region to reduce possibly elevated mercury levels reaching the stream (Pacific Connector 2013).

Additionally while levels of mercury in the East Fork Cow Creek are sometimes over ODEQ Level II screening levels, little sediment would be disturbed or suspended from the crossing activity since the crossing would be done in the dry. With adjacent upland disturbance following the standard ECRP and supplement erosion control actions, upslope potential sediment entry into the stream would be eliminated. Overall, adverse effects to fish from mercury would not occur from Pacific Connector Pipeline Project actions despite occasional elevated mercury levels that naturally occur, because upslope soil erosion would be controlled and dry crossing methods would be used in East Fork Cow Creek, limiting sediment disturbance.

Vegetation and Habitat Removal and Modification

Section 4.5 and the wildlife portion of 4.6 (see above) lists the acres of riparian habitat that would be directly affected by all construction-related activities. Much of this habitat is in forested areas, where stream shading and organic input are most prominent. This area is within one site potential tree height of the stream, the area near streams with the greatest potential effects to stream. Federal lands have additional areas called Riparian Reserves, which are different than the riparian areas shown here (see section 4.1.3.5 and table 4.1.3.5-1a for Riparian Reserve acres). Table 4.6.2.3-6 lists riparian areas disturbed by construction adjacent to perennial and intermittent waterbodies crossed by the pipeline. Removal or alterations in other habitats (e.g., clearcut/regenerating forest, shrub and grasslands, and wetlands) would also contribute to effects on aquatic resources, but to a lesser degree because riparian influence (e.g., shade, organic input, sediment and nutrient filtration) on stream conditions would be less.

Pacific Connector would minimize impacts on riparian vegetation by narrowing the width of its standard construction right-of-way at waterbody crossings, and by maintaining a setback between waterbody banks and TEWAs in forested areas. A riparian strip at least 25 feet wide on private lands and 100 feet wide on federally managed lands, as measured from the edge of the waterbody, would be permanently revegetated. Pacific Connector would plant native tree and shrub species along all fish-bearing streams. Within a 30-foot-wide corridor centered on the pipeline, plants would be kept less than 15 feet high. Overall, about 82 acres (19 percent) of former riparian habitat cleared by pipeline construction would be maintained long term in an herbaceous state. The management of vegetation including the riparian areas is presented in detail in section 4.5. Restricting the low-growth vegetation area to a small portion of the total right-of-way clearing would allow much of the ecological function of the riparian conditions relative to fish needs (e.g., shade, future LWD, and organic input) to more quickly return. This would limit the overall long-term impacts of loss of riparian habitat to a small portion of each stream crossed, reducing future negative effects to fish resources.

TABLE 4.6.2.3-6

Total Riparian Area (acres within one site-potential tree height distance) Disturbed (a/) by Construction Activities Adjacent to Perennial and Intermittent Waterbodies Crossed/Near by the Pacific Connector Pipeline

	Forest Habitat b/					Other Habitat b/						
Landowner	**Late Successional Old-Growth Forest**	**Mid-Seral Forest**	**Forest Regenerating**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland c/**	**Wetland Nonforested c/**	**Nonforested Habitat Unaltered**	**Agriculture**	**Altered Habitat**	**Other**	**Total Riparian Area Impact (acres)**
BLM-Coos Bay District	4	8	6	2	20	0.0	0.0	0	1	2	0	**23**
BLM-Roseburg District	3	2	<1	0	5	0.0	0.0	0	0	<1	<1	**5**
BLM-Medford District	9	3	0	0	12	0.0	0.0	5	0	<1	<1	**18**
BLM-Lakeview District	1	0	0	0	1	0.0	0.0	<1	0	<1	<1	**1**
Forest Service–Umpqua National Forest	2	4	2	0	8	0.1	<0.1	0	0	3	<1	**12**
Forest Service–Rogue River National Forest	<1	<1	1	0	2	0.0	0.0	<!	0	0	<1	**2**
Forest Service–Winema National Forest	2	<1	2	0	5	0.3	0.0	<1	0	<1	<1	**5**
Federal Subtotal	**22**	**17**	**11**	**2**	**52**	**0.4**	**<0.1**	**5**	**<1**	**6**	**1**	**66**
Non-Federal Subtotal	**10**	**60**	**70**	**8**	**147**	**2.0**	**36.9**	**64**	**57**	**23**	**85**	**415**
Overall Total	**32**	**77**	**81**	**10**	**199**	**2.4**	**40.0**	**69**	**58**	**29**	**86**	**481**

Note: Rows/columns may not sum correctly due to rounding. Acres rounded to nearest whole acre; acreages less than 1 are shown as <1.

a/ Project components considered in calculation of habitat "Removed": Pacific Connector construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads. Note that federal lands have "riparian reserve" areas along streams that differ in size than those areas shown here.

b/ Habitat Types within Riparian areas generally categorized as: Late Successional (Mature) or Old-Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Wetland Forested, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

c/ Acreages for wetlands and estuarine areas are rounded to the nearest tenth of an acre.

Water Temperature

The effects of water temperature on salmonid life stages have been extensively reviewed by McCullough (1999) and others. Maximum water temperatures ranging from 71.6 to 75.2°F (22 to 24°C) limit distribution of many salmonid species. For spring Chinook salmon, for example, the optimum temperature for growth is 60.1°F (15.6°C) and higher temperatures during summer could reduce growth and lead to increased mortality rates (McCullough 1999). Vegetative cover that provides shade, especially during summer, is one factor that regulates water temperature (WDNR 1997). If sufficient loss of shade occurs, temperatures in streams are known to increase. Increasing stream temperatures can result in reduced fish production and spawning success, and, if high enough, reduced fish survival also, especially for important northwest salmon and trout species found in many project area streams. The current Oregon state water quality temperature standards, which are addressed in section 4.4 of this EIS, include provisions to limit anthropogenic increases in stream temperature especially in salmon- and trout-bearing streams. Construction of the pipeline across waterbodies would necessitate removal of trees and riparian shrubs at the crossing locations that may influence these stream temperatures. Pacific Connector has proposed to mitigate potential temperature increases on waterbodies through riparian plantings at selected sites and project-wide depending on landowner approval (appendix S). This would include, as mitigation for loss of riparian shade vegetation, replanting the equivalent of 1:1 ratio for construction or 2:1 for permanent riparian vegetation loss impacts (GeoEngineers 2013i).

Available information on the effects of pipeline construction in other regions on water temperature has found no or immeasurable change. The total width of riparian area affected by shade tree removal would be small (less than 100 feet) relative to the length of any stream crossed. In one study, construction across two coldwater, fish-bearing streams in Alberta required removing forested riparian vegetation; water temperatures at construction sites and downstream did not increase above temperatures at control sites upstream from construction (Brown et al. 2002). Similarly, water temperatures measured at four coldwater streams in New York before and during pipeline construction and for three years following construction showed no short-term or long-term effects on water quality parameters, including water temperature, even though such effects were expected because streambank vegetation had to be cleared, which reduced shading (Blais and Simpson 1997). In the Alberta study, the highest water temperature recorded was 66°F (19°C in August). In the New York study, the highest temperature was 79°F (26°C during sometime between August and October). Long-term average water temperatures recorded during July-August in Elk Creek (a tributary to the Umpqua River) at USGS gauge 14338000 are 72 to 73ºF, intermediate to water temperatures in the Alberta and New York studies. Conditions in Oregon appear comparable to those in the cited studies.

Another recent right-of-way clearing study in Oregon found little to no effect from existing and proposed right of clearing on coldwater Cascade mountain streams (Tetra Tech 2013). Monitoring of 22 existing cleared right-of-ways for transmission lines in the Cascade region along the upper North Santiam River averaging 244 feet wide found no significant temperature (peak daily average, and daily maximum) change across the clearings compared to existing uncleared areas on each of these streams. While temperature changes did occur across the clearing (average of peak daily maximum change 0.19°F/100 feet of stream), these increases were no different from the temperature changes in the uncleared wooded areas just upstream of these clearing. While these streams did retain some vegetation in the right-of-way, they were

kept relatively low to ensure no issues with the power lines. Modeling of these streams using the SSTEMP (Bartholow 2002) estimated some relatively small increases, which were generally greatest for smallest streams. The model assumed all or most vegetation would be removed from banks over a 150-foot-wide projected clearing. The results for both existing (summer 2012) and projected worst-case (likely maximum summer air temperature) environmental conditions with very conservative shade assumptions (0 and 25 percent for entire 150-foot clearings) showed an average increase of about 1.1°F (median of about 0.4°F) in the modeled maximum and maximum daily mean temperature across the assumed future clearing of these 22 streams. The small size of the streams in this study affected the model results. All but three of the streams had flow less than 1 cfs and width less than 10 feet. The three larger streams had modeled maximum temperature changes ranging from 0.0 to 0.2°F. Most of these streams had relatively low to moderate temperatures (mean maximum about 55°F); therefore, these low temperature increases were generally not expected to affect fish resources.

An additional model analysis for the Pacific Connector project effects on stream temperature was completed by GeoEngineers (2013i). This analysis also used the SSTEMP model by Bartholow (2002) to estimate potential temperature effects at 15 pipeline crossing locations (each a 75-foot-wide clearing) along the whole route. The streams selected varied in size from 2- to 85-foot-wide (average 29 feet), moderately large streams, with only eight of these having a less than 10-foot flowing width. Conditions modeled were based on conditions measured during late August 2010 and did not consider maximum potential air temperatures though they were likely representative of summer conditions. The average modeled increased for these 15 streams was 0.03°F, and the maximum increase among the streams was 0.3°F. Overall, these estimated changes are relatively low. They are lower than the North State Resources (2009) estimates for one comparable stream, but model conditions were slightly different.

Additional project-specific temperature modeling was also conducted on federal lands stream crossings. Temperature modeling, again using SSTEMP (Bartholow 2002), was conducted at the perennial stream crossings on BLM lands at Middle Creek Deep Creek and Big Creek, and NFS lands at multiple crossing on the East Fork Cow Creek in 2009 and again in 2013 to reflect new pipeline alignment and lower flow conditions (NSR 2009, 2015a,b). During 2013, temperature data recorders were placed at selected locations relative to each crossing during the warmest low-flow summer period to help validate the model. Flows in 2013 represented drought conditions and were about 33 percent of those modeled in 2009 at MP 109.69 in the East Fork Cow Creek. When compared to measured existing conditions, the SSTEMP model overestimated the lower flowing streams' actual existing stream temperature slightly (about 0.2 to 0.4°F) (NSR 2015a,b), indicating the inherent uncertainty in modeling stream temperatures in very small stream channels, and the potential to overestimate temperature changes in small streams.

Model analysis completed in 2014 for perennial stream crossings on BLM and NFS lands of right-of-way clearing effects predicted slight temperature increases on the BLM channel crossings in Middle Creek (0.1 °F) and higher increase on a small tributary to Big Creek (1.1°F). Limited temperature changes likely were due to relatively higher flows (Middle Creek), cooler air temperatures and relative channel orientations (NSR 2015a). During the drought conditions of 2013, modeled 7-day maximum stream temperature just below in the multiple East Fork Cow Creek crossings showed potential temperature increases of 1.2°F to 4.2°F under the rare drought flow conditions that occurred in 2013 (NSR 2015b). Measured stream volumes ranged from

0.045 cubic feet per second to 0.115 cubic feet per second with modeled total vegetation removal in the whole 75-foot right-of-way for post-construction shade levels ranging from 1.2 to 3.7 percent. Under the drought conditions of 2013 (high temperature and low flow), modeled results suggest temperatures may exceed the TMDL thresholds (0.1°C or 0.18°F at the point of maximum impact) or ODEQ Core Cold-Water Habitat temperature criteria of 16 °C (61 °F) in small perennial channels in the East Fork Cow Creek. This occurrence likely overestimates temperature changes that would most often occur, because of the rare conditions that occurred in 2013 and the potential to overestimate temperature in low-flow channels from the SSTEMP model as noted above. The 2015 analysis showed larger temperature increases than those reported in NSR (2009) primarily due to much lower flows during 2013.

Although exposure to solar radiation may cause temperature increases, temperatures downstream from limited stream-side forested clearings have often been found to cool rapidly once the stream re-enters forested regions (Zwieniecki and Newton 1999). Other studies have noted downstream cooling below timber harvest areas as well, but the extent of this cooling is not entirely clear and varies by stream (Moore et al. 2005; Poole et al. 2001). Although there is some debate on the magnitude of cooling provided by riparian vegetation and the extent to which stream temperatures return to non-cleared temperature levels after exiting a cleared area, studies emphasize that riparian buffers assist in maintaining water temperatures (Correll 1997; Gomi et al. 2006). Generally, changes in temperature, especially in small streams, may recover quickly from cooler surrounding conditions downstream (e.g., streambed cooling, evaporation, hyporheic inflows, shade). This was validated by stream temperature data recorded on the Umpqua National Forest in 2013. Results from field measurements of existing conditions on the Umpqua National Forest showed decreasing stream temperatures of as much as -7.6°F per 100 feet with an overall average over 2,040 feet of the East Fork Cow Creek of -0.1°F per 100 feet (NSR 2015b). The presence numerous of small wetlands adjacent to the stream channel provide evidence of likely groundwater interactions. Most of this 2,040-foot reach also has substantial shade, suggesting the retention of shading structures, or at least partial shade, may greatly reduce increases in stream temperature. These data also support the NSR (2009) finding that potential temperature increases are partially offset by cooling from groundwater interactions in the stream channel.

Observations of these streams suggest that LWD and low-growing willows, huckleberries, and other brush species can provide effective shade for small, narrow channels. Blann et al. (2002) noted that riparian grasses and forbs supply as much shade as wooded buffers for streams less than 8 feet (2.5 meters) wide. In many cases during pipeline crossing construction, low-growing brush outside of the immediate crossing construction area could be retained minimizing shade loss. In the mainstem of the East Fork Cow Creek, LWD provides significant shade that helps maintain cooler water temperatures. As described in the ECRP and waterbody crossing requirements for the project, all LWD and boulders removed from the crossing area would be replaced during site restoration and low-growing brush would be retained where possible. Many of the channels crossed by the Pacific Connector pipeline on federal lands are very small, and could easily be shaded by the placement of LWD and willow plantings. Site-specific modeling on BLM and NFS perennial stream crossings suggests temperature increases would over natural pre-project levels. The site-specific stream restoration plans prepared by the BLM and Forest Service will be implemented to reestablish pre-crossing shade conditions using items such as willows, boulders, and LWD.

With the revegetation of shading brush on small channels, the placement of LWD, and the replanting of willows, downstream temperatures are expected to be comparable to the existing condition and to remain below ODEQ thresholds on the East Fork Cow Creek. Additionally, any temperature increases in small streams would likely be masked by the assimilative capacity of larger streams at the stream network scale (NSR 2009, 2014).

Over the whole pipeline project region, plantings and regrowth in riparian areas, as suggested by these modeling results, would help moderate potential temperature increases in the short term (a few years). Much of the riparian area would be allowed to regrow from plantings with herbaceous plants (only 10 feet wide would be maintained without some growth) and conifer and other trees (all but 30-foot width). On small streams and to a lesser extent on larger streams, even 10- to 15-foot-high trees would supply shade, reducing solar heating effects on streams. Thus, the slight effects of solar heating from clearing would gradually be reduced or completely eliminated over time, based on the model, most between 5 and 10 years.

Potential cumulative watershed temperature increases from project riparian clearing would be unlikely. The number of crossings resulting in riparian shade area cleared in any watershed would be slight. Other than the Coos Bay-Frontal watershed (with 41 perennial crossings), no more than eight perennial streams would be crossed in any one of the other 18 watersheds crossed by the pipeline route. Primarily perennial stream clearings are likely to have effects on temperature during the warmest part of the year, because many intermittent streams would be dry during the peak temperature periods (July–September). Thus, peak seasonal temperatures would be unlikely to affect many intermittent streams. Even considering the total number of streams crossed in watersheds, which ranges from zero to 56 crossings per watershed, most watersheds would have less than 15 crossings (table 4.6.2.3-4). The riparian area lost that could affect watershed stream temperature relative to all available riparian areas in the watershed would be slight. About 9.5 linear stream miles of streambank could be affected along the whole project route (GeoEngineers 2013i; note this counts both banks separately so stream length affected would be half of this value). A likely relative change in cumulative watershed stream temperature from project clearing can be approximated through an estimate of increased heat budget from clearing. An example of this estimate is based on three fifth-field watersheds in the South Umpqua subbasin. These watersheds have an estimated total daily thermal load of about 50,592 million kcal/day. The estimate of the increased thermal load from the project due to initial construction clearing in these watersheds is about 11.0 million kcal/day, or about 0.022 percent. The relative change would likely be 0.004 percent to load once vegetation is allowed to grow back outside of the 30-foot permanently maintained right-of-way clearing (GeoEngineers 2013i). Considering the very small portion of total watershed riparian stream cover removed and low estimates of thermal increase, streamside clearing would not result in any measurable cumulative watershed-level changes in water temperature.

Based on available information, we conclude that any changes in water temperature, related to 75-foot-wide right-of-way vegetation clearing at waterbody crossings, are likely to be very small and undetectable through measurements, except for possibly the very smallest and often intermittent flowing streams, that also generally contain limited fish populations. Any temperature changes that may occur would gradually be reduced or eliminated over time as most riparian vegetation, from plantings and natural vegetation growth, increases in size increasing

stream shading. Adverse effects on fish resources along the route would be unsubstantial due to limited distribution of any measurable changes to regions with minimal or no fish resources.

Large Woody Debris

A potential effect on fisheries that would result from forest clearing at pipeline crossings of waterbodies is the reduction of LWD in streams and on adjacent uplands (Harmon et al. 1986; Sedell et al. 1988). Large logs provide in-stream channel structures (i.e., pools and riffles), which are critical to salmon spawning and rearing. As the size of individual logs or accumulations of logs increases, the size and stability of pools that are created also increase (Beschta 1983). Riparian forests that undergo harvesting of large trees take on secondary-growth characteristics and contribute lower quantities of woody debris than unmanaged, old-growth forests (Bisson et al. 1987). However, sufficiently wide, carefully managed riparian buffers that retain a full complement of ages, sizes, and species of native trees and vegetation can ensure adequate recruitment of LWD to streams (Bisson et al. 1987; Murphy and Koski 1989; Morman 1993).

Pacific Connector has proposed to mitigate for impacts on waterbodies by installing LWD at agency- and landowner-approved and appropriate areas within the construction right-of-way across certain waterbodies. The use of LWD as a mitigation measure for impacts associated with in-stream construction has been documented as an effective means of creating in-stream habitat heterogeneity, reducing streambank erosion, reducing sediment mobilization (Bethel and Neal 2003), and enhancing local fish abundance (Scarborough and Robertson 2002). Placement of LWD on the streambanks and in the streams can provide slight shade and increase bank stability, while vegetation is maturing following construction. Additionally, placement of LWD in streams or on streambanks can provide habitat for benthic invertebrates and important food source for salmonids, and also increase habitat for forage species with the creation of pools and enhancement of the salmonid rearing potential of an area (Cederholm et al. 1997; Slaney et al. 1997).

To mitigate for short-term losses of LWD from riparian clearing and in-stream removal of wood during construction, Pacific Connector has proposed to install 521 pieces of LWD over several fifth-field watersheds along the pipeline route where the two ESA-listed coho salmon ESUs are present. The plan includes placing from 1 to 4 pieces of LWD per stream crossed in the stream or on the bank, depending on forest conditions, stream flow, and landowner approval. This number of pieces, if no other LWD were present in the stream reach affected by clearing, would be in the range of what is considered “desirable” by ODFW (Foster et al. 2001) for forested streams. Foster et al. (2001) noted that more than 20 LWD pieces/100 meters of stream length (i.e., 4.6 pieces/75 feet of right-of-way clearing) with more than 3 “key” pieces/100 meters (i.e., 0.7 “key” pieces/75 feet right-of-way clearing) is considered “desirable” in forested streams in Oregon. The sizes of LWD pieces to be installed are based on ODF and ODFW (1995) guidelines for sizes of LWD pieces to be present in streams to meet habitat needs for specific stream sizes and number of streams crossed. These final numbers would be developed as part of Pacific Connector’s Mitigation Plan, which may have some modification prior to construction.

Specific streams for LWD installation have been identified by Pacific Connector; however, the specific locations within the streams would be determined through discussion with ODFW and agencies as appropriate, and in consideration of the BMPs outlined in the *Stream Crossing Risk*

Analysis Addendum (GeoEngineers 2015). The size of LWD installed would follow ODF and ODFW (1995) suggested guidelines for size of LWD based on stream size. Depending on private landholder approval, some pieces may be installed at different times and locations, but in general, LWD would be placed at waterbody crossings during the last phases of pipeline construction and right-of-way restoration. Pacific Connector has proposed that, if for some reason not all pieces proposed are actually installed, they would be donated to local water conservation groups for installation locally.

Long-term losses of LWD input would largely be mitigated through riparian replanting of conifers in the right-of-way.

Entrainment and Entrapment

Waterbody crossings using the dry crossing methods, either flume or dam–and-pump, may result in some fish being trapped in streams. Flumes and dams would be completely installed and functioning before any in-stream trenching disturbance occurs. Construction across a waterbody would take up to 4 days using dry open-cut methods, but less for small and intermediate streams. At one crossing of the South Umpqua River, a diverted open-cut crossing would be used. This is similar to a dry open cut in that all in channel construction would be done in the "dry" but would require diversion of the flow to one side of the channel at a time. This method could take about 14 days to complete. Because one channel would be open during the entire crossing, no passage of fish would be impeded and no fish removal would be required.

For typical crossings, once streamflow is diverted through the flume pipe, but before pipeline trenching begins, fish trapped in any water remaining in the work area between the dams would be removed and released using the methods in Pacific Connector's *Fish Salvage Plan*.[104] Adult Pacific lamprey, and possibly lamprey ammocoete larvae, are expected to be captured during fish salvaging by seining. However, salvage techniques for salmonids may not be effective for salvaging lamprey ammocoete larvae, which may remain in dewatered sediments. Electrofishing procedures to sample Pacific lamprey larvae have been recommended (see Appendix A in FWS 2010a) but seining and use of dip-nets may also be effective once the workspace has been dewatered, depending on substrate conditions at the time of construction. Pacific Connector would contract with either the ODFW or a qualified consultant to capture the fish.

Because the flume would maintain streamflow, fish may move upstream through the flume. With the dam-and-pump method, the fish would not be able to move upstream or downstream through the work area until the dams have been removed. Flumes and dams would be removed as soon as possible following backfilling of the trench.

Aquatic Nuisance Species

Currently, there are 180 reported NAS in Oregon, of which 134 are documented within the USGS hydrologic basins crossed by the Pacific Connector pipeline (USGS 2005). Not all non-indigenous species pose a threat to native species and their habitat in Oregon. For example, the largemouth bass provide economic and recreational benefits. Some of the major potential aquatic invasive species are mussels, including the zebra and quagga mussels (*Dreissena polymorpha*, and *Dreissena rostriformis bugenisis*), and New Zealand mud snail (*Potamopyrgus*

[104] See Appendix L to the POD, which was included in Pacific Connector's application to the FERC.

antipodarumis) as well as Cyanobacteria (blue-green algae), and freshwater mold (Saprolegnia). Invasive species can have multiple adverse effects when introduced to their non-native environment. The most common impact is competition with native species for habitat and resources, often with the reduction or elimination of the native species. They also may cause impacts to human uses of the water. For example, zebra mussels have been found to multiply to such great numbers that they effectively block water intakes, such as drinking water supplies. Additionally, invasive species may crossbreed with native stocks of organisms indirectly causing the reduction of viable native pure species. Some invasives may directly kill other native species that have no natural defenses against them.

Pacific Connector's *Hydrostatic Test Plan*[105] includes measures that would prevent the spread of invasive species from one water basin to another. However, Pacific Connector did not address how it would deal with aquatic nuisance species encountered during pipeline construction. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and approval by the Director of OEP, a Project-specific *Aquatic Species Nuisance Treatment Plan*, and documentation that the plan was developed in consultation with ODFW and appropriate resource agencies.**

<u>Blasting</u>

Blasting in stream channels can have adverse effects to fish, especially for fish with swim bladders. Explosives detonated near water produces shock waves that can be lethal to fish, eggs, and larvae by rupturing swim bladders and addling egg sacs (British Columbia Ministry of Transportation 2000). Explosives detonated underground produce two modes of seismic wave (Alaska Department of Fish and Game 1991). Shock waves propagated from ground to water are less lethal to fish than those in-water explosions since some energy is reflected or lost at the ground-water interface (Alaska Department of Fish and Game 1991). Peak overpressures as low as 7.2 pounds per square inch (psi) produced by blasting on a gravel/boulder beach caused 40 percent mortality in coho smolts and other studies revealed 50 percent mortality in smolts with peak overpressures ranging from 19.3 to 21.0 psi (Alaska Department of Fish and Game 1991).

The best way to reduce or eliminate effects to fish is to keep fish out of regions where pressure waves are harmful. The Alaska Department of Fish and Game (1991) reported that a pressure change of 2.7 psi is the level for which no fish mortality occurs and is from 1.7 to 4.5 psi below any level where mortality would be expected. Based on normal charges used in trenching (about 1 to 2 pounds at 8-millisecond delay) the zone of the above pressure wave would extend 34 to 49 feet, depending on substrate near the charge (Alaska Department of Fish and Game 1991). Typically the dry area (where fish could not be) would be at least 25 feet wide during construction. If blasting were to occur with only a 25-foot-wide dry working space buffer between the blast and the stream, the potentially hazardous pressure wave (i.e., greater than 2.7 psi) would extend no more than an additional 25 feet. In all likelihood, the effects would be felt over a much smaller distance. Pacific Connector developed a *Blasting Plan* that outlined measures to reduce impacts on resources. The plan stated that Pacific Connector does not anticipate conducting any in-water blasting in any streams crossed by the pipeline. However,

[105] See Appendix M to the POD, which was included in Pacific Connector's application to the FERC.

blasting may occur in uplands adjacent to streams, or within dry streambeds. In those situations, Pacific Connector would attempt to minimize shock waves from blasting that may affect aquatic resources by the types of explosives selected, the size of charges, and the sequences of firing. In addition, bubble curtains may be used. Lastly, fish may be removed from the crossing area, in accordance with Pacific Connector's *Fish Salvage Plan*.

Hydrostatic Testing

After the pipeline is installed, Pacific Connector would fill it with water under pressure to test it (see section 2.4.2.1). Total water used for hydrostatic testing would be about 62 million gallons. Pacific Connector would obtain its hydrostatic test water from commercial or municipal sources or surface water rights owners to lakes, impoundments, and streams from possibly 11 different locations. About half of the water would be from impoundments or lakes, and the rest from streams, including South Umpqua River, Rogue River, North Fork Little Butte Creek, and Klamath River. All of the streams identified as potential test water sources include anadromous salmonids or resident trout. About 75 potential discharge locations for the test water have been identified (see Table 2 in the *Hydrostatic Test Plan*). During the test, it may be necessary to discharge water at each of the sites; however, discharges would be minimized and water would be conserved as much as practical by cascading water between test sections when feasible (pumping from one segment to the next).

Potential impacts on aquatic resources associated with hydrostatic testing include entrainment of organisms including fish, reduced downstream flows, erosion and scouring at release points, and the transfer of aquatic nuisance species through the test water from one water basin to another. Pacific Connector has developed a *Hydrostatic Test Plan* to minimize impacts from hydrostatic testing on resources. This plan is discussed in more detail in section 4.4.2, Surface Waters, of this EIS.

To prevent the entrainment of most aquatic species, the pumps and intake hoses for hydrostatic test water removal would be screened, in accordance with NMFS screening criteria. To ensure water withdrawal does not cause downstream water level issues (ramping rate), Pacific Connector would submit their withdrawal plans to ODFW for review prior hydrostatic testing. To prevent the transfer of organisms from one water basin to another, Pacific Connector would try to return hydrostatic test water to its basin of origin. However, given the linear nature of the pipeline and the need to cascade test water from one section to another, such a return may not always be possible. Therefore, Pacific Connector would treat the test water after withdrawal (most likely with chlorine) to prevent the spread of invasive species and pathogens. To prevent erosion or scour at discharge locations, the hydrostatic test water would be discharged at low head into energy dissipating devices and dewatering structures in uplands. Volume and flow rates would be controlled to prevent overland flows directly to waterbodies.

Fuel and Chemical Spills

For any large construction project, there is the potential for spills of fuel or other hazardous liquids from storage containers, equipment working in or near streams, and fuel transfers. Any spill of fuel or other hazardous liquid that reaches a waterbody would be detrimental to water quality. The chemicals released during spills could have acute, direct effects on fish, or could have indirect effects such as altered behavior, changes in physiological processes, or changes in food sources. Fish could also be killed if a large volume of hazardous liquid is spilled into a

waterbody. Ingestion of large numbers of contaminated fish could affect primary and secondary fish predators in the food chain.

To minimize the potential for spills, Pacific Connector has developed an SPCCP. Pacific Connector's implementation of this SPCCP would minimize the potential for and the impact of any spill near surface waters. The SPCCP would be updated with site-specific information prior to construction. Specific measures in this plan include prohibiting liquid transfer, vehicle and equipment washing, and refueling within 100 feet of waterbodies and specific steps to be followed to control, contain, and clean up any spill that occurs. The SPCCP is further described in section 4.4.2.2. Pacific Connector's implementation of this SPCCP would minimize the potential for and the impact of any spill near surface water on aquatic resources.

Benthic and Sessile Organisms

Benthic and sessile organisms including benthic invertebrates and freshwater mussels would be affected by most of the same factors noted primarily for fish discussed above. This would include impacts from elevated turbidity and suspended sediments, release of drilling muds, herbicide application, blasting, fuel and chemical spills, and habitat modification. Risk of adverse impact to relatively sessile species, such as mollusks, could extend downstream from construction sites if degradation of water quality affects downstream habitats. However, because they are relatively immobile, the trenched crossing would have the greatest effect and would directly kill many at the trenching site because most would unable to actively move from the area. In the case of many aquatic invertebrates, including insect larvae, these areas would be rapidly (weeks/months) recolonized from upstream drift and new egg deposition from adults. In some cases for longer-lived organism, such as mussels, recolonization would take longer as they are immobile and most take years to grow to full size. The largest impact to benthic and sessile organisms would be directly at the crossing location and the impact would be short term. In the case of mussels, local affects may be long term. However, the overall area affected for any given stream would be small so adverse effects to local populations would be slight.

Operation and Maintenance Activities

Once installed, maintenance of the pipeline would include activities such as aerial inspections, gas flow monitoring, and visual inspection of surrounding vegetation for signs of leaks, and integrity management, which includes smart pigging to investigate the interior surface of the pipe for any signs of stress cracking, pitting, and other anomalies. All of the maintenance activities would be outlined in the *Operations and Maintenance Plan* that would be prepared according to operating regulations in DOT 49 CFR Subpart L, Part 192 and would be completed prior to going in-service. These general maintenance activities would require only surface activities and usage of the existing right-of-way, such as insertion of the pig at one of the pig launching facilities.

Potential estuarine or stream channel disturbance would occur if an integrity issue with the pipeline occurred. If this happened, the pipeline would be unearthed within the right-of-way and repair work done in-water. Within stream sites, repair work could require isolated flow from the section of pipe that is to be exposed. Typically, repairs would be made to the pipe within the right-of-way (within the trench) or, depending on the site-specific conditions and nature of the repair needed, a reroute around the affected section may be considered. Impacts would be similar to those discussed above for initial installation except on a much smaller scale, because

they would only involve one crossing compared to many streams and, in the case of the estuary, just a portion of whole route would be disturbed not the whole 2.4-mile route. However, should repairs be needed out of the standard stream crossing window (i.e., during periods of fish spawning or egg incubation) there would be additional adverse effects to key fish resources at the specific site. The actions would include similar BMPs and mitigation. Any future repairs would require additional permit approval from appropriate state and federal agencies, which would determine the acceptable parameters of these actions. Such pipeline integrity-based in-water projects are very infrequent.

Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip to permanently revegetate with native plant species across the entire right-of-way. To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide would be maintained in an herbaceous state. In addition, trees that are located within 15 feet of the pipeline and that are greater than 15 feet in height would be cut and removed from the right-of-way. We analyzed riparian and forest clearing and revegetation adjacent to waterbodies above, and found those impacts on aquatic resources related to removal of stream shade and increases in water temperature would be unsubstantial.

Herbicide Application

Pacific Connector would not use herbicides for routine vegetation maintenance; however, Pacific Connector would implement an *Integrated Pest Management Plan* that addresses control of noxious weeds. The plan would include the selective use of herbicides where necessary to control noxious weeds by limited application from the ground, where allowed by landowners. Pacific Connector would only use agency-approved herbicides authorized in current planning documents to control noxious weeds where infestations occur in the right-of-way after construction and during operation. Herbicides would not be applied by aerial or broadcast spraying. Noxious weeds would be removed only by manual methods in the riparian zones.

Herbicides can have toxic or other adverse effects on fish and other aquatic organisms. In general, most impacts to aquatic systems occur from direct spray of herbicides, and possibly drift when herbicides are sprayed, and leaching through soils and groundwater (Tu et al. 2001). Pacific Connector would not directly spray, or otherwise apply, herbicides in waterbodies or in riparian zones. The risk of drift would be avoided by selectively applying herbicides from the ground. The six different types of potential herbicides that could be used have various levels of toxicity to aquatic organisms. However, the restriction to selective applications outside of riparian zones would greatly reduce the potential of adverse effects to fish by keeping herbicides outside of riparian zones and preventing herbicides from reaching streams.

Essential Fish Habitat – Pipeline Route

EFH and species present in Coos Bay are described in detail above in section 4.6.2.1. In Coos Bay, the amount of EFH habitat that would be directly disturbed in the estuarine environment from either right-of-way construction or TEWAs is estimated to be about 73 acres (table 4.6.2.3-3). Additional areas would be affected from sediment and turbidity from pipeline installation. The directly disturbed areas would include approximately 5 acre of aquatic eelgrass, an additional 36 acres of intertidal mudflat, and about 33 acres of subtidal habitat. All are important habitat components for estuarine food webs, especially the eelgrass beds. The characteristics and life history of PFMC EFH species that may be in the pipeline area at waterbody crossings are

summarized in table 4.6.2.3-4 and described in our BA and EFH Assessment (FERC 2015) prepared for the Project. Construction-related impacts on the estuarine region of Coos Bay and its EFH would be reduced by Pacific Connector following its *Haynes Inlet Water Route Plan*, which includes the in-water work window developed by ODFW and other measures discussed above.

A list of the waterbodies crossed by the proposed pipeline route and EFH assumed or known for coho and Chinook salmon species is shown in appendix O, table O-2. Sixty-five of the stream and estuary crossing areas (either directly crossed or near the pipeline) contain or are assumed to contain EFH for either one or both of these species. The Haynes Inlet crossing would be wet open cut during the designated in-water work window for Coos Bay. All streams that would be directly crossed would have all construction work done in the dry (three would be passed by HDD, three with conventional bore, and one using a diverted open cut [South Umpqua River]). In-water work for the pipeline crossings would temporarily affect EFH in approximately 59 streams that would be crossed using dry open-cut methods that are potentially designated as EFH for Chinook and/or coho salmon. Waterbody crossings that involve open trenching would be constructed during established in-water work windows. However, some streams may have spawning Chinook salmon present during the crossing period, which would increase the risk of spawning effects from turbidity and sediment.

In freshwater, EFH for Chinook and coho salmon includes habitats for spawning, rearing, and migration corridors (PFMC 2003). Components of the pipeline with the potential to adversely affect designated EFH include removal of terrestrial and riparian vegetation, in-water pipeline construction increasing turbidity and sediment, accidental spills and leaks of hazardous materials, and hydrostatic testing. Construction adjacent to EFH could also result in increased stormwater runoff and/or an inadvertent spill of hazardous materials, either of which could result in substantial adverse effects on EFH. A detailed discussion of measures that would be implemented to avoid or minimize impacts on aquatic resources (including EFH) because of pipeline construction is presented above.

The determinations of effect on EFH resulting from the Pacific Connector Pipeline Project are described below. For actions within the estuary, effects to EFH would be similar to those described for the LNG terminal slip. Additional adverse effects would occur at freshwater crossings that would affect Pacific Coast salmon. For coastal pelagic, groundfish, and Pacific coast salmon, effects would be similar although magnitude would vary (table 4.6.2.3-7).

TABLE 4.6.2.3-7

Potential Impacts to EFH due to Pipeline Construction and Operation

EFH	Description of EFH a/	Project Actions and Potential Impacts	Determination of Effects
Groundfish	All waters from the extent of the high tide line (and parts of estuaries) to offshore to the 3,500 meter (1,914 fathoms) depth.	• Dredging of 2.4-mile pipeline route in Coos Bay • Accidental spills of hazardous substances	Substantial adverse effects to multiple groundfish species (e.g., rockfish, English sole, Starry flounder) EFH (see sections 4.6.2.2 and 4.6.2.3 for impacts and mitigation)
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50 °F and 79 °F	• Dredging of 2.4-mile pipeline route in Coos Bay • Accidental spills of hazardous substances	Substantial adverse effects to coastal pelagic species (northern anchovy, Pacific sardine) EFH (see sections 4.6.2.2 and 4.6.2.3 for impacts and mitigation)

TABLE 4.6.2.3-7

Potential Impacts to EFH due to Pipeline Construction and Operation

EFH	Description of EFH a/	Project Actions and Potential Impacts	Determination of Effects
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon. Estuaries and marine areas extending to the EEZ and beyond.	• Dredging of 2.4-mile pipeline route in Coos Bay • Accidental spills of hazardous substances • Pipeline construction at waterbody crossings • Water withdrawal • Loss of riparian habitat along streams • Short-term disruptions of Chinook salmon active spawning	Substantial adverse effects to Pacific coastal salmon species (coho and Chinook salmon) EFH (see sections 4.6.2.2 and 4.6.2.3 for impacts and mitigation)

a/ PFMC 2006 (update version 7/24/2006)

FERC, as the lead federal agency, is consolidating the EFH and the ESA process for all portions of the Project. This includes development of an EFH Assessment and BA together for submittal to NMFS and FWS with a request to initiate formal consultation.

4.6.2.4 Aquatic Resources on Federal Lands

The Pacific Connector pipeline would have some effect on 47 waterbodies and associated riparian areas within the approximately 71 miles of federal lands that would be crossed by the pipeline. This includes 13 known or assumed fish-bearing stream crossings (table 4.6.2.4-1). The effects to federal lands and resources from the proposed action are addressed fully in section 4.1. Watersheds crossed on federal lands and characteristics of those watersheds are discussed in section 4.1.3.5. Aquatic species present on federal lands would be similar to those discussed in section 4.6.2.3, except no marine and estuarine fish and shellfish are present within the waterbodies crossed on federal lands. Aquatic species found on federal lands would be mostly the same as those on non-federal lands with freshwater habitat. Commercial and recreational fisheries of importance in waterbodies crossed include primarily anadromous salmon and steelhead and resident trout. Specials status species present in some stream segments crossed include federally listed Oregon coastal coho salmon and Southern Oregon/Northern California coastal coho salmon ESU. EFH habitat is also present along the route for coho and Chinook salmon stocks. Other state and federal fish species of special status are discussed in section 4.7. Aquatic habitats that would be affected by the pipeline on federal lands are primarily coldwater and anadromous streams, with a few warmwater ponds adjacent to the construction areas. Much of the stream riparian areas crossed on BLM and NFS lands is heavily forested and shaded by coniferous trees.

The general impacts on aquatic resources, and mitigation for those effects, would be similar on federal lands to those discussed above in section 4.6.2.3 for the entire pipeline. Crossing techniques for most waterbodies would include dry-open cut methods. Fourteen perennial and 29 intermittent streams would be directly crossed by the pipeline construction on federal lands (table 4.6.2.4-1). Of these streams, 5 are known or assumed to contain anadromous fish, and 15 known or assumed to contain resident fish species. ESA species and EFH habitat for salmon may be present in up to 5 stream disturbance areas (table 4.6.2.4-1).

TABLE 4.6.2.4-1

Number of Streams Crossed by the Pacific Connector Pipeline Route on Federal Lands by Fish Status Category within Each Fifth-Field Watershed Coinciding with the Pacific Connector Project

Fifth Field Watershed (Fifth Field HUC)	Federal Land Agency	Perennial Streams	Intermittent Streams	Fish-bearing Streams with (a/): Anadromous Species (assumed) b/	Fish-bearing Streams with (a/): Resident Species (assumed) a/,b/	EFH Species and Habitat Present (assumed) a/	ESA Species or Habitat Present (assumed) a/
Coos County							
Coos Bay Frontal-Pacific Ocean	BLM Coos Bay Dist.	0	1	0	0	0	0
North Fork Coquille River (1710030504)	BLM Coos Bay Dist.	1	5	1	1	1	1
East Fork Coquille River (1710030503)	BLM Coos Bay Dist.	0	2	0	0	0	0
Middle Fork Coquille River (1710030501)	BLM Coos Bay Dist.	1	6	(1)	(2)	(1)	(1)
Middle Fork Coquille River (1710030501)	BLM Roseburg District	1	0	0	0	0	0
Douglas County							
Middle Fork Coquille River (1710030501)	BLM Roseburg Dist.	1	1	0	(1)	0	0
Days Creek-South Umpqua (1710030205)	BLM Coos Bay Dist.	0	1	0	0	0	0
Upper Cow Creek (1710030206)	Forest Service Umpqua NF	5	1	0	(4)	0	0
Jackson County							
Upper Cow Creek (1710030206)	Forest Service Umpqua NF	0	1	0	0	0	0
Trail Creek (1710030501)	Forest Service Umpqua NF	0	1	0	0	0	0
Trail Creek (1710030501)	BLM Medford Dist.	1	0	1	1	1	1
Shady Cove-Rogue River (1710030707)	BLM Medford Dist.	0	5	0	0	0	0
Big Butte Creek(1710030704)	BLM Medford Dist.	2	1	(1)	(1)	(1)	(1)
Little Butte Creek (1710030708)	BLM Medford Dist.	0	5	(1)	1	(1)	(1)
Little Butte Creek (1710030708)	Forest Service Rogue River NF	1	1	0	2	0	0
Klamath County							
Spencer Creek (1801020601)	Forest Service Winema NF	1	2	0	1	0	0
Spencer Creek (1801020601)	BLM Lakeview NF	0	1	0	(1)	0	0
TOTAL		**14**	**36**	**2(3)**	**6(9)**	**2(3)**	**2(3)**

a/ Known and assumed (value in parentheses) crossings by the pipeline with indicated fish category designation
b/ Trout
Note: Based on Pacific Connector's analysis, numbers may differ from federal agency analysis of streams, in some watersheds.

Riparian Reserve Areas

A unique land allocation specific to BLM and NFS lands is Riparian Reserve. This allocation was developed in conjunction with the ACS that is incorporated into each of the BLM and Forest Service LMPs for management of areas associated with streams, lakes, and potentially unstable areas. The ACS was developed as part of the NWFP *Standards and Guidelines* to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within NFS lands

(Forest Service and BLM 1994b) for a variety of species. Major components of the ACS are Riparian Reserves and Key Watersheds (see section 4.1). Riparian Reserves are intended to serve as corridors in the matrix and enable BLM and Forest Service to manage these land allocations to maintain and restore riparian structures and functions of these unique and important features. As described in section 4.1, Riparian Reserves have a unique set of Standards and Guidelines that are applicable wherever these occur. While the ACS places an emphasis on efforts to maintain and restore aquatic and riparian habitat that is necessary to support anadromous salmonids, the nine objectives listed for the ACS include maintaining and restoring aquatic systems, floodplains, wetlands, upslope habitats, and riparian zones in general to support invertebrate and vertebrate species dependent on those habitats. The description of these nine objectives and how they will be maintained under the proposed actions is presented fully in section 4.1.

The Pacific Connector pipeline would cross Riparian Reserves areas along the route on federal lands. Direct and indirect impacts on Riparian Reserves affected by all construction activities (e.g., pipeline right-of-way, TEWAs, permanent and temporary access roads) are discussed in section 4.1.

Key Watersheds on NFS Lands

Key watersheds on NFS land, as designated by the NWFP (Forest Service and BLM 1994a), provide high water quality and are crucial to at-risk fish species and stocks. They are the highest priority for watershed restoration. Tier 1 Key Watersheds consist primarily of watersheds directly contributing to anadromous salmonid, bull trout, and resident fish species conservation. Tier 2 watersheds do not necessarily contain at-risk fish stocks, but are important sources of high quality water (Forest Service and BLM 1994a). The Key Watersheds include three Tier 1 (Days Creek – South Umpqua River [formerly named South Umpqua River], North and South Forks Little Butte, Spencer Creek) and one Tier 2 (Clover Creek) watershed. Potential effects to these Key Watersheds and actions that would be taken by the project to ensure Key Watershed functions are maintained are discussed in section 4.1.

Measures That Would Mitigate Impacts on Aquatic Resources on Federal Lands

Pacific Connector would develop project design, construction, and operation measures to avoid or minimize impacts on aquatic resources to the extent practicable, and to meet long-term consistency with the ACS on NFS and BLM lands. To compensate for unavoidable impacts along streams from loss of upslope and riparian vegetation and LWD input that do not meet the objectives of the ACS, Pacific Connector has developed a CMP.[106] Actions that would be taken on NFS and BLM lands to help meet ACS objectives on those lands are included in appendix F. These additional actions and mitigation measures are summarized in table 2.1.4-1; the effects of implementation of these measures on meeting the ACS objectives by watershed are discussed in section 4.1.

To ensure that the Pacific Connector Pipeline Project is consistent with the objectives of the ACS on NFS and BLM lands, which would in turn aid fish populations on federal land, Pacific Connector would (1) donate LWD to agencies/conservation groups to perform in-stream restoration projects; and/or (2) relocate large boulders greater than 24 inches in diameter for use

[106] Filed with the FERC in September 2013.

as fish habitat structures. To mitigate for Project actions that, even with site-specific actions, may impede maintaining ACS objectives on each watershed (e.g., pipeline crossing LWD placement and riparian vegetation plantings), Pacific Connector would fund the following types of projects that would be implemented on federal land areas not directly affected by Project activity:

- add LWD to several miles of streams outside of the project area;
- restore degraded riparian habitats through off-site revegetation projects;
- conduct off-site in-stream habitat improvement and fish passage projects;
- improve stream road crossings and replace or stabilize culverts that may contribute sediment from fill failure to streams;
- acquire conservation easements on private land to protect or improve important riparian habitats, particularly targeting streams containing listed fish, 303(d) streams, and key watersheds;
- conduct pre-commercial thinning projects where feasible to improve riparian habitats;
- install fences in allotments to improve riparian habitats;
- decommission roads and waterbody features (e.g., culverts, crossings, bridges) identified by the BLM and Forest Service that are no longer needed for resource management to provide numerous benefits including lower road density, minimization of channel extensions, minimization of sedimentation, improvement of fish passage through culvert removal, and reduction of riparian habitat fragmentation;
- close roads that are not in use, which would reduce sediment runoff to streams; and
- stormproof roads (such as adding water bars, ditch cleaning, culvert bypass) to also reduce fine sediment to streams and reduce the risk of road blow out, which could contribute heavy sediment loads to streams.

The list of mitigation measures noted above is not all that would be in place (see table 2.1.4-1), but identifies some of the major efforts that would be undertaken to reduce and mitigate impacts from the proposed action to aquatic resources. Following project construction, habitat and ecosystem function would be restored in-place as much as possible. However, although mitigation actions would restore habitat and have long-term benefits to wetlands, estuarine ecosystems, and habitat for salmonids in general, there would be effects on some non-target species. The goal of additional mitigation would be to restore habitat with similar ecological function for the remaining impacts to aquatic resources to ensure project actions meet the ACS objectives at multiple scales. All of these actions would reduce impacts to fish resources on federal lands by reducing factors known to be harmful or limiting to fish species including elevated suspended sediment and sediment in the stream channel, which affects fish production and survival; loss of LWD in streams, which reduces habitat quality; loss of future riparian LWD and other vegetation supplying input of organic matter; and loss or restriction of fish movement (passage) in streams. Specific sites and actions for the mitigation measures were identified through meetings with the BLM and Forest Service. These are provided in the *Mitigation Plan for Federal Lands* included in appendix F of this EIS. The details of these mitigation actions and how they relate to ensuring the ACS is being met in each of the affected watersheds are discussed in section 4.1.

4.7 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

Federal agencies are required by Section 7 of the ESA (Title 19 U.S.C. Part 1536[c]), as amended (1978, 1979, and 1982), to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of designated critical habitat of a federally listed species. The action agency (e.g., the FERC) is required to consult with the FWS and/or the NMFS to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the Project, and to determine the proposed action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal agency must submit its BA to the FWS and/or NMFS and, if it is determined that the action may adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, the FWS and/or NMFS would issue a BO as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat.

Jordan Cove and Pacific Connector filed an applicant-prepared draft BA in September 2013, and a revised applicant-prepared draft BA in April 2014. We prepared a BA and EFH Assessment (FERC 2015) that was submitted to the FWS and NMFS in February 2015. The effects determination summaries included in this FEIS are based on FERC's February 2015 BA and EFH Assessment (FERC 2015), as well as updated information provided by Jordan Cove and Pacific Connector since we submitted our BA. Based on this updated information and ongoing consultation with FWS and NMFS, our effects determinations for two species, fisher (*Pekania pennanti*; West Coast DPS) and Pacific eulachon (*Thaleichthys pacificus*; Southern DPS), have changed from "not likely to adversely affect" to "likely to adversely affect" since we submitted our BA in February 2015; these updates are reflected in this FEIS. Because consultation with FWS and NMFS is ongoing, additional analysis may be incorporated into the Project's BA in the future, which may result in data or analysis in the BA that is not reflected in this FEIS.

This section analyzes the effects of the Project on special status species. In addition to species listed as threatened or endangered under the federal ESA and Oregon ESA, agencies and organizations such as the FWS, BLM, Forest Service, ODA, and ODFW maintain lists of species that are considered special concern, sensitive, rare, or are otherwise offered protections under agency planning documents. These species are broadly defined in this assessment as "special status species."[107] Although the term "special status species" is used differently by various agencies, for the purposes of this assessment, the term "special status species" includes:

[107] The term "special status species" is also used by the BLM, but in a narrower agency-specific definition than in this assessment. BLM "special status species" include species listed as threatened or endangered under the ESA, species that are proposed for listing under the ESA, species that are candidates for listing under the ESA, and species designated by the BLM as "sensitive" under criteria in BLM Manual 6840. The Forest Service uses similar designations. For both the BLM and Forest Service, "S&M" are managed under specific criteria provided in the Northwest Forest Plan rather than the agency "special status species" programs. Fifteen species are designated as both "special status species" for the BLM and Forest Service and "S&M species." Those species are noted in the assessment and are analyzed here under criteria for both programs.

- species that are listed or proposed for listing by the federal government as endangered or threatened, or are candidates for listing;
- species that are identified by the BLM or Forest Service as "sensitive species" or "strategic species";
- species listed by the State of Oregon as endangered, threatened, or are candidates for listing; and
- species identified by federal or state agencies as rare or protected by federal or state planning documents (e.g., Standards and Guidelines in resource management plans such as "S&M species" identified in the NWFP).

Using data from the Oregon Biodiversity Information Center (ORBIC),[108] FWS, NMFS, discussions with Forest Service and BLM specialists, and information reviews of published and unpublished information, the applicants prepared lists of threatened, endangered, proposed, candidate, and special status species that potentially occur in the vicinity of the proposed Project, as described in the following sections. Species that were initially considered but were dropped from further consideration due to a lack of habitat or because they were not detected during targeted field surveys are listed in tables O-3, O-4, and O-5 in appendix O.

4.7.1 Federally Listed Threatened and Endangered Species

Table 4.7.1-1 lists the federally endangered, threatened, and proposed species that potentially occur in the project area and are discussed below. Three additional species (beyond those listed in table 4.7.1-1) are federally listed in Oregon (i.e., the Canada lynx, bull trout Klamath River DPS, and yellow-billed cuckoo Western DPS); however, these species are not known or expected to occur within the project area and are not discussed further in this document (Canada lynx: Verts and Carraway 1998, McKelvey et al. 2000, ORBIC 2006b; bull trout Klamath River DPS: FWS 1998a, 2002a, ORBIC 2006b; yellow-billed cuckoo: FWS 2013a). In addition, FWS (2015) submitted additional comments on FERC's BA noting that three additional listed species—Shasta crayfish (*Pacifastacus fortis* – endangered), Greene's tuctoria (*Tuctoria greenei* – endangered with critical habitat), and slender Orcutt grass (*Orcuttia tenuis* – threatened with critical habitat)—were included in the FWS' species lists for the project area; these species are also not known or expected to occur within the project area and are not discussed further in this document (ORBIC 2013; FWS 1998b, 2005a, 2007b, 2009a, 2009b). The Eastern DPS of the Steller sea lion, which occurs on the west coast of the U.S. and within the project area, was delisted on December 4, 2013 (78 FR 66139), and thus is not discussed in this section. Table 4.7.1-1 lists all potentially affected federally listed and proposed species, indicates the portion of the project area where they may occur, and provides our preliminary determination of effect.

[108] Formerly known as the Oregon Natural Heritage Information Center (ORNHIC).

TABLE 4.7.1-1

Federally Listed and Proposed Species Potentially Occurring in the Proposed Project Area

Species	Federal Status	State Status	Portion of the Project Area Where Species May Occur	Effect of Proposed Project on Species, Critical Habitat a/
Mammals				
Gray wolf *Canis lupus*	Endangered	Endangered	Pacific Connector pipeline	NLAA
Fisher (West Coast DPS) *Pekania pennanti*	Proposed Threatened	Sensitive-Critical	Pacific Connector pipeline	NJ/LAA (proposed)
Blue whale *Balaenoptera musculus*	Endangered	Endangered	LNG vessel transit in the waterway	NLAA
Fin whale *Balaenoptera physalus*	Endangered	Endangered	LNG vessel transit in the waterway	NLAA
Killer whale –Eastern North Pacific Southern Resident stock *Orcinus orca*	Endangered – Critical Habitat	No listing	LNG vessel transit in the waterway	NLAA, NE
Humpback whale *Megaptera novaeangliae*	Endangered	Endangered	LNG vessel transit in the waterway	NLAA
Sei whale *Balaenoptera borealis*	Endangered	Endangered	LNG vessel transit in the waterway	NLAA
Sperm whale *Physeter macrocephalus*	Endangered	Endangered	LNG vessel transit in the waterway	NLAA
North Pacific right whale *Eubalaena glacialis*	Endangered – Critical Habitat	No listing	LNG vessel transit in the waterway	NLAA, NE
Birds				
Short-tailed albatross *Phoebastria albatraus*	Endangered	Endangered	LNG vessel transit in the waterway	NLAA
Western snowy plover *Charadrius alexandrinus nivosus*	Threatened – Critical Habitat	Threatened	Jordan Cove terminal	NLAA, NLAA
Marbled murrelet *Brachyrampus marmoratus*	Threatened – Critical Habitat	Threatened	LNG vessel transit in the waterway Jordan Cove terminal Pacific Connector pipeline	LAA, LAA
Northern spotted owl *Strix occidentalis caurina*	Threatened – Critical Habitat	Threatened	Jordan Cove terminal Pacific Connector pipeline	LAA, LAA
Streaked horned lark *Eremophila alpestris strigata*	Threatened- Critical Habitat	Sensitive-Critical	Jordan Cove terminal	NLAA, NE
Fishes				
Green sturgeon (Southern DPS) *Acipenser medirostris*	Threatened – Critical Habitat	No listing	LNG vessel transit in the waterway Jordan Cove terminal	LAA, LAA
Coho salmon (S. OR/N. CA Coast ESU) *Oncorhynchus kisutch*	Threatened – Critical Habitat	Sensitive Critical	LNG vessel transit in the waterway Jordan Cove terminal Pacific Connector pipeline	LAA, LAA
Eulachon (Southern DPS) *Thaleichthys pacificus*	Threatened– Critical Habitat	No listing	LNG vessel transit in the waterway Jordan Cove terminal Pacific Connector pipeline	LAA, NE
Coho salmon (Oregon Coast ESU) *Oncorhynchus kisutch*	Threatened – Critical Habitat	Sensitive Critical	LNG vessel transit in the waterway Jordan Cove terminal Pacific Connector pipeline	LAA, LAA
Lost River sucker *Deltistes luxatus*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	LAA, NLAA
Shortnose sucker *Chasmistes brevirostris*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	LAA, NLAA
Amphibians and Reptiles				
Green turtle *Chelonia mydas*	Threatened – Critical Habitat	Endangered	LNG vessel transit in the waterway	NLAA, NE

TABLE 4.7.1-1

Federally Listed and Proposed Species Potentially Occurring in the Proposed Project Area

Species	Federal Status	State Status	Portion of the Project Area Where Species May Occur	Effect of Proposed Project on Species, Critical Habitat a/
Leatherback turtle *Dermochelys coriacea*	Endangered – Critical Habitat	Endangered	LNG vessel transit in the waterway	NLAA, NLAA
Olive Ridley turtle *Lepidochelys olivacea*	Endangered	Endangered	LNG vessel transit in the waterway	NLAA
Loggerhead turtle *Caretta caretta*	Threatened	Threatened	LNG vessel transit in the waterway	NLAA
Oregon spotted frog *Rana pretiosa*	Threatened – Proposed Critical Habitat	Sensitive Critical	Pacific Connector pipeline	NLAA, NLAA/NAM (proposed)
Invertebrates				
Vernal pool fairy shrimp *Branchinecta lynchi*	Threatened – Critical Habitat	No listing	Pacific Connector pipeline	LAA, LAA
Plants				
Applegate's milk-vetch *Astragalus applegatei*	Endangered	Endangered	Pacific Connector pipeline	LAA
Gentner's fritillary *Fritillaria gentneri*	Endangered	Endangered	Pacific Connector pipeline	LAA
Western lily *Lillium occidentale*	Endangered	Endangered	Jordan Cove terminal Pacific Connector pipeline	NLAA
Large-flowered meadowfoam *Limnanthes pumila* ssp. *grandiflora*	Endangered – Critical Habtiat	Endangered	Pacific Connector pipeline	LAA, LAA
Cook's lomatium *Lomatium cookii*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	NLAA, NLAA
Kincaid's lupine *Lupinus suphureus* var. *kincaidii*	Threatened –Critical Habitat	Threatened	Pacific Connector pipeline	LAA, NE
Rough popcornflower *Plagiobothrys hirtus*	Endangered	Endangered	Pacific Connector pipeline	NLAA

a/ Impact Key:
NLAA = Not likely to adversely affect, LAA = Likely to adversely affect, NE = No effect, NJ = not likely to jeopardize the continued existence for proposed species

4.7.1.1 Mammals

Gray Wolf (Federal Endangered Species, State Endangered Species)

Gray wolves are protected by the federal ESA in Oregon west of highways 395-78-95, and are protected by the state ESA throughout Oregon (FWS 2011b). FWS regards any wolf residing west of the Cascade mountain range in Oregon as a listed species and therefore protected under the ESA (PC Trask & Associates 2014a). Wolves are habitat generalists that only require ungulate prey and human-caused mortality rates that are not excessive (FWS 2013b). Wolf pack territory size is a function of prey density, and can range from 25 to 1,500 square miles (FWS 2013b). Both male and female wolves disperse, sometimes greater than 600 miles (FWS 2013b). A radio-collared male (OR7) dispersing from a pack in northeastern Oregon has been documented in southwestern Oregon and northern California since 2011, including in the vicinity of the Project in Jackson, Douglas, and Klamath Counties (ODFW 2013b). The Area of Known Wolf Activity initially mapped by ODFW for OR7 in 2014 (ODFW 2014c) indicates that the pipeline route would cross this area where OR7 was established in 2014.

In May 2014, a female wolf was documented in the same area as OR7, suggesting the wolves had paired (ODFW 2014d). In June 2014, FWS and ODFW biologists confirmed the wolves had mated and produced three pups (ODFW 2014e). This is the first evidence of wolves breeding in

the Oregon Cascades since the early twentieth century (ODFW 2014d). The den is located within the Rogue River National Forest, between Crater Lake and Mount McLoughlin (Young 2014). The pipeline route would not directly affect this den location; however, construction activities that bring human presence into the area could impact wolf movements and behavior. In 2015, the FWS and ODFW designated OR7, his mate, and three pups as the Rogue pack (ODFW 2015). In December 2014 and January 2015, evidence of an additional pair of wolves was documented in the southwest Cascades, west of the town of Keno (ODFW 2015). Below is the determination of effects summary for this species and critical habitat; see our BA for details (FERC 2015).

The Project **may affect** the gray wolf because:

- dispersing and resident wolves have been documented recently within the gray wolf analysis area;
- the OR7 wolf family den was located in the vicinity of the pipeline route in 2014;
- construction noise could disturb wolves if present in the vicinity of the pipeline; and
- increased human presence associated with construction activities could impact wolf behavior and movements, including the chance of collisions with vehicles.

However, the Project is **not likely to adversely affect** the gray wolf because:

- the OR-7 den within the Rogue River National Forest is at least 6 miles from the pipeline;
- Project-related noises are not likely to be substantially different from noises produced by existing recreation and logging activities that wolves have been shown to tolerate;
- during pipeline construction, trash would be removed on a daily basis, and roadside carrion is expected to be present as an existing condition, and not substantially increased by the Project;
- following construction, the restored and revegetated pipeline corridor is likely to increase habitat diversity and forage used by ungulates such as deer, which are prey for gray wolves; and
- Project-related effects on the gray wolf would be unsubstantial and discountable.

No critical habitat has been designated or proposed for the gray wolf.

Fisher (Federal Proposed Threatened Species, State Sensitive-Critical)

The FWS proposed to list the West Coast DPS of fisher as threatened under the ESA on October 7, 2014 (79 FR 60419). Fishers occur in the northern coniferous and mixed forests of Canada and the northern United States (69 FR 18770). In Oregon, this species is currently known to occur in Curry, Douglas, Josephine, Jackson, and Klamath Counties (Aubry and Lewis 2003; Aubry pers. comm. 2007 as cited in FWS 2014a), and consists of two separate and genetically isolated populations in the northern Siskiyou Mountains and the southern Cascade Range (FWS 2014a). Fisher habitat consists of mature, closed canopy coniferous forests at low to mid elevations, including riparian corridors with continuous canopies, and large stands with low levels of fragmentation and a high percentage of dead and downed timber (ODFW 2014f). Fishers have large home ranges, averaging from 24 to 32 square miles (ODFW 2014f).

The southern Oregon Cascades population primarily occurs north of the Project, as close as approximately 5 miles from the pipeline between MP 110 and MP 175 (Aubry and Raley 2006;

Lofroth et al. 2010). Infrequently, fishers from the southern Oregon Cascades population have been observed south of the pipeline in Jackson County, including fishers detected south of Mount McLoughlin near Hyatt Reservoir in 2006 and 2007 (Lofroth et al. 2010). These observations together with the availability of suitable habitat within the pipeline right-of-way indicate that there is some potential for fishers to be present within the analysis area. If present, potential impacts would include disturbance from construction noise, increased risk of collision, habitat removal and modification, habitat fragmentation, and edge effect. However, past surveys conducted in the vicinity of the Project did not detect fishers (Clayton and von Kienast 2009), and fisher detections within five miles of the pipeline are all at least 15 years old (ORBIC 2012; Forest Service NRIS database), indicating that fisher presence within the analysis area is unlikely. Based on available data, our preliminary determination is that the Project is not likely to adversely affect the fisher. However, FWS has indicated during consultation that a likely to adversely affect determination is appropriate. Therefore, we defer to the judgment of their species experts, and concur with their determination. Below is the determination of effects summary for this species. See our BA for details (FERC 2015); however, note that our effects determination for fisher has changed since we submitted our BA in February 2015, and these updates are reflected here.

The Project **may affect** the fisher because:

- individuals from the southern Oregon Cascades population may occur within the analysis area and could be disturbed by the Pacific Connector pipeline; and
- suitable habitat is available within the analysis area and would be impacted by the Pacific Connector pipeline.

Because fishers are proposed for listing, the Project **is not likely to jeopardize the continued existence** of the fisher because:

- known fisher presence within the pipeline right-of-way is limited to infrequent occurrences;
- LSOG habitat removal due to pipeline construction (858 acres) is 0.26 percent of the available habitat within 5 miles (330,360 acres) of the pipeline route, which is low compared to the suitable habitat available; and
- Project impacts would affect a small portion of an individual's home range.

The following determination is warranted to receive a conference opinion: **may affect, likely to adversely affect** because:

- Fishers have the potential to occur in the analysis area.
- 858 acres of LSOG habitat, including snags, would be removed due to pipeline construction.
- Snags could serve as fisher dens.

Critical habitat has not been proposed for the fisher.

Whales

Seven species of federally listed whales potentially occur off the coast of Oregon, including the blue, fin, southern resident killer, humpback, sei, north Pacific, and sperm whales. All of these

whale species are federally protected under the MMPA, and were included in Jordan Cove and Pacific Connector's IHA application to NMFS on October 8, 2014 (Jordan Cove and Pacific Connector 2014). These species tend to feed during the summer in the northern latitudes and migrate to the tropical southern latitudes in the winter for breeding. However, whales could be encountered off the coast of Oregon throughout the year. Project effects on whales would be associated with LNG and construction supply vessel transits in the waterway inbound and outbound from the Jordan Cove terminal. Potential direct effects of the Project could include injury and/or mortality due to ship-strikes and potential adverse effects from a ship fuel spill. Spills could indirectly affect whales by impacting forage species. Below is the determination of effects summary for whales and critical habitat; see our BA for details (FERC 2015).

The Project **may affect** federally listed whales because:

- federally listed whales may occur within the EEZ analysis area (see our BA; FERC 2015) during operation of the proposed action; and
- the proposed action would increase shipping traffic (LNG vessels) within the EEZ analysis area.

However, the Project is **not likely to adversely affect** federally listed whales for the following reasons:

- ship strikes on whales within the EEZ analysis area are infrequent;
- 90 LNG vessel trips per year to the LNG terminal are expected to cause an immeasurable increase in ship strikes to whales over known frequencies of incidents;
- Jordan Cove would provide a ship strike avoidance measures package to LNG vessel operators transporting cargo from the LNG terminal that would consist of multiple measures to avoid striking marine mammals;
- LNG vessels approaching Coos Bay would be traveling slowly and escorted by tractor tugs from 5 nmi offshore to the Port;
- LNG vessel noise would contribute to overall noise within the EEZ while en route to the Port of Coos Bay and effects of ship noise on blue whales could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise, but would not exceed existing background ship noise levels and would not cause injury;
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species; and
- the relative population density of whales within the EEZ would be low enough so that Project-related effects of LNG vessel transit in the waterway would be insignificant and discountable.

No critical habitat has been designated or proposed for blue, fin, humpback, sei, sperm, or North Pacific right whales.

The Project would have **no effect** on designated critical habitat units (CHUs) for the Eastern North Pacific Southern Resident stock of killer whales because:

- none of the designated CHUs occur within the EEZ analysis area off the Oregon coast;

- the nearest critical habitat unit to Coos Bay is the Strait of Juan de Fuca, Washington, more than 390 nmi north; and
- no LNG vessels are expected to transit designated critical habitat.

4.7.1.2 Birds

Short-tailed Albatross (Federal Endangered Species, No State Status)

The short-tailed albatross was listed as endangered throughout its range in the United States on July 31, 2000 (FWS 2000a). In the North Pacific, the coastal habitat for the short-tailed albatross is in high-productivity areas with expansive deep water beyond the continental shelf. Short-tailed albatross have been documented to occur off the Oregon coast in the vicinity of Coos Bay. Because the closest breeding population of short-tailed albatross is within the Hawaiian Islands, the Project should not have an effect on recovery criteria for the species. The short-tailed albatross could potentially be encountered within the LNG vessel transit route; however, short-tailed albatross are expected to avoid LNG marine traffic. Below is the determination of effects summary for the short-tailed albatross and critical habitat; see our BA for details (FERC 2015):

The Project **may affect** short-tailed albatross because:

- short-tailed albatross may occur within the EEZ analysis area during operation of the proposed action; and
- the proposed action would increase shipping traffic (LNG vessels) within the EEZ analysis area.

However, the Project is **not likely to adversely affect** short-tailed albatross for the following reasons:

- other species of albatross have infrequently collided with airplanes in flight but collisions of any albatross species with ships are unknown and are expected to be highly unlikely;
- 90 LNG vessel trips per year to the LNG terminal are expected to cause immeasurable increase in potential ship strikes on short-tailed albatrosses;
- LNG vessels approaching Coos Bay would be traveling slowly and escorted by tractor tugs from 5 nmi offshore; and
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species. Any oil released at sea would be in small enough quantities that potential effects on short-tailed albatrosses would be discountable.

No critical habitat has been designated or proposed for the short-tailed albatross.

Western Snowy Plover (coastal) (Federal Threatened Species with Critical Habitat, State Threatened Species)

The Pacific Coast population of western snowy plover has been listed as a threatened species under the ESA since March 5, 1993 (FWS 1993a). The Pacific coast population includes birds that nest adjacent to tidal waters, including all nesting birds on the mainland coast, peninsulas, offshore islands, adjacent bays, estuaries, and coastal rivers (FWS 1993a). The western snowy plover is a year-round, uncommon resident of the North Spit (BLM 2005); the spit supports the

most productive snowy plover population segment on the Oregon coast (BLM 2008b). Western snowy plovers may be encountered along the LNG vessel transit route from nearshore coastal waters to the LNG terminal site. Potential impacts include increased noise associated with construction of the LNG terminal, operation activities associated with shipping, increased recreation, increased habitat conversion, habitat degradation by human encroachment, and increased illegal harvest (Comer 1982). Conservation measures proposed to reduce impacts include implementation of BMPs, education and outreach, and monitoring. Additionally, Jordan Cove would provide $130,000 in funding over the four-year construction period to a group designated by agencies to provide for fencing, signage, application of shell hash, tree removal, maintenance, and beach grass elimination research. For a complete description of impacts and conservations measures, see our BA (FERC 2015). CHUs OR-10 and OR-9 are located 2.6 and 6.9 miles from the Project, respectively; both units were occupied by western snowy plovers at the time of listing (1993) and in 2012. Below is the determination of effects summary for the western snowy plover and critical habitat; see our BA for details (FERC 2015).

The Project **may affect** western snowy plovers because:

- the closest western snowy plover nesting habitat to the Project is on the North Spit approximately 1.1 miles from Jordan Cove LNG terminal site, although active nesting by western snowy plovers occurs approximately 2.0 miles from the Jordan Cove terminal;
- snowy plovers nesting on the North Spit are currently affected by human use of the area whether due to destruction of nests by dogs, ORV traffic, inadvertent trampling, or deliberate vandalism and to diverse plover responses to human presence;
- snowy plovers nesting on the North Spit are currently affected by scavengers and predators (corvids, coyotes, striped skunk, feral cats) which may be attracted to nesting areas by human actions such as depositing of trash and food remains;
- the Jordan Cove LNG Project would result in a large but temporary increase in people employed on the North Spit during construction (up to 2,937 construction workers) and a much smaller long-term increase of operations staff (about 145 permanent employees);
- it is reasonable to assume that a number of Jordan Cove terminal construction and operations personnel would use the North Spit for recreational purposes and increased recreational use could result in increased plover disturbance; and
- scavengers and predators, most of which are encouraged or attracted by human disturbance such as campsites, garbage dumps, work sites, or even footprints in the sand may increase effects to nesting plovers as human use of the North Spit increases.

The Project is **not likely to adversely affect** western snowy plover because:

- LNG construction noise at active nest sites (approximately 2.0 miles) and critical habitat (approximately 2.6 miles) is not expected be above ambient levels; and
- Jordan Cove would minimize potential secondary effects to the critical habitat primary constituent element (PCE) that identifies disturbance by humans, pets, vehicles or human-attracted predators through implementation of (1) BMPs to minimize predator density related to increased human presence and habitat removal, and (2) education and outreach programs intended to train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including: litter control,

avoidance of nesting and foraging areas, keeping pets on-leash, and remaining on established roads and trails.

Even though the northern end of CHU OR-10 on the North Spit is located approximately 2.6 miles from the LNG terminal, the Project **may affect** designated critical habitat for the western snowy plover because:

- essential physical and biological features of designated critical habitat include the following PCEs: sparsely vegetated areas above daily high tides that are relatively undisturbed by the presence of humans, pets, vehicles, or human-attracted predators;
- snowy plovers nesting on the North Spit are currently affected by human use of the area whether due to destruction of nests by dogs, inadvertent trampling, or deliberate vandalism and to diverse plover responses to human presence; and
- snowy plovers nesting on the North Spit are currently affected by scavengers and predators which may be attracted to nesting areas by human actions.

However, the Project is **not likely to adversely affect** designated critical habitat for the western snowy plover because:

- conservation measures provided by the FWS, the BLM, and the ODFW would be funded by Jordan Cove to enhance critical habitat by installing fencing, signage, applying shell hash, removing tree, eliminating beach grass and annual maintenance;
- funding would be provided to the entity as defined by the agencies and it would be the responsibility of the particular entity to administer the funding; and
- Jordan Cove would minimize potential secondary effects to the critical habitat PCE that identifies disturbance by humans, pets, vehicles or human-attracted predators through implementation of (1) BMPs to minimize predator density related to increased human presence and habitat removal, and (2) education and outreach programs intended to train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including: litter control, avoidance of nesting and foraging areas, keeping pets on leash, and remaining on established roads and trails.

Streaked Horned Lark (Federal Threatened Species with Critical Habitat, State Sensitive-Critical Species)

The streaked horned lark (*Eremophilia alpestris strigata*) is a rare subspecies of the horned lark. It migrates between Oregon and Washington with breeding populations found in the Puget Sound lowlands, Columbia River/coastal Washington, and the Willamette Valley in Oregon from late March to early August. The FWS designated the streaked horned lark as Threatened with critical habitat under the ESA on October 3, 2013 (78 FR 61451). The closest critical habitat to the Project is approximately 80 miles to the north, in Benton County (78 FR 61505). Non-breeding horned larks have been observed in the vicinity of the Project, although these records do not indicate subspecies (FWS 2013c; Gabrielson and Jewett 1940 as cited in FWS 2013c; Contreras 1998). It is possible that some of the horned larks seen in the project vicinity during fall and winter may have been streaked horned larks but there is no way to be certain. A focused field evaluation of the project site on the North Spit was conducted by SHN Consulting (SHN) staff on April 23, 2013, to assess the potential for streaked horned lark habitat to occur (see

Jordan Cove's Resource Report 3). Although potential lark habitat appears to exist in pockets of the Jordan Cove LNG terminal's footprint, these areas do not meet the specific habitat because they are either too small and not adjacent to open water, densely vegetated or experiencing invasive vegetation encroachment, and/or rolling and steep. Consequently, occurrence of the streaked horned lark is not anticipated at the Jordan Cove terminal site. Streaked horned larks may be encountered within the general Project vicinity; however, the species would likely keep a distance and avoid close interactions. Below is the determination of effects summary for the streaked horned lark and critical habitat; see our BA for details (FERC 2015).

The Project **may affect** streaked horned larks because:

- horned larks have been observed during fall and winter in the vicinity of the Jordan Cove LNG terminal analysis area. It is possible that one or more of the horned larks reported was *Eremophila alpestris strigata*.

The Project is **not likely to adversely affect** streaked horned larks because:

- use of the Jordan Cove LNG terminal analysis area by streaked horned larks would be limited to infrequent occurrences because no suitable habitat is present at the project site;
- there are no studies that have confirmed that the species is susceptible to disturbances such as construction noise; and
- encroachment by European beachgrass makes initially identified potential habitat in the area unlikely to be used by streaked horned larks.

The Project would have **no effect** on designated CHUs for the streaked horned lark because:

- the closest critical habitat, subunit 4-C, is approximately 80 miles north of the Project.

Marbled Murrelet (Federal Threatened Species with Critical Habitat, State Threatened Species)

MAMUs in Washington, Oregon, and California were listed as threatened under the ESA on October 1, 1992 (FWS 1992). Critical habitat for the MAMU was first designated on May 24, 1996 (FWS 1996) and subsequently revised in 2011 (FWS 2011c). Throughout the forested portion of their range, MAMU habitat use is positively associated with the presence and abundance of mature and old-growth forests, large core areas of old-growth, low amounts of edge and fragmentation, proximity to the marine environment, and increasing forest age and height, although the presence of platforms is the most important characteristic of nesting habitat (FWS 2006b).

Through a combination of GIS data provided by the BLM and private timber companies, and field surveys conducted between 2007 and 2014, Pacific Connector identified 168 occupied and presumed occupied MAMU stands within 0.25 mile of the proposed action, or within 0.5 mile of federally-designated critical habitat that would be affected by the proposed action.

Construction of the Project would remove a total of about 901 acres of MAMU habitat (suitable, recruitment, capable), including about 55 acres of suitable habitat removed from 25 stands. There is the potential that indirect impacts could extend over a total of about 6,767 acres of suitable nesting habitat in the terrestrial nesting analysis area, where project-related noise,

primarily use of access roads, may affect MAMU behavior, including breeding activities. Eleven occupied and 28 presumed occupied MAMU stands occur within CHU OR-06 (b, c, and d) within the proposed terrestrial analysis area. Overall, construction of the Pacific Connector Pipeline Project would remove about 3 acres of suitable MAMU nesting habitat (PCE-1) and about 5 acres of recruitment habitat (PCE-2) within CHU OR-06-d.

Pacific Connector would implement a number of measures to reduce impacts on MAMU habitat, including using UCSAs, and replanting conifer trees outside of the 30-foot-wide maintenance corridor on certain federal lands and non-federal lands. However, replanted trees may be harvested from non-federal lands or federal lands slated for timber harvest (i.e., Matrix lands), and if allowed to grow would provide minimal benefit to MAMUs because it would take decades at a minimum to restore replanted forests to recruitment or suitable habitat conditions. To avoid direct effects to MAMU, timber would be removed outside of the entire MAMU breeding season (after September 15 but before March 31) within 300 feet of MAMU stands to ensure that trees with active murrelet nests and chicks are not felled.

The FWS prepared a Conservation Framework for the Pacific Connector Pipeline Project that provides direction and methods to quantify and categorize the impacts to MAMUs (and NSOs) and their habitat, guidance for offsetting these impacts, and additional guidance on calculating impact and mitigation to supplement the Framework (PC Trask & Associates 2013a, 2014b; FWS 2014b). Following direction within the Conservation Framework, Pacific Connector conducted individual assessments for each MAMU stand (occupied and presumed occupied) to evaluate and determine the type and amount of mitigation proposed to compensate for impacts from the proposed action.

As mitigation for impacts to older MAMU habitat, Pacific Connector proposed in their CMP[109] to acquire, preserve, and manage in perpetuity old-growth MAMU habitat. After acquisition and/or purchase of conservation easement, this land would be deeded to a third-party conservation group for preservation and long-term management. Pacific Connector filed with FERC an Amendment to the Draft Compensatory Mitigation Plan (appendix F-2)[110] that identifies mitigation for effects to MAMU, including compensation for potential disturbance/disruption during project activities in the MAMU critical and late breeding season. In the Amendment to the Draft Compensatory Mitigation Plan, Pacific Connector proposed two mitigation options to replace the draft CMP. Under Pacific Connector's preferred option, mitigation would include NSO and MAMU habitat acquisition (up to $45 million) and management (up to $4.5 million); both options include the contribution of funds (~$350,000) toward monitoring a multi-year corvid-related MAMU nest predation mitigation program that would include public education and outreach as as control of anthropogenic food sources. The Amendment to the Draft Compensatory Mitigation Plan supplements the BA's proposed action.

Additionally, certain mitigation projects proposed by the BLM to meet RMP objectives have the potential to benefit MAMU. A summary of these mitigation projects and their potential impacts are provided in table 2.1.4-1 in chapter 2 of this EIS. Additionally, benefits to MAMU from these BLM projects are identified in the BA (FERC 2015). Below is the determination of effects summary for the MAMU and critical habitat; see our BA for details (FERC 2015).

[109] Filed with the FERC in September 2013; updated CMP filed in April 2014.
[110] Filed with FERC August 13, 2015.

The Project **may affect** MAMUs because:

- suitable habitat is available within the terrestrial nesting analysis area; and
- MAMUs have been located within the terrestrial nesting analysis area during survey efforts for the proposed action.
- MAMUs are expected to forage offshore in the EEZ analysis area, and along the waterway for LNG vessel transit within Coos Bay.

The Project is **likely to adversely affect** MAMUs for the following reasons:

- disturbance associated with Pacific Connector Pipeline Project activities would occur within the critical breeding season and within 0.25 mile of known MAMU stands. Proposed actions that generate noise above local ambient levels might disturb or disrupt MAMUs and interfere with essential nesting behaviors:
  - 83 MAMU stands (23 occupied and 60 presumed occupied) are within 0.25 mile of the pipeline that could be constructed during the breeding season.
  - 161 MAMU stands (48 occupied and 113 presumed occupied) are within 0.25 mile of access roads that could be used during pipeline construction in the breeding season;
- blasting for the pipeline trench may occur within 0.25 mile of MAMU stands between April 1 and September 30;
- helicopter use for removal of timber during pipeline construction within 0.25 mile of 9 MAMU stands (8 occupied and 1 presumed occupied) during the breeding period (between April 1 and September 15) could occur and disturb MAMU adults and nestlings, as well as potentially blow nestlings out of the nest tree within 7 MAMU stands (6 occupied and 1 presumed occupied) from rotor wash;
- the Pacific Connector Pipeline Project would remove and modify potential suitable nesting habitat and recruitment habitat within the range of the MAMU, which does not support the recovery of the species; approximately 55 acres of suitable MAMU habitat would be removed, or approximately 0.4 percent of the 13,743 acres of suitable habitat available in the terrestrial nesting analysis area; and
- LNG vessel traffic in the waterway to the Jordan Cove terminal could cause potential behavioral effects to foraging MAMU, fuel and lubricant spills from LNG vessels could cause injury or mortality to foraging MAMUs, and MAMUs could collide with powerlines associated with the LNG terminal facility.

A **may affect** determination is warranted for MAMU critical habitat because:

- the Pacific Connector Pipeline Project occurs within designated MAMU critical habitat; and
- the Pacific Connector Pipeline Project would result in habitat impacts within designated critical habitat areas.

A **likely to adversely affect** determination is warranted for MAMU critical habitat because:

- the proposed action could remove or degrade individual trees with potential nesting platforms or the nest platforms themselves, resulting in a decrease in the value of the trees for future nesting use (PCE 1, or suitable or potentially suitable habitat); and

- the proposed action could remove or degrade trees adjacent to trees with potential nesting platforms that provide habitat elements essential to the suitability of the potential nest tree or platform, such as providing cover from weather or predators (PCE 2, or recruitment/capable habitat).

Amendment BLM-1, Site-Specific Exemption of Requirement to Protect Marbled Murrelet Habitat on the BLM Coos Bay and Roseburg Districts

On BLM lands, MAMU contiguous existing and recruitment habitat within 0.5 mile of occupied MAMU sites becomes part of the LSR network and is designated as "unmapped LSR." Section 4.1.3.6 of this EIS discloses the direct and indirect effects of this proposed RMP amendment on mapped and unmapped LSRs and on occupied MAMU stands on BLM lands. In terms of impacts on MAMUs and their habitats, the effects of this amendment are the same as those described for construction and operation of the Project. On BLM lands on the Coos Bay District, the Project would clear approximately 34 acres of MAMU habitat in 12 stands (table 4.1.3.6-3). On BLM lands on the Roseburg District, the Project would remove approximately 19 acres of MAMU habitat in 4 stands (table 4.1.3.6-7).[111] Potential impacts on MAMUs are summarized above and described in detail in our BA (FERC 2015).

Northern Spotted Owl (Federal Threatened Species with Critical Habitat, State Threatened Species)

In Oregon, the NSO is found in low- and mid-elevation coniferous forest in the Coast, Siskiyou, and Cascade Ranges (Forsman 2003). Suitable habitat for NSOs provides elements necessary for nesting, roosting and foraging. NSOs generally nest in forests with a dominant tree canopy of 60 to 80 percent and multiple layers provided by large trees (more than 30 inches dbh), a high basal area (greater than 240 square feet/acre), and a high diversity of different diameters of trees. NSOs have large home ranges and utilize large tracts of land containing significant acreage to meet their biological needs and a wide array of forest types and structures are necessary to support the various life histories (FWS 2011a). Typically, a larger area is required for NSOs in more fragmented habitats (Courtney et al. 2004). NSOs remain on their home range throughout the year. As a result, NSOs have large home ranges that provide all the habitat components and prey necessary for the survival and successful reproduction of a territorial pair.

Surveys conducted by Pacific Connector in 2007 identified 12 NSO pairs and a resident single but no nests. In 2008, surveys found NSO pairs at 20 locations, with two nests identified, and resident singles noted at 6 sites. In addition to NSO sites identified by these surveys, Pacific Connector also considered home range information from the BLM and Forest Service, historic home ranges, best location home ranges (alternate sites closest to proposed action), and Pacific Connector-assumed home ranges (determined by Pacific Connector's assessment of habitat maps).

The Project would affect habitat within 99 NSO home ranges and 10 nest patches. Sixty-two activity sites occur in federally designated CHUs. About 37 miles of pipeline route would cross

[111] Pacific Connector filed updated impact calculations with FERC on April 27, 2015 (in response to FERC's April 16, 2015 Data Request) that indicated the Project would clear approximately 30 acres of MAMU habitat in 12 stands on BLM lands on the Coos Bay District, and remove 16 acres in 4 stands on BLM lands on the Roseburg District. However, the values listed here are based on the analysis that was conducted by the BLM in conjunction with the applicant following this response by the applicant.

7 designated critical habitat sub-units. Project construction would remove a total of about 522 acres of nesting, roosting, or foraging (NRF) habitat for NSO and 234 acres would be modified, including high NRF habitat, of which 137 acres would be permanently lost within the 30-foot-wide corridor maintained in an herbaceous state.

Potential direct effects to NSOs would include the following: (1) removal of a known nest tree during the entire breeding season (March 1 through September 30), and (2) human and noise disturbance due to right-of-way clearing and construction during the breeding period, including noise due to blasting and helicopter support during construction, and smoke from prescribed burnings. Potential indirect effects include the following: (1) removal or modification of suitable NRF habitat, dispersal habitat, and habitat that would be capable, over the life of Project, to achieve dispersal or NRF habitat characteristics but for the Project's impacts within LSR, Riparian Reserves, or NSO home ranges; (2) habitat fragmentation; and (3) other indirect effects that occur due to project-related increases in edge habitat and loss of interior forest habitat, including increased predation, increased competition, and effects on prey utilized by NSOs.

Pacific Connector would minimize impacts on NSO habitat using the BMPs for crossing forested lands described in section 4.5.2.2 of this EIS. To reduce disturbance or disruption, timber removal would occur outside the entire NSO breeding season (March 1 through September 30) within 0.25 mile of NSO activity centers, and as a result, no nest trees within activity centers would be removed during the NSO nesting period. Additionally, Pacific Connector would install the pipeline within 0.25 mile of activity centers after the critical breeding period (after July 15). Because effects by the proposed action cannot be fully mitigated on-site, Pacific Connector has proposed a CMP that would fund off-site mitigation, including habitat acquisition and barred owl management. Additionally, mitigation projects proposed by the BLM and Forest Service to meet BLM RMP and Forest Service LRMP objectives would benefit NSO. These projects include stand thinning to improve the growth of trees, fuel reduction to reduce wildfires, and the reallocation of Matrix to LSR. A summary of these mitigation projects and their environmental consequences are provided in table 2.1.4-1 in chapter 2 of this EIS. Additionally, benefits to NSO from these BLM projects are identified in the BA (FERC 2015).

A comment letter received after the end of the formal scoping period about the Pacific Connector Pipeline Project expressed a concern that commercial logging has been proposed as mitigation for take of NSOs and MAMUs. We addressed this comment in section 2.1.4 of this EIS to clarify possible misunderstandings.

The FWS prepared a Conservation Framework for the Pacific Connector Pipeline Project that provides direction and methods to quantify and categorize the impact to NSOs (and MAMUs) and their habitat, guidance for offseting these impacts, and additional guidance on calculating impact and mitigation to supplement the Framework (PC Trask & Associates 2013b, 2014b; FWS 2014b). Following direction within the Conservation Framework, Pacific Connector conducted individual assessments for each NSO activity center to evaluate and determine the type and amount of mitigation proposed to compensate for impacts from the proposed action, and presented this information in the CMP.

Pacific Connector filed with FERC an Amendment to the Draft Compensatory Mitigation Plan (appendix F-2)[112] that identifies mitigation for effects to NSO. In the Amendment to the Draft Compensatory Mitigation Plan, Pacific Connector proposed two mitigation options to replace the draft CMP. Under Pacific Connector's preferred option, mitigation would include NSO and MAMU habitat acquisition (up to $45 million) and management (up to $4.5 million); both options include the contribution of funds (~$197,400) to support barred owl management. The Amendment to the Draft Compensatory Mitigation Plan supplements the BA's proposed action.

Below is the determination of effects summary for the NSO and critical habitat; see our BA for details (FERC 2015):

The Project **may affect** NSOs because:

- suitable habitat is available within the Provincial Analysis Area;[113] and
- NSO pairs and resident singles have been located within the Provincial Analysis Area during survey efforts.

The Project is **likely to adversely affect** NSOs for the following reasons:

- noise from blasting and helicopter use during pipeline construction within 0.25 mile of NSO sites during the late breeding season would occur and could increase the risk of predation to fledglings that are generally not as able to escape as adults during the latter part of the breeding season;
- construction of the Pacific Connector Pipeline Project would remove high NRF and NRF habitat within the range of the NSO including effects to nest patches, core areas, and home ranges of known, best location, and Pacific Connector-assumed owls, some of which are currently below thresholds needed to sustain NSOs. Once suitable NRF habitat is reduced or modified in NSOs' home ranges, there is an increased likelihood that NSOs remaining in the Project area would be subject to:
  - displacement from nesting areas;
  - concentration into smaller, fragmented areas of suitable nesting habitat that may already be occupied;
  - increased interspecific (with barred owls) and intraspecific competition for suitable nest sites;
  - decreased survival due to increased predation and/or limited resource (forage) availability; and
  - diminished reproductive success for nesting pairs.
- construction of the Pacific Connector Pipeline Project would remove and modify high NRF, NRF, dispersal only, and capable habitat for NSOs throughout the project area, including removal of habitat within the home range of 90 NSOs, 59 of which are currently below sustainable threshold levels of suitable habitat for continued persistence in their home range and/or core area; and

[112] Filed with FERC August 13, 2015.
[113] The Provincial Analysis Area includes the extent of the following potential Project effects: 1) habitat removal or modification, and 2) disturbance/disruption of NSO during the breeding season. See the BA (FERC 2015) for details.

- construction of the Pacific Connector Pipeline Project would bring two NSO core areas below the 50 percent NRF threshold (one known NSO activity center and one best location activity center) and one NSO home range below the 40 percent NRF threshold (best location activity center).

A **may affect** determination is warranted for NSO critical habitat because:

- the Project would occur within designated NSO critical habitat; and
- the Project would result in habitat impacts within designated critical habitat areas.

A **likely to adversely affect** determination is warranted for NSO critical habitat because:

The proposed action would remove or potentially downgrade PCEs in critical habitat sub-units ORC-6, KLE-1, KLE-2, KLE-3, KLE-4, KLE-5, and ECS-1 as defined in the Final Rule designating critical habitat for the NSO (FWS 2012).

Amendment BLM-2, Site-Specific Exemption of Requirement to Retain Habitat in Known Owl Activity Centers on the Roseburg District

On BLM lands, the KOAC land allocation is a component of the LSR network. Section 4.1.3.6 of this EIS discloses the direct and indirect effects of this proposed RMP amendment on mapped and unmapped LSRs and on KOACs on BLM lands. In terms of impacts on KOACs and NSOs, the effects of this amendment are the same as those described for construction and operation of the Pacific Connector Pipeline Project. A total of approximately 7 acres would be cleared in three different KOACs (table 4.1.3.6-9).[114] Potential impacts on NSOs are summarized above, and described in detail in our BA (FERC 2015).

4.7.1.3 Fish

In this section, we summarize the listing status, life history, and presence and determination of project action effects to the federally listed fish species and their critical habitat that could be affected by the Project. The details of existing conditions and potential impacts of Project actions and conservation measures to each of the ESA-listed fish species are provided in the BA for this Project. The species addressed include the Coho Salmon-Southern Oregon/Northern California Coast ESU, Coho Salmon-Oregon Coast ESU, North American Green Sturgeon–Southern DPS, Eulachon–Southern DPS, Lost River sucker, and shortnose sucker. Impacts to waterbodies by the Project are described in section 4.4.2 of this EIS. Impact minimization measures are currently proposed to reduce impacts to threatened and endangered fish species. Overall, the types, methods, and magnitude of impacts to listed fish species are represented by those presented for fish in general as presented earlier in section 4.6.2 of this EIS. The detailed information on minimization measures, mitigative actions, and impacts to federally listed fish species can be found in our BA (FERC 2015).

[114] Pacific Connector filed updated impact calculations with FERC on July 7, 2015 (Addendum #1 to Response to April 16, 2015 Data Request) that indicated the Project would clear approximately 6 acres in three different KOACs. However, the value listed here (i.e., 7 acres) is based on the analysis that was conducted by the BLM and Forest Service in conjunction with the applicant following this response by the applicant.

Coho Salmon-Southern Oregon/Northern California Coast ESU (Federal Threatened)

The Southern Oregon/Northern California Coast (SONCC) ESU coho salmon was listed as a threatened species on May 6, 1997, between Punta Gorda, California, and Cape Blanco, Oregon. It includes all naturally spawning populations as well as three artificial propagation programs, of which one, the Cole Rivers Hatchery (ODFW stock #52) located on the Rogue River, is within the Project area. The status was reaffirmed by NMFS in 2005 (70 FR 37106).

At the time of initial listing, less than 10,000 naturally reproducing SONCC coho salmon were estimated (NMFS 1997b). Historically, this ESU consisted of 59 populations found in six major areas including the Rogue, Klamath, and Eel River basins and within the coastal basins and subbasins among three regions (northern, central and southern regions) (Williams et al. 2006). More recent short-term research suggests the coho salmon populations of this ESU continue to decrease (NMFS 2011). Critical habitat for the SONCC ESU was designated in May 5, 1999 (74 FR 24249) and includes the accessible reaches of all rivers (including water, substrate, and adjacent riparian zone of estuarine and riverine reaches) between the Mattole River in California and the Elk River in Oregon. The Pacific Connector pipeline route would cross designated critical habitat within waterbodies of the Upper Rogue HUC (17100307) below the Lost Creek, Willow Creek, and Fish Lake Dams. The detailed assessment of impacts and conservation measures for SONCC coho salmon is provided in our BA (FERC 2015).

Five life phases are generally recognized for the coho salmon: juvenile rearing, juvenile migration, growth and development, adult migration, and spawning. Juvenile summer and winter rearing areas and spawning areas are often located in small headwater streams. Juvenile migration corridors, adult migration corridors, and spawning areas are found in tributaries as well as mainstream reaches and estuarine zones. Growth and development to adulthood happen primarily in near- and off-shore marine waters. Final maturation takes place in freshwater tributaries when the adults return to spawn (NMFS 1999). Typically, coho salmon begin their spawning migration as three year olds in late summer and fall and spawn by mid-winter. Eggs incubate for 1.5 to 4 months and then hatch. Juveniles rear for about 15 months in freshwater before migrating in spring to the ocean. They generally spend two growing seasons within the ocean before migrating back to their natal stream to spawn (NMFS 1997b).

Major rivers, estuaries, and bays known to support coho salmon within the range of the SONCC ESU include the Rogue River, Smith River, Klamath River, Mad River, Humboldt Bay, Eel River, and Mattole River (NMFS 1999), two of which (i.e., the Rogue and Klamath Rivers) are within the project area although this ESU is currently prevented from accessing the potential project affected Klamath River areas due to dam passage barriers downstream.

Below is the determination of effects summary for SONCC Coho Salmon ESU and critical habitat; see the BA for details.

The Project **may affect** coho salmon in the SONCC ESU because:

- several stages and activities of coho salmon (upstream adult migration, juvenile rearing, and juvenile out-migration) are expected to occur at various locations in the riverine analysis area during construction and operation of the proposed action.

The Project is **likely to adversely affect** coho salmon in the SONCC ESU for the following reasons:

- exposure of juveniles to elevated TSS concentrations during dry open-cut construction (fluming or dam-and-pump) for more than 20 hours. Such an exposure could cause a short-term reduction in both feeding rate and feeding success;
- exposure of juveniles to elevated TSS concentrations during dry open-cut construction (fluming or dam-and-pump) for 40 hours of more. Such an exposure could cause minor physiological stress in juvenile coho salmon;
- a site crossing failure while dry open-cut construction is underway could result in elevated TSS concentrations, which could cause moderate physiological stress to coho salmon;
- blasting at 17 streams where this species occurs could cause mortality to fish by rupturing swim bladders;
- fish salvage would occur for some dry stream crossings. During fish salvage operations, coho salmon are considered vulnerable to electrofishing, subject to injury and mortality. Seining and handling may also adversely affect Oregon Coast coho salmon; and
- lack of LWD is a limiting factor in most streams within range of SONCC coho salmon. Removal of mid-seral riparian forest (40 to 80 years old) would have long-term effects to recruitment of LWD, and removal of LSOG forest (80 years old or older) would have permanent effects to recruitment of LWD because planted conifers would not attain those age classes within the 50-year life of the Project.

The Project **may affect** designated critical habitat for coho salmon in the SONCC ESU because:

- the Pacific Connector pipeline crosses designated critical habitat within waterbodies of the Upper Rogue HUC (17100307) below the Lost Creek, Willow Creek, and Fish Lake Dams.

The Project is **likely to adversely affect** proposed critical habitat for coho salmon in the SONCC ESU for the following reasons:

- freshwater spawning sites would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would remove substrate at crossing sites and produce turbidity downstream that could affect previously utilized redds;
- increases in turbidity are expected to temporarily affect the water quality downstream from stream crossing sites during construction;
- food resources would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would remove substrate and benthos at crossing sites;
- freshwater migration corridors would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would create temporary barriers to in-stream movements; and
- approximately 105 acres of native riparian vegetation (forest, wetlands, and nonforested habitats) and altered habitat would be removed during construction within riparian zones associated with designated critical habitat. Adverse effects to riparian zones would be

long term or permanent depending on whether mid-seral riparian forests (24 acres) or LSOG riparian forests (25 acres) are removed.

Coho Salmon-Oregon Coast ESU (Federal Threatened)

This coho salmon ESU has a complicated listing history. It was first proposed for listing on July 25, 1995 (60 FR 38011) and subsequently listed as threatened on June 20, 2011 (76 FR 35755). The Oregon Coast ESU includes all naturally spawned populations of coho in Oregon coastal streams south of the Columbia River and north of Cape Blanco, including the Cow Creek (ODFW stock # 37) coho salmon hatchery program (NMFS 1995). In the early 1900s, escapement of Oregon Coast coho was estimated to number at least one million, which supported a harvest of nearly 400,000 fish. More recent examination of escapement and harvest concluded that recruits over the past few years (through 2009) have been close to the 1960–2009 average (about 200,000); however, this is only a fraction of its abundance prior to 1940 (about 1.4 million circa 1900) (Stout et al. 2012). Furthermore, of 21 primary populations, there was no trend (i.e., no significant increase or decrease in abundance for the period from 2000–2009) for any of these (NOAA Fisheries 2009). Critical habitat for Oregon Coast coho salmon was also designated on February 11, 2008 (73 FR 7816) and includes water, substrate, and adjacent riparian zones of estuaries and rivers within the range of the Oregon Coast ESU. There are three Critical Habitat subbasins that coincide with the Project: South Umpqua Subbasin (HUC 17100302) and Coquille Subbasin (HUC 17100305), which are crossed by the Pacific Connector pipeline; and Coos Subbasin (HUC 17100304), which includes the Coos Bay estuary where the LNG terminal and slip and the in-water portion of the Pacific Connector pipeline route would be located. Life stage requirements of coho salmon within freshwater habitats in the Oregon Coast ESU are expected to be similar to those described above for coho salmon in the SONCC ESU.

The detailed assessment of impacts and conservation measures for Oregon Coast coho salmon is provided in our BA (FERC 2015). Below is the determination of effects summary for Oregon Coast Coho Salmon ESU and critical habitat; see our BA for details.

The Project **may affect** coho salmon in the Oregon Coast ESU because:

- several stages and activities of coho salmon (upstream adult migration, juvenile rearing, and juvenile out-migration) are expected to occur at various locations in the riverine analysis area during construction and operation of the proposed action;
- several stages and activities of coho salmon (juveniles, adults) are expected to occur within the estuarine analysis area during construction and operation of the proposed action; and
- adult coho salmon area expected to occur within the EEZ analysis area during operation of the proposed action.

The Project is **likely to adversely affect** coho salmon in the Oregon Coast ESU for the following reasons:

- discharge of maintenance dredge spoils offshore at ocean Site F would generate a turbidity plume that could affect coho salmon and their food sources within the EEZ analysis area;

- juvenile coho may be susceptible to stranding by LNG vessel wakes along the portion of the waterway within the Coos Bay navigation channel;
- water intakes by LNG vessels at the Jordan Cove terminal berth during engine cooling operations could entrain or impinge juvenile salmon;
- dredging of the Jordan Cove terminal access channel in Coos Bay could remove eelgrass and benthic community that potential food resources and rearing habitat for Oregon Coast coho salmon;
- construction of the Pacific Connector pipeline across Haynes Inlet would remove eelgrass and the benthic community that provide potential food resources and rearing habitat for Oregon Coast coho salmon;
- levels of TSS could be raised by dredging of the Jordan Cove access channel and construction of the Pacific Connector pipeline across Haynes Inlet, adversely affecting coho salmon;
- exposure to TSS concentrations during dry open-cut construction (fluming or dam-and-pump) for more than 20 hours could potentially cause a short-term reduction in feeding rate and short-term reduction in feeding success;
- exposure to TSS concentrations during dry open-cut construction (fluming or dam-and-pump) for 40 hours of more could potentially cause minor physiological stress in juvenile coho salmon;
- a failure while dry open-cut construction is underway could cause moderate physiological stress effects on juvenile coho salmon;
- a failure of dry open-cut crossing could cause moderate habitat degradations and potentially change coho salmon habitat preferences;
- blasting at 30 streams where this species occurs could cause mortality to fish by rupturing swim bladders;
- fish salvage would occur at some crossings. During fish salvage, coho salmon are considered vulnerable to electrofishing, subject to injury and mortality. Seining and handling may also adversely affect Oregon Coast coho salmon; and
- lack of LWD is a limiting factor in most streams within range of Oregon Coast coho salmon. Removal of mid-seral riparian forest (40 to 80 years old) would have long-term effects to recruitment of LWD, and removal of LSOG forest (80 years old or older) would have permanent effects to recruitment of LWD because planted conifers would not attain those age classes within the 50-year life of the Project.

The Project **may affect** designated critical habitat for coho salmon in the EEZ analysis area, the estuarine analysis area, and the riverine analysis area for the Oregon Coast ESU because:

- construction and operation of the Project would occur in or cross designated critical habitat within waterbodies of the Coos, Coquille, and South Umpqua sub-basins.

The Project is **likely to adversely affect** proposed critical habitat for coho salmon in the Oregon Coast ESU for the following reasons:

- discharge of maintenance dredge spoils offshore at ocean Site F would generate a turbidity plume that could affect coho salmon and their food sources within the EEZ analysis area;
- juvenile coho may be susceptible to stranding by LNG vessel wakes transiting in the waterway along the Coos Bay navigation channel;
- dredging of the Jordan Cove terminal access channel in Coos Bay could remove eelgrass and benthic community that potential food resources and rearing habitat for Oregon Coast coho salmon;
- construction of the Pacific Connector pipeline across Haynes Inlet would remove eelgrass and the benthic community that provide potential food resources and rearing habitat for Oregon Coast coho salmon;
- freshwater spawning sites would potentially be affected over the short term by dry open cut and diverted open cut construction methods that would remove substrate at crossing sites and produce turbidity downstream that could affect previously utilized redds;
- increases in turbidity are expected to temporarily affect the water quality downstream from stream crossing sites during construction;
- a failure of dry open-cut crossing could cause moderate habitat degradations and potentially change coho salmon habitat preferences;
- food resources would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would remove substrate and benthos at crossing sites;
- freshwater migration corridors would potentially be affected over the short-term by dry open-cut and diverted open-cut construction methods that would create temporary barriers to in-stream movements;
- a total of 293 acres of riparian zone habitat associated with waterbodies within range of Oregon Coast coho ESU would be directly affected by all construction-related activities. Adverse effects to riparian zones would be long term or permanent depending on whether mid-seral riparian forests (56 acres) or LSOG riparian forests (14 acres) are removed.

North American Green Sturgeon – Southern Distinct Population Segment (Federal Threatened)

On January 23, 2003 (NMFS 2003), NMFS determined that the North American green sturgeon comprises two DPSs that qualify as species under the ESA: (1) a northern DPS consisting of populations in coastal watersheds northward of and including the Eel River in California; and (2) a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River. On April 7, 2006, NMFS listed the southern DPS as federally threatened under the ESA within California, including spawning populations of green sturgeon south of the Eel River, principally the Sacramento River spawning population (NMFS 2005). Designated critical habitat extends from U.S. marine waters to 110 meters depth (360 feet) or 60 fathoms from Monterey Bay, California, north to Cape Flattery, Washington, including the Strait of Juan de Fuca (74[195] FR 52300 [October 9, 2009]). Critical

habitat includes three components that are occupied by and are essential to different life stages of green sturgeon: (1) freshwater riverine systems, (2) estuarine areas, and (3) nearshore marine waters. Several rivers in California are included such as the Sacramento, lower Feather, and lower Yuba Rivers. No rivers in Oregon were included in the listing. However, many estuaries were part of the critical habitat proposal in Washington, Oregon, and California. Estuaries in Oregon proposed for inclusion were the Columbia River estuary, Winchester Bay, Yaquina Bay, Nehalem Bay, and Coos Bay. Large numbers of this green sturgeon DPS are within Coos Bay. Subadults and adults may occupy Coos Bay for feeding, optimization of growth, and thermal refuge, and the Bay supplies oversummer habitat. Similarly, coastal marine waters 110 meters deep or less. The North American green sturgeon (both northern and southern DPSs) occurs within Coos Bay and its adjacent waterbodies (Israel and May 2007), and is considered abundant in the bay (73 [174] FR 52084 [September 8, 2008]). This fish may also occur in the lower portions of the Coos River.

Green sturgeons spawn every three to five years in deep pools in large, turbulent river mainstems, generally from March through July (Tracy 1990; Moyle et al. 1992). Little is known about sturgeon feeding, but some studies have found that adults and juveniles feed on benthic invertebrates including shrimp, mollusks, amphipods, and even small fish (Moyle et al. 1992; Radtke 1966). Natural reproduction in this estuary is considered low (Wagoner et al. 1990). The Coos River system is not considered to provide suitable spawning habitat for green sturgeon (Whisler et al. 1999). Green sturgeon, likely less than three years of age, may utilize both shallow and deep water habitats within the estuarine area, though there is no information relating individual occurrence to DPS membership. Green sturgeon may also occur in bottom areas along the LNG vessel transit route, in waters mostly less than 360 feet deep, which would be primarily only during entry and exit of the vessels as they would travel in deeper water during transit between ports. Below is the determination of effects summary for the Southern DPS of green sturgeon and critical habitat; see our BA (FERC 2015) for details.

The Project **may affect** green sturgeon (Southern DPS) because:

- adult and/or subadult green sturgeons may occur within the estuarine analysis area during construction and operation of the proposed action;
- adult and/or subadult green sturgeons may occur within the EEZ analysis area during operation of the proposed action;
- the proposed action may affect potential food resources and water quality during the short-term construction period and maintenance dredging within the estuarine and nearshore marine analysis area; and
- the discharge of future maintenance dredge spoils at Site F may directly entrap small subadults during maintenance dredge and discharge at this marine location.

The Project is **likely to adversely affect** green sturgeon (Southern DPS) because:

- bottom disturbance from project construction and maintenance dredging may reduce benthic food supply within Coos Bay and at ocean Site F; and
- discharge of maintenance dredge spoils at ocean Site F may bury subadults that are present.

The Project **may affect** critical habitat for green sturgeon (Southern DPS) because:

- the estuarine analysis area includes the Coos Bay estuary, which is included as estuarine critical habitat; and
- the EEZ analysis area includes coastal marine waters 110 meters (60 fathoms) deep or less, between Monterey Bay and Coos Bay and between Coos Bay and Strait of Juan de Fuca, which have been included as nearshore marine critical habitat.

The Project is **likely to adversely affect** critical habitat for the southern DPS of green sturgeon because:

- bottom disturbance from project construction and maintenance dredging may disrupt local food supply and habitat usability within Coos Bay; and
- discharge of maintenance dredge spoils at ocean Site F may also reduce local food sources and have repeated short-term reduction of usability during discharge from elevated turbidity.

Pacific Eulachon – Southern Distinct Population Segment (Federal Threatened)

On March 18, 2010, the NMFS published in the Federal Register the final rule to list the southern DPS of the Pacific eulachon as threatened under the ESA (75 FR 13012 [March 18, 2010]). NMFS has identified the eulachon southern DPS as those populations which spawn in rivers south of the Nass River in British Columbia, Canada, to and including the Mad River in California (NMFS 2008b). The southern DPS has been further segregated into four subareas: Klamath River, Columbia River, Fraser River, and British Columbia coastal rivers south of the Nass River (NMFS 2008b). A total of 16 distinct regions in Washington, Oregon, and California have been designated as critical habitat for Pacific eulachon (76 FR 65323 [October 20, 2011]). No project area stream is included in this designation except the Umpqua River, but critical habitat is well outside of the project area.

Adult Pacific eulachon usually spend three to five years in saltwater before returning to freshwater to spawn from late winter though early summer in rivers (74 FR 10857 [March 13, 2009]). Spawning time is mostly likely dependent on geographic location, with those individuals in the southern part of the range spawning earlier than their northern counterparts. Within the Columbia River system, spawning typically begins as early as December and January. Most eulachon adults die after spawning. Eggs are fertilized in the water column, sink, and adhere to the river bottom typically in areas of gravel and coarse sand. Pacific eulachon eggs hatch in 20 to 40 days, with incubation time dependent on water temperature. Shortly after hatching, the larvae are carried downstream and dispersed by estuarine and ocean currents (74 FR 10857 [2009]).

Little is known about the marine water use of eulachon and, due to paucity of sampling, little specific information exists on eulachon distribution off the U.S West Coast, including Oregon (Gustafson et al. 2010). After leaving estuarine rearing areas, juvenile Pacific eulachon move from shallow near shore areas to deeper areas over the continental shelf. Larvae and young juveniles become widely distributed in coastal waters, with fish found mostly at depths up to 15 meters (171 feet) but sometimes as deep as 182 meters (597 feet; Hay and McCarter 2000). There is currently little information available about eulachon movements in nearshore marine

areas and the open ocean. Larger rearing fish have been reported to be in the near benthic habitats in open marine waters of the continental shelf between 20 and 150m (66-492 feet) deep (Barraclough 1964 as cited in Gustafson et al. 2010).

Adults and juveniles commonly forage at moderate depths (15 to 182 meters [50 to 600 feet]) in inshore waters, feeding on zooplankton, primarily eating crustaceans (Hay and McCarter 2000). Although Coos Bay is within the historic range of the eulachon, south of the Columbia River mouth, eulachon have been identified in very few coastal streams (Cowlitz Indian Tribe 2007). Adults are found rarely in Coos Bay (64 FR 66601 [1999]). No recent spawning runs have not been documented for the Coos River. Occasional adult eulachon have been reported in Coos Bay where they may utilize both shallow and deep habitats with the estuary (64 FR 66601 [1999]). A 1971 report (Cummings and Schwartz 1971) noted their distribution only in the outer 7 miles of Coos Bay. Detailed larvae and juvenile fish sampling in Coos Bay over a 3.5-year period (1998-2001) found no eulachon (Miller and Shanks 2005). More recently, pelagic Tucker trawl samples over a 17-month period found larvae and small juveniles of a close relative, surf smelt, but no eulachon in the vicinity of the proposed terminal in Coos Bay (Shanks et al. 2011). The detailed assessment of impacts and conservation measures for eulachon is provided in our BA (FERC 2015).

Below is the determination of effects summary for Pacific eulachon (Southern DPS) and critical habitat. See our BA for details; however, note that our effects determination for Pacific eulachon has changed since we submitted our BA in February 2015, and these updates are reflected here.

The Project **may affect** Pacific eulachon (Southern DPS) because:

- Pacific eulachon may be present within the estuarine analysis area during construction and operation of the Project;
- Pacific eulachon may occur within the EEZ analysis area during operation of the proposed action;
- the proposed action may affect potential food resources and water quality during the short-term construction period and maintenance dredging within the estuarine and nearshore marine habitats in the EEZ analysis area;
- the discharge of maintenance dredged materials at ocean Site F may directly entrap adults if present at this marine location;
- cooling water intake by LNG vessels at dock could entrain some individuals: and
- the proposed action may affect water quality during the long-term operation period within the EEZ analysis area.

The Project is **likely to adversely affect** Pacific eulachon (Southern DPS) because:

- the possibility that the infrequent discharge of maintenance dredge spoils at ocean Site F would entrap adults is very remote but not discountable; and
- even though eulachon would be rare in Coos Bay and their large size would allow them to be able to avoid the LNG vessel cooling water intake, some limited number could be entrained during vessel loading in the bay.

The Project would have **no effect** on critical habitat for the Pacific eulachon (Southern DPS) because no designated critical habitat is present within the estuarine analysis area or other project streams.

Lost River Sucker (Federal Endangered, State Endangered)

The Lost River sucker was listed as a federally endangered species on July 18, 1988, because of a variety of factors including loss of habitat and access to historical range, overfishing, degraded water quality, lack of significant recruitment, inadequate regulatory mechanisms, and a variety of other reasons resulting in declining populations (FWS 1988). Since listing, some of the factors, including overharvest and lack of regulatory protection, have been removed; however, many of the other factors remain (ISRP 2005 as cited in Reclamation 2007). Lost River sucker critical habitat was originally proposed in 1994 (59 FR 61744) but the critical habitat determination was never finalized. In 2012, a final listing of critical habitat occurred where most of the known populations are in two units: the Upper Klamath Lake Unit and Lost River Basin Unit in December 11, 2012 (77 FR 73739).

Historically, Lost River suckers were found in the Lost River watershed, Tule Lake, Lower Klamath Lake, and Sheepy Lake. The present distribution of the Lost River sucker includes Upper Klamath Lake and its tributaries, Clear Lake Reservoir and its tributaries, Tule Lake and the Lost River, the Klamath River, and Copco, Iron Gate, and John C. Boyle Reservoirs with no substantial change since listing (Reclamation 2007, 2012; FWS 2007b). They have also been found in Tule Lake (Reclamation 2012; FWS 2007b, 2013d). Critical habitat that could potentially be affected by construction of the Pacific Connector pipeline includes the Klamath River.

In the Upper Klamath Lake watershed, the Lost River sucker spawning runs are primarily limited to Sucker Springs in Upper Klamath Lake, and the Sprague and Williamson Rivers. Spawning runs also occur in the Wood River and in Crooked Creek in this watershed. In the project vicinity, Lost River suckers spawn in the Lost River and are present in John C. Boyle Reservoir, downstream from the pipeline crossing at RM 225 (National Research Council 2004). In addition to collections of Lost River suckers in John C. Boyle Reservoir, ORBIC (2012) cites records of collections in Lake Ewauna and in the Lost River Diversion Channel connecting the Klamath River (at RM 249.8) to the Lost River at the Lost River Diversion Dam, approximately 10 river miles downstream from the Pacific Connector pipeline crossing of the Lost River at RM 9.5.

The Lost River sucker is a lake-dwelling fish that migrates into streams to spawn. It is a long-lived species, reaching ages over 30 years. Most spawning by Lost River suckers lasts from late February to early June in the larger tributaries of inhabited lakes (FWS 2007d). River spawning habitat occurs in riffles or runs with gravel or cobble substrate, with moderate flows, and in water 8 to 50 inches deep. Some Lost River suckers have been noted to spawn in lakes, particularly at springs occurring along the shorelines (FWS 2007d). Larval Lost River suckers are present in Upper Klamath Lake from the beginning of May through mid-July. By mid-summer, larval suckers have become juveniles, which, in Upper Klamath Lake, tend to occupy shoreline habitats less than 4 feet deep with and without emergent vegetation and/or shoreline vegetation.

The Pacific Connector pipeline route would cross Lost River (MP 212.05) 7.6 miles upstream of the known spawning area downstream of Anderson–Rose Dam, using a dry, open-cut method during low flows that coincide with the ODFW instream construction window extending from July 1 through March 31.

Spawning occurs within limited areas of the Lost River (FWS 2013d, Reclamation 2012), and occasional individuals have been found in this stream region (NMFS and FWS 2013), which suggests it is possible that Lost River sucker may be where the Pacific Connector pipeline route would cross at MP 212.05 during the non-spawning period. Two stream crossings by Project roads would occur on stream channels upstream of where these two sucker species may be present, one at an existing crossing on an ephemeral channel and one at new temporary road crossing. Adults and juveniles subject to fish salvage within the isolated construction site at the Lost River could be injured or killed if electrofishing is used and stressed if seining is used. Similar conditions could occur at the Klamath River if crossing methods other than HDD are used, although no changes in crossing methods have been proposed. Incidental take of a Lost River sucker is possible, but salvage operations within the crossing would follow the latest Handling Guidelines for Klamath Basin Suckers developed as part of the Klamath Project Operations Biological Opinion (Reclamation 2008; these guidelines may be updated frequently). Consistent with Reclamation's *Handling Guidelines for Klamath Basin Suckers*, salvaged fish would be retained in aerated water until released upstream of the capture site unless otherwise indicated through agreement with FWS. Fish would be released at the end of the day on which they were captured or when 100 fish are in holding, whichever comes first. Pacific Connector has included these guidelines in their *Fish Salvage Plan* that would be used in the vicinity of listed suckers. These protocols would use a variety of netting methods (e.g., beach seining, dip netting) before using electrofishing to reduce this potential impact. Some of the main factors in handling are the requirement of having a 0.5 percent saline solution of unchlorinated well water in which to place any captured listed sucker should it be collected during fish salvage operations. Aeration would also be supplied and the container a sucker is placed into would have been coated with a commercially available slime coat. Fish would be retained in this solution until released upstream of the capture site unless otherwise indicated through agreement with FWS.

Despite these measures, it is still possible that Lost River suckers could be killed by salvage operations.

Below is the determination of effects summary for Lost River sucker and critical habitat; see our BA (FERC 2015) for details.

The Project **may affect** Lost River suckers because:

- Lost River suckers occur within the Upper Klamath River sub-basin and Lost River sub-basin, which would be affected during construction of the proposed action.

The Project is **likely to adversely affect** Lost River suckers because:

- there is a remote possibility that Lost River suckers could occur within the Lost River when it would be crossed by the Pacific Connector pipeline;
- there is a low risk of a frac-out during the HDD of the Klamath River that would release drilling muds, which may cause short-term avoidance response by suckers in the river;

- fish salvage during the Lost River crossing could result in injuring or killing fish if electroshocking is used, and stressing fish if seining is used; and
- the holding of salvaged Lost River suckers also can result in stress, injury, or death of the fish.

The Project **may affect** designated critical habitat for the Lost River sucker because:

- there is a low risk of HDD failure during crossing of the Klamath River, resulting in a frac-out that releases drilling mud into the river.

Considering overall project actions effects to habitat are not substantial, project actions are **not likely to adversely affect critical habitat.**

Shortnose Sucker (Federal Endangered, State Endangered)

The shortnose sucker was listed as a federally endangered species on July 18, 1988 (FWS 1988). The final rule to list the shortnose sucker as endangered suggested several reasons for their decline, including the construction of dams, water diversions, overfishing, competition and predation by exotic species, water quality problems associated with timber harvest, removal of riparian vegetation, livestock grazing, lack of significant recruitment, inadequate regulatory mechanisms and agricultural practices. Since listing, some of the factors, including overharvest and lack of regulatory protection, have been removed; however, many of the other factors remain (ISRP 2005 as cited in Reclamation 2007). Shortnose sucker critical habitat was originally proposed in 1994 (59 FR 61744) but the critical habitat determination was never finalized. A final listing of critical habitat including two units where most of the known populations are—the Upper Klamath Lake Unit and Lost River Basin Unit—occurred on December 11, 2012 (77 FR 73739). The Upper Klamath Lake unit includes Upper Klamath Lake and Agency Lake, portions of Williamson River, lower Sprague River, Link River, Lake Ewauna, and Klamath River from the Lake Ewauna outlet downstream to Keno Dam. The Klamath River is the only critical habitat for the shortnose sucker crossed by the pipeline or potentially affected by any project actions.

The historical range included the entire upper Klamath basin, except for higher colder streams, which were dominated by trout, and the upper Williamson, which was isolated by Williamson Canyon. Currently, shortnose suckers are present in upper Klamath Lake and tributaries, Lost River, Clear Lake Reservoir, the Klamath River, and three large Klamath reservoirs (Keno, Copco, and possibly Iron Gate Reservoirs) with no substantial change since listing (Reclamation 2007, 2012). They have also recently been found in Tule Lake and Gerber Reservoir (Reclamation 2012; FWS 2007c, 2013e).

Shortnose suckers live in lakes and spawn in rivers, streams or springs associated with the lake habitats, generally from early February through mid-April. After hatching, larval suckers migrate out of spawning substrates, which are usually gravels or cobbles, and drift downstream into lake habitats from early May to mid-June (FWS 1988, 1993b).

The shortnose sucker is known to migrate out of Tule Lake to spawn in the Lost River below Anderson–Rose Dam about 7.6 miles downstream from the Lost River crossing. Therefore, shortnose suckers could occur within the Lost River when it would be crossed by the Pacific Connector pipeline.

Adults and juveniles subject to fish salvage within the isolated construction site at the Lost River could be injured or killed if electroshocking is used and stressed if seining is used. Pacific Connector has included guidelines noted above under the Lost River sucker section in their *Fish Salvage Plan* that would be used in the vicinity of listed suckers. These protocols specify a variety of netting methods (e.g., beach seining, dip netting) before using electrofishing to reduce this potential impact. Incidental take of a shortnose sucker is still possible. Pacific Connector would follow the latest Handling Guidelines for Klamath Basins Suckers (Reclamation 2008; these guidelines may be updated frequently) and as modified as discussed above for the Lost River sucker. However, despite these measures, it is still possible that shortnose suckers could be killed by salvage operations. Due to the potential changes in protocols for sucker handling use updated methods as requested for Lost River sucker above.

Spawning occurs within limited areas of the Lost River (FWS 2013d; Reclamation 2012), and occasional individuals have been found in this stream region (NMFS and FWS 2013), suggesting it is possible that shortnose sucker may be where the Pacific Connector pipeline route would cross at MP 212.05 during the non-spawning period.

The Project **may affect** shortnose suckers because:

- shortnose suckers occur within the Upper Klamath River sub-basin and Lost River sub-basin, which would be affected during construction of the proposed action.

The Project is **likely to adversely affect** shortnose suckers because:

- there is a possibility that shortnose suckers could occur within the Lost River where it would be crossed by the Pacific Connector pipeline;
- there is a low risk of HDD failure when crossing the Klamath River, which may result in a frac-out releasing drilling mud into the river;
- fish salvage when crossing the Lost River could injure or kill fish if electroshocking is used, and stress fish if seining is used; and
- the holding of salvaged shortnose suckers also can result in stress, injury, or death of the fish.

The Project **may affect** designated critical habitat for the shortnose sucker because:

- there is a low risk of HDD failure during crossing of the Klamath River, resulting in a frac-out that releases drilling mud into the river.

Considering overall Project actions effects to habitat are not substantial, Project actions are **not likely to adversely affect** critical habitat.

4.7.1.4 Amphibians and Reptiles

Oregon Spotted Frog (Federally Threatened Species, Proposed Critical Habitat, State Sensitive-Critical)

On August 29, 2014, FWS listed the Oregon spotted frog as threatened and indicated a final determination concerning critical habitat for the Oregon spotted frog would be made in the near future (79 FR 51657). This species is almost always found in or near a perennial body of water

that includes zones of shallow water and abundant emergent or floating aquatic plants, which the frogs use for basking and escape cover (Corkran and Thoms 1996; FWS 2013f). The closest proposed critical habitat unit to the Project is CHU 14 – Upper Klamath, which consists of 262 acres of lakes and creeks in Klamath and Jackson Counties and is currently occupied by Oregon spotted frogs (79 FR 34685). The Buck Lake population within CHU 14 is the closest occurrence of Oregon spotted frogs to the Project. This site includes seasonally wetted areas adjacent to the western edge of Buck Lake, encompassing Spencer Creek, three unnamed springs, and Tunnel Creek, as well as Spencer Creek downstream of Buck Lake (FWS 2013g; FWS 2014c; ORBIC 2012; BLM 2006a).

The Project would cross Spencer Creek on the north side of Clover Creek Road, approximately 6,400 feet upstream from the proposed CHU 14 at Buck Lake, and pass within 220 feet of critical habitat in Spencer Creek downstream of Buck Lake. Potential impacts to Oregon spotted frogs as a result of the Project include increased turbidity, acoustic shock, introduction of non-native species and/or disease, fuel and chemical spills, and herbicides, although these effects are unsubstantial and/or discountable. Conservation measures proposed by Pacific Connector to minimize construction and operation impact to waterbodies and riparian zones would apply to Oregon spotted frogs.

Below is the determination of effects summary for the Oregon spotted frog and proposed critical habitat; see our BA for details (FERC 2015).

The Project **may affect** Oregon spotted frogs because:

- the Pacific Connector pipeline route would cross Spencer Creek, which is hydrologically connected to Buck Lake which is occupied by the frog; and
- the Pacific Connector pipeline route is within 220 feet of Spencer Creek and would cross tributaries to Spencer Creek downstream of Buck Lake, which is occupied by the Oregon spotted frog.

However, the Project **is not likely to adversely affect** Oregon spotted frogs for the following reasons:

- Buck Lake is approximately 6,400 feet downstream from where the pipeline route would cross Spencer Creek. Suspended sediment generated by the proposed action is expected to remain in the water column for 1,450 feet downstream from the construction site.
- Suspended sediment resulting from the crossing of Spencer Creek would pass through Buck Marsh, which Oregon spotted frogs do not currently inhabit. If the Oregon spotted frog does occur in Buck Marsh at the time of pipeline construction, conservation measures would limit potential effects due to acoustic shock, introduction of non-native species and/or disease, fuel and chemical spills, and herbicides.
- Future presence of Oregon spotted frogs in the Spencer Creek upstream of Buck Lake at the time of construction is extremely unlikely and considered to be discountable.
- Although the right-of-way occurs as close as 220 feet from Spencer Creek downstream of Buck Lake, the right-of-way and Spencer Creek are separated by Clover Creek Road and are not hydrologically connected; BMPs and erosion control measures should prevent sediment from the construction right-of-way from entering Spencer Creek.

- Effects on Oregon spotted frogs from the discharge of hydrostatic test waters would be insignificant because the nearest discharge site is approximately 6,000 feet upstream of occupied habitat via an ephemeral drainage, and BMPs would prevent adverse effects from sedimentation or introduction of non-native species and disease.

The Project **may affect** proposed critical habitat for the Oregon spotted frog because:

- the Pacific Connector pipeline route would be within 220 feet of proposed critical habitat within Spencer Creek downstream of Buck Lake; and
- the hydrostatic discharge site at MP 173.1 is adjacent to an ephemeral tributary to Spencer Creek approximately 6,000 feet (1.1 miles) upstream of proposed critical habitat in Spencer Creek.

The Project would **not adversely modify** proposed critical habitat for the Oregon spotted frog because:

- the proposed critical habitat within 220 feet of the pipeline is not hydrologically connected to the right-of-way because it is separated by Clover Creek Road; and
- test water from the hydrostatic discharge site at MP 173.1 is not expected to reach the proposed critical habitat in Spencer Creek, so effects to PCEs from changes in hydrology or introduction of nonnative species from the Project are discountable.

If FWS designates proposed Unit 14 as critical habitat for the Oregon spotted frog, a **may affect, not likely to adversely affect** determination would be warranted.

Sea Turtles

Four federally listed sea turtles potentially occur in the vicinity of the Project: green sea turtles, leatherback sea turtle, olive ridley sea turtle, and loggerhead sea turtle. All four species are federally threatened and state endangered.

Green sea turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south (NMFS 2007a). Green turtles primarily use three types of habitat: oceanic beaches (for nesting), convergence zones in the open ocean, and benthic feeding grounds in coastal areas (NMFS 2007a). Reports of strandings suggest that the green turtle is a frequent visitor off of California. Based on this data, green turtles are likely infrequent, transient visitors to the Oregon Coast, but may occasionally be found in the EEZ action area.

The leatherback sea turtle is the most common sea turtle in United States waters north of Mexico (NMFS and FWS 1998), and numerous sightings have been documented off the Oregon Coast. Adult leatherback turtles are highly migratory and available information indicates that eastern Pacific migratory corridors exist along the west coast of the United States (NMFS and FWS 1998). The west coast of the United States may represent some of the most important foraging habitat in the world for the leatherback turtle (NMFS and FWS 1998). Despite occasional reports of leatherbacks sighted at sea, and a growing database documenting their incidental catch in coastal and pelagic fisheries, there are very few areas where the species is routinely encountered. Exceptions include Monterey Bay, California (NMFS and FWS 1998). These data suggest that leatherback sea turtles would be present in the EEZ analysis area in higher densities relative to other sea turtle species, but still in low densities overall.

At-sea occurrences of olive ridley sea turtles in waters under United States jurisdiction are limited to the west coast of the continental United States and Hawaii, where the species is rare, but possibly increasing. Based on sightings off the Oregon Coast, olive ridley turtles may occasionally occur in the EEZ action area.

Loggerhead sea turtles occupy three different ecosystems during their lives—the terrestrial zone, the oceanic zone, and the neritic zone (NMFS 2007b). In the United States, occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California (NMFS 2007b). The potential importance of Oregon waters and the EEZ action area to loggerhead turtles is unknown, although two loggerhead turtles have been reported stranded in Oregon and Washington since the beginning of 1997 through 2007 (NMFS 2008c).

Direct effects of the proposed action include injury and/or mortality due to ship-strikes, underwater ship noise, and potential adverse effects from a vessel spill or ship release of LNG and fire at sea. Spills and/or release could indirectly affect federally listed sea turtles by impacting forage species. Below is the determination of effects summary for the federally listed sea turtles and critical habitat; see our BA for details (FERC 2015).

The Project **may affect** federally listed sea turtles because:

- these sea turtles may occur within the EEZ analysis area during operation of the proposed action;
- the proposed action would increase shipping traffic (LNG vessels) within the EEZ analysis area; and
- the continental U.S. Pacific Coast provides important foraging habitat for leatherback turtles.

However, the Project is **not likely to adversely affect** federally listed sea turtles because:

- ship strike on sea turtles would be highly unlikely;
- 90 LNG vessels per year transiting to and from the Jordan Cove terminal would cause an immeasurable increase for potential ship strikes to these turtles;
- Jordan Cove would provide a ship strike avoidance measures package to LNG vessel operators transporting cargo from the terminal that consists of multiple measures to avoid striking marine mammals, which should also benefit sea turtles;
- LNG vessels approaching Coos Bay would be traveling slowly and escorted by tractor tugs from 5 nmi offshore to the Port;
- noise produced by LNG vessels would contribute to overall noise levels within the EEZ en route to the Port of Coos Bay and effects of ship noise on sea turtles could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise, but would not exceed existing background ship noise levels and would not cause injury; and
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species. Fuel released at sea, if any, would be in small enough quantities that potential effects on listed sea turtles would be insignificant, especially given the low density of sea turtles within the EEZ analysis area.

No critical habitat has been designated or proposed for the green, olive ridley, or loggerhead sea turtles.

The Project **may affect** designated critical habitat for the leatherback turtle because:

- the EEZ analysis area that would be transited by LNG vessels includes coastal marine waters between Coos Bay, Oregon, and Cape Flattery, Washington, that are designated critical habitat; and
- critical habitat in Coos Bay is adjacent to the LNG terminal would be dredged during LNG terminal construction and operation.

However, the Project is **not likely to adversely affect** designated critical habitat for the leatherback turtle because:

- LNG vessels and the LNG terminal are not likely to contribute oil, fuel, lubricants, or other contaminants to critical habitat to the extent that would adversely affect the occurrence of prey species, primarily jellyfish, of sufficient condition, distribution, diversity, and abundance to support individual as well as population growth, reproduction and development (PCE 1); and
- disturbance of critical habitat during disposal of maintenance dredging material at Site F are expected to be of sufficiently short duration and small scale relative to the area of prey species availability (Area 2) that effects on PCE 1 are expected to be insignificant.

4.7.1.5 Invertebrates

Vernal Pool Fairy Shrimp (Federally Threatened Species with Critical Habitat, No State Status)

Vernal pool fairy shrimp were listed as threatened under the ESA on September 19, 1994 (FWS 1994a). This crustacean inhabits vernal pools, or seasonal wetlands that fill with water during fall and winter rains, in California and southwestern Oregon. Suitable vernal pool habitat occurs within and adjacent to Project facilities, some of which has not been surveyed. Additionally, a proposed pipe storage yard is located in the Burrill Lumber industrial yard adjacent to the vernal pool fairy shrimp critical habitat unit VERFS 3A. Potential impacts to vernal pool fairy shrimp and critical habitat include possible disturbance to pools from driving or storing equipment or pipes near or on pools or wetlands, and alteration of hydrology. These effects would be minimized through conservation measures. Specifically, Pacific Connector has indicated they would avoid using areas within yards that may contain vernal pool fairy shrimp and, if this species is noted during survey efforts, they would implement proper sedimentation control barriers to minimize potential impacts to the species. Below is the determination of effects summary for the vernal pool fairy shrimp and critical habitat; see our BA for details (FERC 2015).

The Project **may affect** vernal pool fairy shrimp for the following reason.

- Potentially suitable habitat for vernal pool fairy shrimp has been identified within and adjacent to the pipeline right-of-way from MPs 145.34 and 145.40. However, surveys of this potential habitat have not been conducted.

The Project is **likely to adversely affect** vernal pool fairy shrimp because:

- direct and indirect effects to vernal pool fairy shrimp are possible from right-of-way construction activities if the species is present.

A **may affect** determination is warranted for vernal pool fairy shrimp critical habitat because:

- the Project occurs adjacent to designated vernal pool fairy shrimp critical habitat; and
- the Project may result in habitat impacts within adjacent designated critical habitat.

A **likely to adversely affect** determination is warranted for vernal pool fairy shrimp critical habitat because:

- the proposed action could potentially adversely modify geographic, topographic, and edaphic features that support systems of hydrologically interconnected pools, swales, and other ephemeral wetlands and depressions within a matrix of surround uplands (PCE 2) through surface disturbances, soil compaction by heavy machinery, and/or dust caused by increased traffic within and adjacent to the Burrill Lumber pipe storage yard, which is within 527 feet of designated CHU VERFS 3A.

Potentially suitable but unsurveyed habitat could be affected by the Project within and adjacent to the pipeline right-of-way from MPs 145.34 and 145.40. Use of the Burrill Lumber Yard could result in modifications to adjacent critical habitat for vernal pool fairy shrimp. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and approval by the Director of OEP, a plan to avoid both direct and indirect impacts on vernal pool fairy shrimp habitat at proposed Burrill Lumber Yard and the pipeline route between MPs 145.3 and 145.4.**

4.7.1.6 Plants

A botanical analysis area applies to the extent of project-related effects on listed plant species within a general 400-foot-wide corridor of the pipeline (i.e., 200 feet on each side of the Pacific Connector pipeline centerline) as well as the footprint for the LNG terminal facilities. The botanical analysis area includes all areas surveyed for sensitive and listed plant species, including the LNG terminal and associated facilities, the pipeline construction right-of-way, TEWAs, UCSAs, rock source and disposal sites, storage yards, and aboveground facilities. Surveys are incomplete in areas along the pipeline route where landowner permission was denied. Those areas would be surveyed after the Project is certificated, but before construction begins (i.e., if the project is approved and Pacific Connector gains access using eminent domain proceedings under Section 7h of the NGA). However, Pacific Connector was able to identify unsurveyed areas that may contain suitable habitat for listed species, as discussed in our BA.

Pacific Connector has developed a *Federally-listed Plant Conservation Plan* to address how avoidance, minimization, propagation, restoration, and other conservation measures would be applied to protect listed plant species, as well as how potential impacts on unsurveyed lands would be addressed. For example, if populations of listed plant species are identified where surveys were previously denied, Pacific Connector would apply mitigation measures that have

been developed for surveyed lands to minimize and avoid impacts to these species including (1) minor alignment or route adjustments; (2) narrowing or necking-down the construction right-of-way; or (3) eliminating or removing a portion of a TEWA or UCSA (depending on where new populations of these species were identified). Additional construction measures that would be implemented in areas that contain listed plants to minimize and avoid impacts to these species, if they occur, include the following:

- surveying and flagging the construction right-of-way and TEWAs to clearly mark the limits of construction disturbance (i.e., clearing/grading);
- to avoid listed plant species located within the project area, the construction right-of-way may be narrowed or necked down is some areas (i.e., in areas adjacent to listed plant species) and some TEWAs or UCSAs may be eliminated or a portion of the area removed from project use when feasible;
- where feasible, the EI would monitor the survey and flagging efforts and would provide additional protective buffers or neckdowns to ensure protection of adjacent plant populations or provide additional avoidance. The EI would consult with Pacific Connector's Chief Inspector and the construction contractor during construction to determine where additional buffer protections or neckdowns could be accommodated without affecting construction safety;
- known plant populations adjacent to the construction right-of-way or other plants populations identified during preconstruction surveys would be protected by safety fence and silt fence to ensure these plants are not inadvertently affected by project activities;
- equipment would be inspected and cleaned of potential noxious weed seed or plant parts consistent with the requirements of Pacific Connector's *Integrated Pest Management Plan*;
- topsoil salvaging would occur within affected populations after species-specific seed, bulb, or whole plant salvage has occurred. The salvaged topsoil would be returned to its original location during restoration;
- the construction right-of-way would be restored to its original contours and reseeded with an appropriate seed mixture recommended by FWS prior to the following growing season;
- when feasible, Pacific Connector would collect and bag seeds of affected listed plants and provide these seeds to a suggested repository. If permission is granted by the property owner, Pacific Connector would use the collected seed to plant outside of the permanent right-of-way after construction (e.g., see replanting measures proposed for Applegate's milk-vetch);
- construction activities would occur in the fall and winter outside the critical growing, flowering, and seeding periods; and
- wetland mats would be used in travel areas in saturated soil areas to minimize soil rutting and soil compaction and protect existing plants that may be present.

The *Federally-listed Plant Conservation Plan* (which contains measures that have been developed to avoid or minimize impacts to plants, including a mitigation plan for Applegate's milk-vetch, Gentner's fritillary, Kincaid's lupine, and Cox's mariposa-lily) can be found in Appendix J of Pacific Connector's POD, which was included in Pacific Connector's application to the FERC. In addition, the BLM and Forest Service have developed mitigation

measures/requirements related to their Right-of-Way Grant that may also benefit listed plant species (see table 2.1.4-1 in chapter 2 of this EIS and appendix F). The FWS, BLM, Forest Service, and applicant are currently working together to determine the extent to which BLM and Forest Service required mitigation would benefit listed plant species.

As currently designed, only one required BLM mitigation program would directly benefit listed plants. This program requires that Pacific Connector fund a 600-acre habitat improvement project on the Medford BLM District, which would include outplantings of Gentner's fritillary bulbs. This effort would be conducted by the BLM, and funded in part by Pacific Connector (more details regarding this mitigation program can be found in appendix F of this EIS.

In addition to the applicant prepared *Federally-listed Plant Conservation Plan* and the BLM and Forest Service required mitigation discussed above, the Pacific Connector filed with FERC an Amendment to the Draft Compensatory Mitigation Plan (appendix F-2) related to compensatory mitigation for impacts to Applegate's milk-vetch, Gentner's fritillary, and Kincaid's lupine. The amendment lists the following measures aimed at compensating for impacts to these ESA listed plants (these are direct quotes from the Amendment):

A. *Fund conservation easements/land acquisition and third party management/maintenance for ESA-listed plants, as identified by the Service including at least $39,108 for Applegate's milkvetch, at least $48,500 for Kincaid's lupine, and at least $47,400 for Gentner's fritillary. (Estimates provided here are for conservation easements; if acquisition was necessary to secure these parcels, the cost would be roughly double.)*

B. *Contribute a combined $114,940 towards additional third party acquisition or research in place of the salvage BMP for both Applegate's milkvetch and Kincaid's lupine.*

C. *Contribute $20,000 to the work of a Service-approved conservation entity in place of the second year of surveys and the associated avoidance and minimization BMPs for Gentner's fritillary.*

D. *Contribute $24,500 to the work of a Service-approved conservation entity in place of the second year of the seed collection BMP for Applegate's milkvetch and Kincaid's lupine.*

E. *Decision-making and receipt and management of funds for parts A-D would be vested as described for the Conservation Program, except that, at the discretion of the Service, funds may be provided directly by Pacific Connector to applicable action entities rather than a third-party fund manager or, if a fund manager is utilized, might be different than the Conservation Program Fund Manager.*

Below is a discussion of each federally-listed plant species that could be affected by the Project; however, see our BA (FERC 2015) for more details. The mitigation measures discussed above would apply to all federally-listed plants discussed in this section.

Applegate's Milk-vetch (Federally Endangered Species, State Endangered Species)

Applegate's milk-vetch was federally listed as endangered on July 28, 1993 (FWS 1993c). It was believed to be extinct until its rediscovery in 1983 and at the time of listing was only known from two extant sites. Applegate's milk-vetch grows only in flat-lying, seasonally moist, alkaline soils with underlying clay hardpans. The species' habitat was historically characterized

by sparse, native bunch grasses and patches of bare soil, allowing for some seed dispersal by wind. Today, dense coverage of the habitat by introduced grasses and weeds means seed dispersal is highly localized, with most seedling establishment found adjacent to mature plants (FWS 1998c). This species has a narrow range, known only in the Lower Klamath Basin (the plain containing Lower Klamath Lake), near the city of Klamath Falls in southern Oregon. At the time of the recovery plan, there were three known extant populations, all in Klamath County, numbering about 12,000 plants (FWS 1998c). Currently, the number of individuals is estimated to be 33,800 plants on six known sites (FWS 2008b). The largest population is located near the Klamath Falls Airport (21,049 plants in 2008). Two sites are known to have been extirpated (FWS 2008b).

Surveys for Applegate's milk-vetch and its habitat were conducted by SBS for Pacific Connector starting in 2007. A site located within and adjacent to the botanical analysis area (the "Collins Tract site") was first discovered in 1998, and field surveys conducted by ORBIC in 2007 discovered two large sub-populations, each several acres in size (Roninger 2008). Expanded survey efforts by FWS and SBS in 2008 discovered several sub-population clusters on the Collins Tract site, including plants between MPs 195.35 and 196.5 (Roninger 2008; SBS 2008b). In the 1998 Recovery Plan (FWS 1998c), the site was named a self-sustaining population. Pacific Connector has revised its proposed route slightly in this area to avoid direct impacts to the plants identified in 2008 (see further discussion in our BA [FERC 2015]).

The route has been relocated to avoid known populations of Applegate's milk-vetch as well as suitable habitat found during surveys conducted during summer 2008; therefore, no direct effects to these known plants are expected. However, project surveys of all suitable habitat have not been completed for this species; therefore, additional plants could potentially be encountered and affected by the pipeline project. Below is the determination of effects summary for Applegate's milk-vetch and critical habitat; however, see our BA (FERC 2015), for more details.

The Project **may affect** Applegate's milk-vetch because:

- suitable habitat is available within the botanical analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Applegate's milk-vetch because:

- potential suitable habitat occurs along the pipeline route and comprehensive surveys have not been conducted in all areas; therefore, it is possible that unidentified plants occur within the construction right-of-way and workspace;
- grazing had occurred prior to surveying one area of potential habitat (thereby potentially masking existing plants by removing aboveground tissues) and plants may be located at that site; and
- unidentified plants could occur within unsurveyed habitat, where landowner denied survey permission.

Critical habitat has not been designated for Applegate's milk-vetch.

Gentner's Fritillary (Federally Endangered Species, State Endangered Species)

Gentner's fritillary was federally listed as endangered on December 10, 1999 (FWS 1999). Gentner's fritillary is found in small, scattered locations in Jackson and Josephine Counties in Oregon, with one small population recently discovered in northern California (FWS 2003b). It is often found in grassland habitats within, or on the edge of dry, mixed forest types where overstory can be dominated by Oregon white oak, madrone, Douglas-fir, and ponderosa pine. It occurs at a wide range of elevations, from 1,000 to 5,100 feet, in the rural foothills of the Rogue River Valley of Josephine and Jackson Counties (FWS 2003b; SBS 2008b). It is usually associated with shrubs that provide protection from the wind and sun.

During 2008 survey efforts, this plant was found in five locales within the analysis area: (1) on Indian Creek access road, 50 feet below road; nearby site recorded non-flowering plants; (2) 46 feet from TEWA 128.01-W; (3) 100 feet from proposed access road EAR-128.05; (4) near MP 129, outside of project's right-of-way but within the 200-foot vegetation survey buffer; and (5) within TEWA 142.07-N near MP 142.

As plants have been identified along the pipeline project's route and surveys of all suitable habitat have not been completed for this species, Gentner's fritillary could potentially be encountered and affected by the Project. Below is the determination of effects summary for Gentner's fritillary and critical habitat; however, see our BA (FERC 2015)for more details.

The Pacific Connector Pipeline Project **may affect** Gentner's fritillary because:

- suitable habitat is available within the analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Pacific Connector Pipeline Project is **likely to adversely affect** Gentner's fritillary because:

- not all potential suitable habitat was surveyed due to landowner access denial;
- Gentner's fritillary does not flower every year, and has been documented to not flower for several years; therefore, it is possible that the two years of surveys conducted for this flower did not locate this species; and
- *Fritillaria* sp. leaves were documented within and adjacent to the project, and it is nearly impossible to determine if those leaves, without flowers, belong to Gentner's fritillary or another *Fritillaria* species.

Critical habitat has not been designated for Gentner's fritillary.

Western Lily (Federally Endangered Species, State Endangered Species)

The western lily was federally listed as endangered on August 17, 1994 (FWS 1994b). This lily inhabits 31 small, widely separated populations in sphagnum bogs, coastal scrub and prairie, as well as other poorly drained soils along the coast of southern Oregon and northern California. Western lilies have an extremely restricted distribution, and occur in seven widely separated regions along the coast within 4 miles of the Pacific Ocean. Such populations are densely clumped and mostly occur on isolated wetlands that are less than 10 acres in size (FWS 1994b, 1998d).

The closest known western lily occurrence in relation to the Project is approximately 5.5 miles northeast of the Project at Hauser Bog (ORBIC 2005). There are no records of western lily north of Hauser, and the FWS typically considers Hauser the northern extent for the species along the Oregon Coast. Jordan Cove conducted surveys at the LNG Terminal site in 2006 and again in 2012; no occurrences of western lily were detected during these surveys conducted for Jordan Cove (SHN 2006c, 2012). Surveys for western lily and its habitat were conducted by SBS for Pacific Connector starting in 2007, with the latest survey conducted in 2014; no occurrences of western lily were detected during these surveys conducted for Pacific Connector.

Although no plants were identified in the area and potential occurrence of this species in the area is low, surveys of all suitable habitat in the area have not been completed for this species; therefore, western lily could potentially be encountered and affected by the Project. Below is the determination of effects summary for western lily and critical habitat; however, see our BA (FERC 2015) for more details.

The Project **may affect** the western lily because:

- known populations occur within 10 miles of the botanical analysis area; and
- potential suitable habitat is available within the analysis area.

The Project is **not likely to adversely affect** the western lily because:

- surveys of potential western lily habitat at the Jordan Cove LNG terminal site, at the South Dunes Power Plant site, and along the pipeline route did not document western lily, nor did the surveys identify suitable western lily habitats within the botanical analysis area;
- initial reviews of soils at potential suitable habitat sites that have not been surveyed do not appear to be suitable to support western lily plants;
- the closest known population of western lily is 5.2 miles northeast of the LNG terminal site at Hauser Bog;
- surveys in potentially suitable habitat would occur prior to ground-disturbing activities; if plants are identified, conservation measures developed to avoid or minimize impacts to future plants would be applied;
- measures would be taken to avoid impacts to this species if present (see the discussion of mitigation measures in the BA); and
- consultations with the FWS would be reinitiated if this species is found to be present in the area and impacts cannot be avoided.

Critical habitat has not been designated for the western lily.

Large-Flowered Meadowfoam (Federally Endangered Species, State Endangered Species)

The large-flowered meadowfoam was federally listed as endangered on November 7, 2002 (FWS 2002b). It is an annual herb endemic to the Agate Desert area in southern Oregon. It grows on the wetter, inner edges of vernal pools mostly in the Rogue River Valley. The plant is capable of self-fertilization and self-pollination. In the Rogue River Valley, large-flowered meadowfoam is

often found in the same vernal pool habitats as Cook's lomatium and the vernal pool fairy shrimp.

In 2010, FWS designated eight CHUs (5,840 acres) for the large-flowered meadowfoam in the Agate Desert complex. Two of the units designated are shared by the designated habitat for Cook's lomatium. All designated CHUs are currently occupied (or expected to be occupied; FWS 2010). Within the vicinity of White City, Oregon, where multiple pipe storage yards would be located, CHUs RV6 (6A through 6H) and RV8 have been designated. All units are surrounded by industrial parks.

Botanical surveys were conducted for this species during the flowering season (April 2007) in expected habitat at three of these five pipe storage yards. Permission to access the other two storage yards was denied. Four small patches of suitable habitat were located during surveys conducted at the three storage yards where access was granted, within vernal pool habitat in approximately 3 acres of suitable habitat north of the Burrill Lumber pipe storage yard (in a CHU that is not shared with Cook's lomatium; see figure 4.6-1 in our BA [FERC 2015]). Based on indirect surveying techniques, two of the surveyed yards are expected to be unsuitable habitat; the third yard may have some low quality habitat. Pacific Connector modified the footprints of several of the yards to avoid wetlands or to align the footprint with parcel boundaries; in addition, the pipe storage yards "Avenue C & 7th" as well as "Medford industrial Park" have been eliminated from the Project proposal, and would not be used during construction or operation. However, use of the Burrill Lumber pipe storage yard is still part of the current Project proposal, and indirect impacts to the CHU near this area are possible (see discussion below). See our BA (FERC 2015) for more details regarding surveys conducted at each yard.

As project surveys of all suitable habitat have not been completed for this species, large-flowered meadowfoam could potentially occur at the low quality habitat found at the unsurveyed storage yards and may be affected by the pipeline project. In addition, indirect effects to the CHUs in the vicinity of pipe storage yards (especially near the Burrill Lumber pipe storage yard) may occur as a result of increased road use to access the pipe storage yards near these areas. Below is the determination of effects summary for large-flowered meadowfoam and critical habitat; however, see our BA (FERC 2015) for more details.

The Pacific Connector Pipeline Project **may affect** large-flowered woolly meadowfoam because:

- suitable habitat may be available within the analysis area.

The Pacific Connector Pipeline Project is **likely to adversely affect** large-flowered woolly meadowfoam because:

- use of proposed or potential storage yards, even if they do not support the species, potentially could indirectly affect large-flowered woolly meadowfoam and vernal pools if they are 527 feet away, possibly in designated critical habitat, since intact hydrologic connections between the yard and vernal pools might be affected by additional soil compaction by heavy machinery.

The Pacific Connector Pipeline Project **may affect** designated critical habitat for large-flowered woolly meadowfoam because:

- the pipeline project occurs adjacent to large-flowered woolly meadowfoam critical habitat; and
- the pipeline project may result in habitat impacts within adjacent CHUs.

A **likely to adversely affect** determination is warranted for large-flowered woolly meadowfoam critical habitat for the following reason:

- the proposed action could potentially adversely modify habitat areas (e.g., near the Burrill Lumber pipe storage yard and/or other yards) that are located less than 527 feet away from the project actions. Indirect effects to hydrology could be expected within 527 feet of suitable or potentially suitable vernal pool habitat because at least 20 acres of habitat is considered essential for intact hydrology and 527 feet is the radius of a circle with an area of 20 acres. This indirect impact could affect PCEs 1 and 4.

Cook's Lomatium (Federally Endangered Species, State Endangered Species)

Cook's lomatium was listed as federally endangered on November 7, 2002 (FWS 2002c). It is a small perennial in the parsley family. Its range is on seasonally wet soils limited to two areas: (1) along vernal pools in the Agate Desert area of the Rogue River Valley, Jackson County, and (2) in alluvial floodplains within the Illinois River Valley area near Cave Junction, Josephine County. The Jackson County populations occur in vernal pool habitats within a 20,510-acre landform known as the Agate Desert. The plant flowers from late March to May and is pollinated entirely by insects. In the Rogue River Valley, Cook's lomatium is often found in the same vernal pool habitats as the large-flowered meadowfoam and the vernal pool fairy shrimp.

In 2010, the FWS designated 16 units (6,289 acres) of critical habitat for the Cook's lomatium. Two of the designated units are shared by the designated habitat for large-flowered meadowfoam. All designated CHUs are currently occupied (FWS 2010). CHUs RV6 (A, H, F, and G) and RV8 have been designated within the vicinity of White City, Oregon, where multiple pipe storage yards would be located. These units are surrounded by industrial parks. CHU RV8 is closest (within 850 feet) to the Medford Industrial Park storage yard, which was originally proposed for use as part of this project; however, Pacific Connector is no longer proposing to use the Medford Industrial Park storage yard for the Project's construction or operation, thereby minimizing the potential risks that the Project would have to Cook's lomatium.

Several patches of Cook's lomatium have been documented in Denman Wildlife Management Area and Agate Desert Preserve, 0.25 mile and 0.5 mile south/southwest of two pipe storage yards (Oregon Opportunities and Avenue C & 7th – Elite Cabinets & Doors), respectively (Friedman 2006). Pacific Connector conducted botanical surveys for this species in expected habitat at three of the pipe storage yards for Jackson County where access was permitted and in potentially suitable habitat in Douglas County. Suitable habitat was discovered during surveys; however, no Cook's lomatium plants were identified. Furthermore, Pacific Connector is no longer proposing to use the "Avenue C & 7th" storage yard for the Project's construction or operation, thereby minimizing the potential risks that the Project would have to Cook's

lomatium. Pacific Connector has also modified the footprints of several of the yards to avoid wetlands or to align the footprint with parcel boundaries.

As project surveys of all suitable habitat have not been completed for this species, Cook's lomatium could potentially occur at the low quality habitat found at the unsurveyed storage yard and may be affected by the pipeline project. Below is the determination of effects summary for Cook's lomatium and critical habitat; however, see our BA (FERC 2015) for more details.

The Pacific Connector Pipeline Project **may affect** Cook's lomatium because:

- potential suitable habitat is available within the analysis area.

The Pacific Connector Pipeline Project is **not likely to adversely affect** Cook's lomatium because:

- surveys of suitable habitat at pipe storage yards in Jackson County and along the pipeline did not document Cook's lomatium;
- Pacific Connector would avoid using portions of pipe storage yards with high-quality vernal pool habitat;
- Pacific Connector is no longer proposing to use the pipe storage yard "Avenue C & 7th" during construction or operation;
- effects to suitable habitat by the proposed action are likely to be unsubstantial to the point where no meaningful measurement, detection, or evaluation of impact would be possible (i.e., impact would not reach a level where individual plants would be lost);
- sedimentation barriers would be used, as appropriate, to prevent run-off and changes in hydrology;
- conservation measures have been developed to avoid or minimize impacts to future plants identified during surveys prior to pipeline construction;
- known sites within the vicinity of the pipeline project are farther than 0.25 mile from pipe storage yards;
- unsurveyed habitat is low quality vernal pool habitat located over 0.25 mile from known sites with no apparent hydrologic connectivity; and
- consultation with the FWS would be reinitiated if this species is found to be present in the area and impacts cannot be avoided.

The Pacific Connector Pipeline Project **may affect** designated critical habitat for Cook's lomatium because:

- the pipeline project occurs near Cook's lomatium critical habitat.

Project components are **not likely to adversely affect** Cook's lomatium critical habitat for the following reason.

- The proposed action is not expected to adversely modify habitat areas that provide buffer protection from adjacent development and weed sources, continuous nonfragmented

habitat, and intact hydrology (PCEs 1 and 4). Effects from surface disturbances and/or soil compaction by heavy machinery within proposed storage yards are already present, and would be at least 527 feet away from CHU for Cook's lomatium.

Kincaid's Lupine (Federally Threatened Species, State Threatened Species)

Kincaid's lupine was listed as federally threatened on January 25, 2000 (FWS 2000b). It is a long-lived perennial herb inhabiting native prairies and foothills (FWS 2000b). In Douglas County, Oregon, it occupies sites that are more shaded, occurring in areas with tree (i.e., Douglas-fir, Pacific madrone, ponderosa pine, incense cedar) and shrub canopy cover of 50 to 80 percent (FWS 2006e). The plant was historically found from Lewis County, Washington, in the north, south to the foothills of Douglas County, Oregon; however, most of the known and historical populations are found in Oregon's Willamette Valley (FWS 2006f).

Multiple populations of lupine have been identified in the project's botanical analysis area, within Douglas County. In addition, some suitable habitats within the project area have not been surveyed to date, indicating that additional unknown populations may be present within areas that could be affected by the Pacific Connector Pipeline Project (see our BA [FERC 2015]for more details).

About 600 acres have been designated as critical habitat for this species; however, all of these designated habitats are located outside of areas that would be disturbed by the pipeline project. The PCEs of Kincaid's lupine critical habitat are those that provide: (1) early seral upland prairie or oak savanna habitat, with a mosaic of low-growing grasses, forbs, and spaces to establish seedlings or new vegetative growth under an absence of dense canopy vegetation and undisturbed subsoils; and (2) the presence of insect outcrossing pollinators, with unrestricted movement between existing population patches (FWS 2006e). Management activities that could adversely modify critical habitat are those that alter PCEs to an extent that the conservation value for Kincaid's lupine is appreciably reduced (FWS 2006e). These activities that may affect critical habitat include, but are not limited to: (1) removal or destruction of prairie habitat supporting Kincaid's lupine populations by grading, leveling, plowing, mowing, burning, motorized equipment operation, or herbicide spraying; and (2) actions that further isolate or reduce genetic interchange among populations within a unit or between subunits, including road construction and expansion, housing and building development, and infrastructure construction (FWS 2006e). The Pacific Connector pipeline route would not affect any of the PCEs because no critical habitat would be affected (i.e., the Project does not intersect critical habitat).

Kincaid's lupine and its suitable habitat are present within the project area; therefore, this species could be affected by the pipeline project. The mitigation measures described above would be implemented; however, complete avoidance of known Kincaid's lupine plants by the pipeline is not possible and some plants would be directly affected. Below is the determination of effects summary for Kincaid's lupine and critical habitat; however, see our BA (FERC 2015) for more details.

The Pacific Connector Pipeline Project **may affect** Kincaid's lupine because:

- suitable habitat is present within the analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Pacific Connector Pipeline Project is **likely to adversely affect** Kincaid's lupine because:

- individual plants would be removed;
- indirect impacts are expected to occur to documented or suspected plants outside of the construction right-of-way and along access roads;
- trenching activities associated with the pipeline could impact below-ground stems and the expected impact to extant plants is unknown; and
- potential suitable habitat has not been surveyed due to landowner access denial; therefore, additional unidentified plants may be affected.

A **no effect** determination is warranted for Kincaid's lupine critical habitat because:

- the pipeline does not occur within designated Kincaid's lupine critical habitat.

Rough Popcornflower (Federally Endangered Species, State Endangered Species)

The rough popcornflower was federally listed as endangered on January 25, 2000. It is found in seasonal wet meadows or wet prairies in poorly drained clay or silty clay loam soils at elevations ranging from 100 to 900 feet. It generally blooms June through July. Rough popcornflower grows in scattered groups and reproduces largely by insect-aided cross-pollination and partially by self-pollination (FWS 2008c). The herbaceous plant occurs in the vicinity of Sutherlin and Yoncalla, mostly on private lands in the Umpqua River drainage (FWS 2003c).

Pacific Connector conducted botanical surveys for the rough popcornflower between MP 48 to 89 in the Umpqua Foothills and Valley region between mid-May and mid-June. Of the area surveyed, 4 acres were considered suitable for this species, although no plants were documented. SBS identified and surveyed 43 acres of potentially suitable habitat for rough popcornflower between MPs 50.2 and 60.0 in the Olalla area in 2007; no plants were documented. However, ORBIC (2012) identified this plant just south of proposed pipe yard Old Highway 99 in 1983, and approximately 120 feet west of Sutherlin John Murphy Pipe Yard in 1998. This area may be utilized by the pipeline project, but has not been surveyed to date. However, the applicant has stated that if these sites are used for pipe storage, then only the existing paved portions of the site would be used (thereby avoiding areas where the this sensitive species would likely occur if present).

Due to the potential for the plant to occur within an area that has not been surveyed by the applicant and may be disturbed by construction activities, the pipeline project may affect rough popcornflower. Below is the determination of effects summary for rough popcornflower and critical habitat; however, see our BA (FERC 2015) for details.

The Pacific Connector Pipeline Project **may affect** rough popcornflower because:

- historical populations occur in the vicinity of two pipe storage yards; and
- potential suitable habitat might be present within the 200-foot botanical analysis area extending from the perimeter of either yard.

The Pacific Connector Pipeline Project is **not likely to adversely affect** rough popcornflower because:

- suitable wetland habitats within the 200-foot botanical analysis area surrounding either yard may be present;

- surveys in potentially suitable habitat identified within the botanical analysis areas surrounding the two yards would occur prior to ground-disturbing activities; if plants are identified, conservation measures developed to avoid or minimize impacts to future plants would be applied;
- given current use of the two pipe yards, rough popcornflowers are not likely present within portions of the sites that may be used for pipe storage; and
- consultation with the FWS would be reinitiated if this species is found to be present in the area and impacts cannot be avoided.

Critical habitat has not been designated for rough popcornflower.

4.7.2 State-Listed Threatened or Endangered Species

In addition to species that are federally threatened or endangered, there are 13 species designated as threatened or endangered by the State of Oregon that could potentially occur in the project area (table 4.7.2-1).

TABLE 4.7.2-1

State-Listed Species Potentially Occurring in the Proposed Project Area

Species	FWS Status	ODFW Status	Portion of the Project Area Where Species Potentially Occur
Mammals			
Kit fox *Vulpes macrotis*	None	Threatened	Pacific Connector Pipeline
Gray Whale *Eschrichtius robustus*	Delisted	Endangered	LNG vessel transit in the waterway
Birds			
California brown pelican *Pelecanus occidentalis*	None	Threatened	Port access channel Jordan Cove terminal
Plants			
Pink sand verbena *Abronia umbellata* ssp. *Breviflora*	Species of Concern	Endangered	Jordan Cove terminal
Point Reyes bird's-beak *Cordylanthus maritimus* ssp. *palustris*	Species of Concern	Endangered	Jordan Cove terminal; Pacific Connector pipeline
Wayside aster *Eucephalis vialis (Aster vialis)*	Species of Concern	Threatened	Pacific Connector pipeline
Peck's milk-vetch *Astragalus peckii*	None	Threatened	Pacific Connector pipeline
Pumice grape-fern *Botrychium pumicola*	None	Threatened	Pacific Connector pipeline
Cox's mariposa-lily *Calochortus coxii*	Species of Concern	Endangered	Pacific Connector pipeline
Umpqua mariposa-lily *Calochortus umpquaensis*	Species of Concern	Endangered	Pacific Connector pipeline
Dwarf wooly meadowfoam *Limnanthes pumila* ssp. *pumila*	Species of Concern	Threatened	Pacific Connector pipeline
Silvery phacelia *Phacelia argentea*	Species of Concern	Threatened	Jordan Cove terminal
Wolf's evening primrose *Oenothera wolfii*	Species of Concern	Threatened	Jordan Cove terminal

4.7.2.1 Mammals

Kit Fox (No ESA Status, State Threatened Species)

The kit fox reaches its northern limit in southern Oregon. In Oregon, it is found in arid desert valleys dominated by halophytic plants like greasewood and shadscale, intermingled with

sagebrush. Kit foxes are opportunistic nocturnal carnivores, feeding on rodents (especially kangaroo rats), rabbits, birds, reptiles, and insects. Home ranges for this species are one to two square miles in size. Preferring easily worked soil, they dig shallow dens with several entrances. During the breeding season, they often use more than one den (Csuti et al. 2001). Although the Project may affect suitable kit fox habitat, the expected distribution of this species does not include the Project area. Because kit foxes have not been recently observed within the Project area (ORBIC 2012), the Project is not expected to affect this species.

Gray Whale (Federal Delisted Species, State Endangered Species)

The gray whale is a large baleen whale that is distributed in the northern Pacific Ocean in western and eastern stocks. The eastern stock, found along the west coast of North America, was federally delisted on June 16, 1994 (59 FR 115), but remains state endangered in Oregon. The eastern Pacific stock feeds in the summer in the Chukchi Sea, the western Beaufort Sea, and the northern Bering Sea. They migrate south from November through early February to lagoons on the Pacific coast of central and southern Baja California. Northward migration occurs after the calving and breeding season, from early February to May. These whales have the longest known migration of any mammal. Gray whales feed on infaunal benthic species that are buried in sediments (Maser et al. 1981). Gray whales are federally protected under the MMPA, and were included in Jordan Cove and Pacific Connector's IHA application submitted in October 2014 (Jordan Cove and Pacific Connector 2014).

Potential impacts to gray whales include injury and/or mortality due to ship strikes, underwater ship noise, and potential adverse effects from a ship fuel spill at sea. Spills could indirectly affect gray whales by impacting forage species. These potential impacts would be similar to the impacts to federally listed whales that are discussed in our BA (FERC 2015), except that gray whales migrate in coastal waters north and south parallel to the Pacific Coast, making them more susceptible to ship strikes in nearshore waters during migration. Impacts specific to gray whales are presented here.

According to OPRD (2007), gray whales are the most predominant whales seen along the Oregon coast. They migrate twice a year, in winter and spring, and about 200 of them feed along the coast during the summer months. Gray whales may be encountered along the LNG vessel transit route during their southern migration from November through early February or from early February to May during the northern migration. Gray whales have been struck by ships. Based on data in Pacific waters between 1999 and 2003, they are struck at a rate of 1.2 whales annually (Angliss and Outlaw 2007). The 32,000 ship-miles per year contributed by LNG vessels would amount to a 1.6 percent increase in shipping in coastal Oregon and Washington over the 1998–1999 estimates. That increase would be less if based on current vessel traffic volumes. That increase could cause an increase in the probability of whales being struck by ships, or of being disturbed during migration. Measures that Jordan Cove would implement to avoid or minimize impacts on federally listed whales (see section 4.7.1.1) would serve to avoid or minimize impacts on the gray whale. As a result of these conservation measures, effects on gray whales from the proposed action are expected to be minimal.

4.7.2.2 Birds

California Brown Pelican (Federal Delisted Species, State Endangered Species)

The brown pelican was listed as a federally endangered species on June 2, 1970, within California, Oregon, Texas, and Washington states, as well as Central and South America (FWS 1970). It was delisted in December 2009 (FWS 2009c); however, Oregon still considers the brown pelican an endangered species under state law.

The California brown pelican is a primarily coastal species, rarely seen inland or far out at sea (FWS 2005b). They feed mostly in shallow estuarine waters, normally staying within 20 miles of shore (FWS 2005b). Pelicans make extensive use of sand spits, offshore sand bars, and islets for nocturnal roosting and daily loafing, especially by non-breeders and during the non-nesting season (FWS 2005b).

Brown pelicans nest in colonies, mostly on small coastal islands in California (FWS 1985, 2007d). Brown pelicans generally breed between February and October and are most abundant in Oregon during post-breeding migration (FWS 2005b). In Oregon, numbers peak in late August through October and gradually decline from October through early November as birds move south (Gilligan et al. 1994). Since brown pelicans have wettable feathers, they return to land daily to roost and dry their feathers (FWS 2005b). Sand islands within three large estuaries in Oregon and Washington serve as primary night roosts (Jaques and O'Casey 2006 as cited in FWS 2007d). The total number of brown pelicans in Oregon in 2001 was estimated to be 6,095 (Marshall et al. 2003).

Brown pelicans are regularly seen in moderate numbers during the summer months in Coos Bay, and they also occur in small numbers in the winter (Contreras 1998). Coos Bay provides excellent habitat for this species. Brown pelicans were recorded foraging near the Project site more than 500 feet from the shore and loafing across the bay in moderate numbers daily during surveys in October 2012 (SHN 2012). The species was also observed during surveys conducted in 2005-2006 until early September (LBJ 2006). The Project site provides no nesting habitat for the brown pelican. Roosting and feeding sites have been documented within the Project area, although the last observation was in 1985. Roosting was reported on the north side of Coos Bay on a sunken jetty close to the Bay mouth and on a sand spit on the North Spit of Coos Bay, as well as on dredge spoil islands around MPs 3R through 4R (ORBIC 2012). In May 1997, BLM documented a brown pelican at the mouth of Coos Bay (BLM 2006), and the species has been documented intermittently by the National Audubon Society during annual National Audubon Society (2012) CBC surveys between 1982 and 2011, primarily from Coos Bay though occasionally from the Coquille Valley during that same period.

In the past, California brown pelicans have been affected by human disturbances at nesting colonies and roosting habitats. Existing nesting and roosting habitats within the Coos Bay Estuary and LNG terminal area have not been documented. If they occur within the estuary during construction and operation of the proposed action, pelicans may be associated with on-shore fish-cleaning stations where they possibly feed on offal (Marshall et al. 2003). Existing fish-cleaning stations are present at the Empire Boat Ramp, Oceanside RV Park and Bastendorff Beach County Park, both in Charleston. Fish-cleaning could also occur at the Charleston Marina, California Street Boat Ramp, and BLM Boat Ramp, though they are not designated as such.

Noise and human activities associated with construction and operation of the Project are likely to be the only direct effect to brown pelicans if they occur within one or more of the Project's action areas. However, the possibility of adverse effect to the species at fish-cleaning stations by noise, particularly at the dredge spoils stockpile site is expected to be minimal since individual pelicans would already be associated with human-generated sounds at the BLM Boat Ramp and Empire Boat Ramp, which are approximately 0.6 and 2 miles south of the Project (specifically, the slip and access channel), respectively. Noise generated by stockpiling activities would be of lower intensity than noise created by pile driving and construction in general.

Brown pelicans that forage within the LNG terminal action area could ingest low levels of contaminants through the food web that are re-suspended from dredging activities. However, sediments at the LNG terminal site and pipeline route within Coos Bay are not expected to contain levels of sediment contaminants that could adversely affect brown pelicans. Access channel dredging and maintenance dredging would not occur during the period of peak pelican abundance in the lower bay. The proposed action would not significantly disrupt normal behavior patterns for brown pelicans.

Pacific Connector is proposing construction within Haynes Inlet (MPs 1.67R to 4.10R) in November. Jordan Cove is proposing construction of its access channel in Coos Bay during the ODFW recommended in-water work window between October 1 and February 15. This schedule would also minimize effects to brown pelicans since there is a gradual decline in populations in Oregon as birds move south from October through early November (Gilligan et al. 1994). It is possible that the brown pelican could be present within Coos Bay and its vicinity during the time of construction (see Contreras 1998); however, it is not expected that construction within Haynes Inlet would interfere with brown pelican roosting and feeding.

There is some evidence in the literature that high intensity continuous anti-collision lights on structures may result in an increased number of bird strikes, especially at night or during fog and overcast conditions. The number of strikes can apparently be reduced by strobe or blinking the anti-collision lights. The LNG storage tanks would not be illuminated with high intensity lighting. The intensity and number of lights would be limited to what is required for security and operations. With the low-intensity lighting to be used, the likelihood of adverse effects to brown pelicans from collisions with the LNG storage tanks is minimal.

Brown pelicans may be encountered during any portion of the LNG vessel transit route in the waterway. There is no evidence that pelicans are struck by current cargo ships using the Port.

During operation of the Pacific Connector pipeline, aerial inspection of the pipeline route would occur within the permanent right-of-way. Aerial inspections would generally occur during all times of year, although inspections would not affect nesting or breeding brown pelicans since they do not nest or breed within Coos Bay. Additionally, aerial inspection should not disturb migrating, roosting, or foraging brown pelicans since air traffic is a constant disturbance within Coos Bay from the existing North Bend airport.

4.7.2.3 Plants

Pink Sand Verbena (Federal Species of Concern, State Endangered Species)

Pink sand verbena only inhabits the littoral sandy beach areas and unstabilized sand dunes of the coastal strip (ORBIC 2010). Of the 12 reported occurrences in Oregon, only 2 have more than 50 plants; many of the populations consist of only one plant and would probably not persist. The pink sand verbena's present range is along miles of coastal beach and foredune, predominantly from Cape Blanco (Curry County), southern Oregon to Point Reyes National Seashore in Marin County, California. Additionally, they sporadically occur along Oregon's northern and central coast. Historically, there were two populations of pink sand verbena documented near the mouth of Coos Bay (ORBIC 2012). Approximately 15 miles north of the entrance to Coos Bay at the outlet of Tenmile Creek, 19 plants were documented in 1995 within a protected (public entry prohibited) snowy plover nesting area (ORBIC 2012).

No pink sand verbena plants have been reported within the Pacific Connector pipeline area (ORBIC 2006a). The Pacific Connector pipeline route would not affect coastal sand dune habitat; therefore, botanical surveys for this species were not conducted for the pipeline and no incidental documentations of this species occurred.

Jordan Cove identified suitable habitat for the plant along the eastern portion of the LNG terminal in areas of actively moving dunes and European beachgrass. However, surveys conducted at the Jordan Cove project area (including portions of the worker's camp) did not locate any pink sand verbena plants (SHN 2006c, 2012). As surveys (related to the LNG terminal) and historic data indicate that pink sand verbena is not present within the project area, the JCE & PCGP Project is not expected to affect this species.

Point Reyes Bird's-beak (Federal Species of Concern, State Endangered Species)

Point Reyes bird's-beak inhabits salt marshes along the coast, sometimes growing just above tidewater in wet areas. Its habitat requirements are specific: approximately 7.5 to 8.5 feet (2.28 to 2.59 meters) above mean lower low water, soil salinity of 34 to 55 parts per thousand, sandy substrate covered by 1 to 10 cm (0.39 to 3.93 inches) organic silt, and less than 30 percent bare soil in summer. This plant flowers from June to October. Within the counties crossed by the Project, Point Reyes bird's-beak is found in Coos County.

Several occurrences of Point Reyes bird's-beak are located in the vicinity of the Project (including both the Jordan Cove Project and the Pacific Connector Pipeline Project). Populations with 1,000 to 10,000 plants are located along the margins of Coos Bay and on sand salt marshes near the edge of high water marks (ORBIC 2006a). The closest known occurrence to the LNG terminal area is along the shoreline east and west of the South Dunes Power Plant site. Potential habitat for this species has also been observed along the shoreline south of the South Dunes Power Plant. These populations have the potential to be affected by construction of the South Dunes Power Plant (i.e., direct mortality and removal due to construction activities), as well as during the temporary dewatering activities conducted in the Jordan Cove project area to stabilize and "densify" the soils underlying the facility (see the GSI Water Solutions [2015] dewatering models).

The pipeline alignment is within the vicinity of documented populations of Point Reyes bird's-beak (with the closest known occurrence located about 0.2 mile north of the pipeline in Coos

County) and the pipeline route would cross suitable habitat. Surveys for this species were conducted during the flowering season within suitable habitat. One population of about 1,000 Point Reye's bird's-beak plants was located on a spoils island owned by the Port. Pacific Connector has altered the pipeline route in this area so that the pipeline route would not affect the Point Reyes bird's-beak plants on the spoils island. However, other plants have been documented adjacent to Haynes Inlet (ORBIC 2012) within the vicinity of the Pacific Connector pipeline route.

As Point Reyes bird's-beak is found within and near the Project (including both the LNG terminal area and the pipeline), construction of the Project has the potential to impact individual plants. However, Pacific Connector has committed to protecting plants adjacent to the construction areas through the appropriate installation of safety and silt fence as determined by Pacific Connector's EIs.

Wayside Aster (Federal Species of Concern, State Threatened Species)

The wayside aster's range is limited to central, southern, and western Oregon and the northern California state line (ORBIC 2010). About 100 populations are known, totaling fewer than 9,000 individuals. Threats to this species include fire suppression, logging activities, exotic weed invasion, habitat fragmentation/inbreeding depression, browsing, roadside maintenance, and recreation (Wogen 1998). Many populations are along roadsides and in areas of residential development; none are protected. Wayside aster occurs in areas of natural and man-made disturbance, edges and openings in woodlands and forests, in second and old-growth, and in shaded roadsides. Most populations are centered in the southern Willamette Valley of Lane County or in southern Jackson and Josephine Counties. A few populations exist in the adjacent counties of California (ORBIC 2010).

ORBIC (2012) has identified several populations of wayside aster plants that have been documented recently within Douglas and Jackson Counties; however, with the exception of one site discussed below, these historic records are more than 2 miles from the pipeline, including its associated access roads. Botanical surveys were conducted for this species in expected habitat during its flowering season from July to early August 2007 in Coos Bay, Roseburg, and Medford BLM Districts; Umpqua National Forest; and Jackson County. This species was documented adjacent to an existing access road that would require improvements, which is about 100 meters (328 feet) from another site documented along the same road in 1998 (ORBIC 2012). This area was surveyed in 2009 and additional surveys were conducted within 0.25 mile of this site; however, no plants were located at location of this documented historic site or within the adjacent area.

Although the species is documented near the Project, based on historical data, the surveys conducted by Pacific Connector for the wayside aster did not detect this plant's presence. However, surveys for approximately 10 percent of existing roads to be used to access the pipeline have not been conducted, and it is possible that suitable habitat and/or this plant could occur along the remaining unsurveyed roads. These areas would be surveyed prior to construction during the planned pre-construction surveys.

Peck's Milk-vetch (Federal Species of Concern, State Threatened Species)

Peck's milk-vetch occurs east of the Cascades Mountain range. Most populations of Peck's milk-vetch are centered in three separate areas: one in north-central Deschutes County, another in north-central Klamath County, and the third in south-central Klamath County. These populations total about 300,000 individuals. The plant occurs in very dry sites, on loose, sandy soil or pumice. Peck's milk-vetch is often found in or along dry water courses, in sagebrush or rabbitbrush openings in lodgepole pine forests (in the south) or in western Juniper woodlands (in the north), and occasionally on barren flats.

Peck's milk-vetch has not been documented within the vicinity of the Project (ORBIC 2006a). No suitable habitat for Peck's milk-vetch occurs within the areas crossed by the pipeline route; therefore, Pacific Connector did not conduct botanical surveys for this species. As this species is not expected to occur along the pipeline route, it would probably not be affected by construction and operation of the Project.

Pumice Grape-Fern (No ESA Status, State Threatened Species)

This species is one of the rarest grape-ferns, and in Oregon is found only within the Crater Lake area and Paulina Mountains in Deschutes and Klamath Counties. Most known populations are found in fine pumice gravel (without humus) at elevations above 7,800 feet (2,400 meters). It has also been located within frost pockets in lodgepole pine forests with bitterbrush, in areas with deep, sterile pumice. In Oregon, pumice grape-fern is typically associated with Brewer's sedge and buckwheat species (Eastman 1990; ORBIC 2010).

The Project would not be located in the vicinity of the known sites for this plant, and no suitable habitat for this plant occurs within the areas crossed by the pipeline route; therefore, Pacific Connector did not conduct botanical surveys for this species. As the pumic grape-ferm is not expected to occur along the pipeline route, the Project would probably have no effect on this species.

Cox's Mariposa Lily (Federal Species of Concern, State Endangered Species)

The Cox's mariposa lily is limited to a small area (30 m^2), and it is only found on a small portion of a narrow geologic formation in Douglas County, Oregon. Individuals number less than 10,000 (ORBIC 2010). All populations are on serpentine soils, mostly on shady, north-facing, mesic sites near ridgelines. Typically, it grows in serpentine grasslands and forest margins.

Based on existing data, the Pacific Connector pipeline route would cross one population near MP 75 and would be within 0.4 mile of another; both of these populations were documented in 1992 (ORBIC 2010). Pacific Connector conducted botanical surveys for this species in April 2007 within the documented site crossed and within other serpentine soils crossed by the pipeline. In all, 32 acres were surveyed for this species, of which 20 were considered suitable habitat. Based on these survey results, the Pacific Connector pipeline route would cross one population between MPs 75.04 and 75.33 and be within 0.4 mile of another population where approximately 500 to 5,000 plants have been documented (ORBIC 2012).

Additional botanical surveys for this species were conducted within the previously documented sites and within other serpentine soils located within the project area in April 2007. Thirty-two acres were surveyed for this species, of which 20 acres were considered suitable habitat.

Botanical surveys conducted in this area in 2007 by Pacific Connector located approximately 500 plants on both sides of an existing BLM roadbed within about a 0.3-mile length of the construction right-of-way.

Pacific Connector has developed a mitigation plan (i.e., the *Federally-Listed Plant Conservation Plan*) to avoid and minimize potential impacts to sensitive plant species (see Appendix J of the POD). This mitigation plan describes how the construction right-of-way would be narrowed in areas that containing this species, and a portion of a USCA would be eliminated. Appropriate barriers would be installed along areas that contain this species to ensure that the lily populations are not affected by sediments and debris from the right-of-way. Slopes where this species was found would also be protected from erosion and caving to the extent possible. To accommodate the reroute and changes in construction techniques in this area, three TEWAs would be added or modified. Additional mitigation techniques that would be employed to protect these populations of Cox's mariposa lily include seed collection and bulb salvage, site restoration and monitoring, and some habitat enhancement for this species at UCSAs in the area.

Umpqua Mariposa Lily (Federal Species of Concern, State Endangered Species)

The Umpqua mariposa-lily is known to occur within 17 localities, with total plants numbering fewer than 25,000 (ORBIC 2010). This plant grows in both forests and meadows, but it is the most vigorous in margins between forests and meadows. In southwestern Oregon, it is associated with a diverse array of plants, and it is found in diverse soils, aspects, and slopes.

Several large populations of this plant (5,000+) are between 1.3 and 2.5 miles east of the pipeline alignment near MP 99.55. These were identified between 1990 and 1992 in a variety of habitats (ORBIC 2006a). No known populations occur within 0.1 mile of the Pacific Connector pipeline route, although potential suitable habitat could occur within the project pipeline area (serpentine soils in ecotone between forest and grassland sites at low elevations less than 2,500 feet). Pacific Connector conducted botanical surveys for this species in May and early June 2007 in potential habitat within 200 feet of the pipeline in lands administered by the Roseburg BLM District and Umpqua National Forest. No plants were located during the survey effort, although suitable habitat was identified within the pipeline right-of-way near the site where Cox's mariposa-lily was documented (see discussion above).

Dwarf Woolly Meadowfoam (Federal Species of Concern, State Threatened Species)

Dwarf woolly meadowfoam's range is restricted to two small protected areas, totaling about 2 square miles with at least 10,000 individuals (ORBIC 2010). Dwarf woolly meadowfoam inhabits small depressions in thin clay soil overlying old basalt at the edges of deep vernal pools, which are dry by mid-summer and generally exposed to full sunlight. The only known occurrences are on Table Rock in Jackson County (on Lower and Upper Table Rocks); which is over 12 miles southwest of the Pacific Connector pipeline. There is no documentation of dwarf woolly meadowfoam within the vicinity of the Pacific Connector pipeline (ORBIC 2006a).

Because the dwarf woolly meadowfoam is endemic to vernal pools at Table Rocks, the applicants did not conduct botanical surveys for this species. However, it is anticipated that if present within the area, it would have been documented incidentally during survey efforts for other vernal pool–associated species. As this species is not expected to occur along the pipeline route, it would probably not be directly affected by construction and operation of the Project.

Silvery Phacelia (Federal Species of Concern, State Threatened Species)

The silvery phacelia is known to occur within 24 locations, totaling 15,000 individuals (ORBIC 2010). It is the only phacelia growing along the coastline in open sand or on dunes along the south coast of Oregon. It inhabits sandy beach dunes and bluffs near the coast, and some partially-stabilized or unstabilized dunes. Silvery phacelia occurs along the coastline of Coos and Curry Counties and in adjacent northern California, Del Norte County (near Crescent City).

Silvery phacelia has not been documented in the vicinity of the Project (ORBIC 2006a); however, suitable habitat for this species does exist at the LNG terminal area, in regions of active and semi-active dunes where the European beachgrass and the red fescue-salt rush herbaceous vegetation associations occur (see section 4.5 of this EIS). Surveys conducted by Jordan Cove have not detected this species (SHN 2006c, 2012). Based on the lack of occurrences (from both historical data as well as surveys), it is not expected that the Project would impact this species.

Wolf's Evening Primrose (No ESA Status, State Threatened Species)

Wolf's evening primrose occurs in sandy soils with adequate moisture in coastal bluff scrub, coastal prairie, and coastal dune habitats (Tibor 2001). This species is associated with a high disturbance regime and several occurrences in California are located along roadsides with sandy soil (CNDDB 2005). Wolf's evening primrose is typically associated with low elevation coastal habitats, but there have been reported occurrences in lower montane coniferous forest in California, at elevations greater than 2,500 feet above MSL (Tibor 2001).

The closest known occurrence of Wolf's evening primrose to the Project is in Port Orford, Oregon, approximately 60 miles to the south of the Jordan Cove LNG Terminal site; however, suitable habitat for this species is present at the LNG Terminal area. Surveys conducted at the LNG Terminal rea did not detect the Wolf's evening primrose (SHN 2006c, 2012). Considering the lack of occurrences (based on historic and recent survey data), it is likely that this species does not occur along the Project, and it is not expected that the Project would impact this species.

4.7.3 Other Special Status Species

In addition to the federal and state threatened, endangered, candidate, and proposed species described above, there are species that have been given special status designations by federal or state agencies that could potentially occur in the Project area (see tables O-3, O-4, and O-5 in appendix O). The FWS and NMFS maintain a list of federal species of concern, which are species whose conservation standing is of concern but for which status information is still needed. The ODFW also assigns special status to fish and wildlife species that are not listed. State special status designations include sensitive-critical (SC) and sensitive-vulnerable (SV) (ORBIC 2012). Sensitive-critical refers to species with pending threatened or endangered status or species that should be listed as threatened or endangered if immediate conservation actions are not taken. Sensitive-vulnerable species are not believed to be at immediate risk for listing as threatened or endangered and such listing can be avoided through continued or expanded use of adequate protective measures and monitoring. In addition to the threatened and endangered plant species described above, ODA designates candidate species for listing. ODA candidate species include any plant species designated for study by the director of ODA whose numbers are believed low or declining, or whose habitat is sufficiently threatened and declining in quantity

and quality, so as to potentially qualify for listing as a threatened or endangered species in the foreseeable future (ODA 2014).

4.7.3.1 U.S. Fish and Wildlife Service and National Marine Fisheries Service

The FWS (2006c, 2006d, 2013h) and NMFS (2006d) list 94 special status fish and wildlife species that potentially occur in counties coinciding with the Project. Two additional species are candidates for listing under the ESA, of which one has been documented within the Project area (red tree vole, see discussion below and in the Survey and Manage Report [appendix K of this EIS]). There are 65 species of concern, whose conservation standing is of concern but for which status information is still needed. The list of FWS special status wildlife species includes 24 mammals, 25 birds, 8 reptiles, 9 amphibians, 12 fish, and 14 invertebrates. These species are listed in tables O-3, O-4, and O-5 in appendix O of this EIS. Expected habitat for each species is described within tables O-3, O-4, and O-5 in appendix O. The FWS has noted that the Umpqua chub may be present in the Umpqua River, and this species is of concern because it has rapidly decreased in abundance. This species is discussed in detail in the BE (see appendix L of this EIS).

4.7.3.2 Oregon Department of Fish and Wildlife

The ODFW identified 92 species with special status that potentially occur in counties coinciding with the JCE & PCGP Project area, the majority of which are also considered federal species of concern. This list includes 25 mammals, 35 birds, 12 fish, 6 reptiles, and 14 amphibians. The ODFW does not assign special status for invertebrates. Tables O-3, O-4, and O-5 in appendix O provide the following information for each state special status species: expected habitat and documentation within each county, BLM district, and National Forest crossed by the Pacific Connector pipeline and vicinity.

Although the species listed in tables O-3, O-4, and O-5 may occur in counties noted by FWS (2006c, 2006d) and ODFW (ORBIC 2006a, 2012), distributions and/or habitat associations of some preclude their potential occurrence in the project area.

4.7.3.3 Oregon Department Agriculture

The ODA identified 39 candidates for listing that potentially occur in counties coinciding with the project area, 19 of which are also federal species of concern. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these special status species as a result of the Project are presented in table O-3 in appendix O.

4.7.3.4 Other Special Status Species Presence

Other special status mammals, birds, fish, amphibians, reptiles, invertebrates, and vascular plants that may be present and potentially affected by construction of the LNG terminal or pipeline are described here. For species that are also BLM and Forest Service sensitive species (see below), occurrence and potential impacts on federal lands are also described below in section 4.7.4, Environmental Effects on Federal Lands.

Mammals

There are 13 other special status mammals that may be present and potentially affected by construction of the LNG terminal or pipeline. These include 8 species that are federal species of concern, and 10 species that are state sensitive. Descriptions of expected habitat, documented or

suspected occurrences, and a description of potential Project impacts to these special status species within the project area are presented in table O-3 in appendix O. Two of these special status species, the sea otter (*Enhydra lutris*, BLM strategic) and Steller sea lion (*Eumatopias jubatus* – Eastern DPS, BLM sensitive), are federally protected under the MMPA, and were included in Jordan Cove and Pacific Connector's IHA application submitted in October 2014 (Jordan Cove and Pacific Connector 2014).

Birds

There are 33 other special status birds that may be present and potentially affected by construction of the LNG terminal or Pacific Connector pipeline. These include 18 federal species of concern, and 1 candidate for listing (greater sage-grouse). Twenty-four of these species are state sensitive. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these special status species as a result of the Project are presented in table O-3 in appendix O.

Fish

There are 11 other special status fish species that may be present along the LNG vessel transit route, or in the waters of Coos Bay potentially affected by construction of the LNG terminal or Pacific Connector pipeline, or in waters crossed by the pipeline. Of these species, 6 are anadromous and 5 are non-anadromous. These include 7 FWS (2006c, 2006d) and NMFS (2006d) federal species of concern. Nine of these species are state sensitive (ORBIC 2006a, 2006b). Descriptions of life histories, expected habitat, and potential occurrences of these special status fish species within the Project area are presented in table O-4 in appendix O.

Amphibians and Reptiles

There are 10 other special status amphibians and reptiles that may be present and potentially affected by construction of the LNG terminal or Pacific Connector pipeline. These include 8 federal species of concern. All 10 of these species are state sensitive. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these special status species within the project area are presented in table O-3 in appendix O.

Invertebrates

Aquatic

There are five other special status aquatic invertebrates that may be present and potentially affected by construction of the LNG terminal or Pacific Connector pipeline. All five are federal species of concern and are associated with freshwater environments. Table O-4 in appendix O provides summarizes the life history, habitat associations, and occurrence of these invertebrates.

Terrestrial

There are two other special status terrestrial invertebrates that may be present and potentially affected by the construction of the LNG terminal or Pacific Connector pipeline: Siskiyou short-horned grasshopper (*Chloealtis aspasma*) and Franklin's bumblebee (*Bombus franklini*). Both species are federal species of concern. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these special status species within the Project area are presented in table O-3 in appendix O.

Vascular Plants

There are three other special status vascular plant species that may be present and potentially affected by the construction of the LNG terminal or Pacific Connector pipeline: clustered lady's slipper (*Cypripedium fasciculatum),* Bellinger's meadowfoam (*Limnanthes floccosa* ssp. *bellingeriana*), and Detling's microseris (*Microseris laciniata* ssp. *detlingii*). All three species are federal species of concern, and two are state candidates for listing. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these species within the project area are presented in table O-5 in appendix O.

4.7.4 Environmental Effects on Federal Lands

The BLM and Forest Service maintain lists of sensitive species to ensure that their actions do not contribute to a loss of viability or cause a trend toward listing under the ESA. Additionally, under the respective LMPs, the BLM and Forest Service maintain a list of S&M species, or species that are rare and uncommon or poorly understood that are closely associated with late successional or old-growth forests within the range of the NSO (Forest Service and BLM 2001a). Potential impacts to species on these lists on BLM and NFS lands are discussed here.

Species that are on both the sensitive list and the S&M list are discussed under section 4.7.4.3, Survey and Manage. Additionally, although the Forest Service and BLM include federal and state threatened, endangered, proposed, and candidate species on their species lists, these species are not discussed in this section as they are presented above.

4.7.4.1 BLM and Forest Service Sensitive Species

The BLM maintains lists of sensitive and strategic species as required by BLM 6840, Special Status Species Manual, to ensure that BLM actions do not contribute to a loss of viability or cause a trend toward listing under the ESA. According to Instruction Memorandum No. OR-2007-072, sensitive species are those that are documented or suspected endangered or threatened at the federal or state level, federal de-listed species, are Oregon Heritage List 1 or List 2, and have been documented on at least one Oregon BLM district. These species should be managed to ensure that activities on BLM lands do not contribute to their listing.

Strategic species are not federal candidates or federal or state-listed threatened or endangered, but are Oregon Heritage List 1 or List 2 species. Strategic species are not classified as Special Status for management purposes. The only requirement for this group of species is to record sites found during any survey efforts. Therefore, strategic species are not discussed in this section unless observed during surveys.

Like the BLM, the Forest Service is required by FSM 2760 to maintain a list of sensitive species for each region, including species listed as federally threatened, endangered, or proposed under the ESA, as well as species that are threatened by human activities. Activities on NFS lands must be managed to ensure that current federally listed species do not become extirpated or that activities do not result in ESA listing for other sensitive species.

The Region 6 Regional Forester's Special Status Species List and OR/WA State Director Special Status Species List were updated on December 1, 2011 (ISSSSP 2011). Table 4.7.4.1-1 is a summary of BLM and Forest Service sensitive species documented or suspected to occur within the districts and forests crossed by the Pacific Connector pipeline (ISSSSP 2011).

TABLE 4.7.4.1-1

Numbers of BLM and Forest Service Sensitive Species within the Four BLM Districts and Three National Forests Crossed by the Proposed Pacific Connector Pipeline a/

	Number in BLM Districts				Number in National Forests		
Taxonomic Group	**Coos Bay**	**Roseburg**	**Medford**	**Lakeview**	**Umpqua**	**Rogue River**	**Winema**
Mammals	5	5	4	6	5	5	6
Birds	18	9	10	15	12	10	14
Reptiles	1	1	1	1	1	1	1
Amphibians	2	1	4	3	2	5	3
Non-anadromous Fish	1	1	1	13	1	0	15
Anadromous Fish	8	3	5	0	2	4	0
Invertebrates	18	9	18	8	14	24	21
Fungi	12	12	14	0	11	15	4
Non-vascular Plants	34	20	19	2	28	29	17
Vascular Plants	41	39	96	47	38	98	49

Note: A species is tallied in multiple columns where it occurs and is sensitive on multiple BLM Districts or National Forests.
a/ Source: ISSSSP (2011)

Not all species documented or suspected in BLM districts and national forests crossed by the Project occur within the project area. Many were excluded from consideration after review of range and habitat information. Other species were excluded if they were not known to occur in the Project vicinity based on special status species locations within 3 miles of the Project obtained from the BLM GeoBOB database and Forest Service NRIS database (BLM 2006a; Forest Service 2006b; NSR 2012), and through ORBIC data requests (ORBIC 2006a, 2012).

Pacific Connector conducted surveys from 2007 through 2014 for special status mollusks, fungi, and vascular and non-vascular plants, including BLM and Forest Service sensitive species. The results of those surveys were submitted by Pacific Connector to the FERC, BLM, and Forest Service as part of the FERC's application process (stand-alone biological reports). The results of 2014 surveys were filed with FERC on April 27, 2015, in response to FERC's data request. Special status mollusks, fungi, and vascular and non-vascular plants not detected during these complete, targeted surveys were determined to not be present, and thus not affected by the Project. Forest Service and BLM sensitive species that are documented or suspected to occur on BLM districts and/or national forests crossed by the Project, but were dropped from further consideration due to a lack of habitat or because they were not detected during targeted field surveys are listed in tables O-3, O-4, and O-5 in appendix O. Information provided for each of these species in appendix O includes expected habitat, county, national forest, and BLM district distribution, known occurrences in relation to the Project, and impact determination and rationale for this determination.

BLM and Forest Service sensitive species that may be affected by the Project are listed below in table 4.7.4.1-2, excluding the state and federally listed, proposed, and candidate species discussed above, and the S&M species discussed below. Where suitable habitat was documented for a species but species-specific surveys were not conducted, presence was assumed, and potential impacts to these species are discussed here.

TABLE 4.7.4.1-2

BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project a/

Common Name	Scientific Name	Forest Service Sensitive	BLM Sensitive
Mammals			
Pallid bat	*Antrozous pallidus*	X	X
Townsend's big-eared bat	*Corynorhinus townsendii*	X	X
Fringed myotis	*Myotis thysanodes*	X	X
Birds			
Grasshopper sparrow	*Ammodramus savannarum*	X	
Red-necked grebe	*Podiceps grisegena*	X	X
Horned grebe	*Podiceps auritus*	X	X
American white pelican	*Pelecanus erythrorhynchos*	X	X
Snowy egret	*Egretta thula*		X
Aleutian Canada goose	*Branta canadadnsis leucopareia*		X
Harlequin duck	*Histrionicus histrionicus*	X	X
Bufflehead	*Bucephala albeola*	X	
Franklin's gull	*Larus pipixcan*		X
White-tailed kite	*Elanus leucurus*		X
Upland sandpiper	*Bartramia longicauda*	X	
Bald eagle	*Haliaeetus leucocephalus*	X	X
American peregrine falcon	*Falco peregrinus anatum*	X	X
Greater sage-grouse	*Centrocercus urophasianus*	X	X
White-headed woodpecker	*Picoides albolarvatus*	X	X
Lewis' woodpecker	*Melanerpes lewis*	X	X
Purple martin	*Progne subis*	X	X
Oregon vesper sparrow	*Pooecetes gramineus affinis*		X
Tricolored blackbird	*Agelaius tricolor*	X	X
Reptiles			
Western pond turtle (formerly Pacific pond turtle)	*Actinemys marmorata*	X	X
Amphibians			
Foothill yellow-legged frog	*Rana boylii*	X	X
Terrestrial Invertebrates			
Traveling sideband	*Monadenia fidelis celeuthia*	X	X
Siskiyou hesperian	*Vespericola sierranas*	X	X
Franklin's bumblebee	*Bombus franklini*	X	X
Western bumblebee	*Bombus occidentalis*	X	X
Siskiyou short-horned grasshopper	*Chloealtis aspasma*	X	X
Gray-blue butterfly	*Plebejus podarce*	X	X
Johnson's hairstreak	*Callophrys johnsoni (Mitoura johnsoni)*	X	X
Insular blue butterfly	*Plebejus saepiolus littoralis*	X	X
Mardon skipper	*Polites mardon*	X	X
Coronis fritillary	*Speyeria coronis coronis*	X	X
Aquatic Invertebrates			
Western ridgemussel	*Gonidea angulata*	X	X
A caddisfly (no common name)	*Namamyia plutonis*	X	X
Montane Peaclam	*Pisidium ulttramontanum*	X	X
Pacific walker	*Pomatiopsis californica*	X	X
Archimedes springsnail	*Pyrgulopsis archimedis*	X	
A caddisfly (no common name)	*Rhyacophila chandleri*	X	X
Lined ramshorn	*Vorticifex effusa diagonalis*	X	X
Non-anadramous Fish			
Umpqua chub	*Oregonichthys kalawatseti*	X	X
Upper Klamath redband trout	*Oncorhynchus mykiss newberrii*	X	
Millicoma dace	*Rhinichthys catarctae* ssp.		X
Anadramous Fish			
Chinook Salmon Southern Oregon Coast/California Coast ESU, Fall-run, Spring-run	*Oncorhynchus tshawytscha*	X	X

TABLE 4.7.4.1-2

BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project a/

Common Name	Scientific Name	Forest Service Sensitive	BLM Sensitive
Steelhead Klamath Mountains Province ESU Summer/winter run	*Oncorynchus mykiss*		X
Steelhead Oregon Coast ESU	*Oncorynchus mykiss*	X	X
Bryophytes			
No common name	*Metzgeria violacea*		X
Vascular Plants			
Bensonia	*Bensoniella oregana*	X	X
Bellinger's meadowfoam	*Limnanthes floccosa* ssp. *bellingeriana*	X	X

a/ Excluding state and federally listed, proposed and select candidate species and S&M species, which are discussed in other sections of this EIS.

Excluding federal and state threatened, endangered, proposed, and select candidate species (discussed above), and S&M species (discussed below), a total of 49 BLM and Forest Service sensitive species have the potential to be affected by the Project: 3 mammal, 19 bird, 1 reptile, 1 amphibian, 17 invertebrate, 6 fish, and 2 plant species (table 4.7.4.1-2). Tables O-3, O-4, and O-5 in appendix O provide habitat descriptions for these species. Forest Service sensitive species that would potentially be affected by the proposed action are additionally addressed in the BE (appendix L), and S&M species that would potentially be affected by the proposed action are addressed in more detail in the Survey and Manage Report (appendix K of this EIS).

4.7.4.2 BLM and Forest Service Sensitive Species Presence and Potential Impacts

BLM and Forest Service sensitive species that may be present and potentially affected by construction of the pipeline on federal lands are described here. If species were documented during targeted surveys, those locations and potential impacts are also described.

Mammals

There are three BLM and Forest Service sensitive mammals that may be present and potentially affected by construction of the pipeline on federal land: the pallid bat (*Antrozous pallidus pacificus*), Townsend's big-eared bat (*Corynorhinus townsendii*), and fringed myotis (*Myotis thysanodes*). Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these special status species within the project area are presented in table O-3 in appendix O. As all three of these species are Forest Service sensitive, they are additionally addressed in the BE (appendix L).

Birds

There are 19 BLM and/or Forest Service sensitive birds that may be present and potentially affected by construction of the pipeline on federal land. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these special status species as a result of the Project are presented in table O-3 in appendix O. Forest Service sensitive birds that would potentially be affected by the proposed action are additionally addressed in the BE (appendix L).

Fish

There are six BLM and/or Forest Service sensitive fish species that may be present along the LNG vessel transit route, in the waters of Coos Bay potentially affected by construction of the pipeline, or in waters crossed by the pipeline. Of these species, three are anadromous and three are non-anadromous. Descriptions of life histories, expected habitat, and potential occurrences of these special status fish species within the Project area are presented in table O-4 in appendix O. Forest Service sensitive fish that would potentially be affected by the proposed action are additionally addressed in the BE (appendix L).

Amphibians and Reptiles

There are two BLM and Forest Service sensitive amphibians and reptiles that may be present and potentially affected by construction of the pipeline on federal land: western pond turtle (*Actinemys marmorata*) and foothill yellow-legged frog (*Rana boylii*). Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these special status species within the Project area are presented in table O-3 in appendix O. As both species are Forest Service sensitive, they are additionally addressed in the BE (appendix L).

Invertebrates

Aquatic

There are seven BLM and Forest Service sensitive aquatic invertebrates that may be present and potentially affected by construction of the pipeline on federal land. All of the species are associated with freshwater environments. Table O-4 in appendix O summarizes the life history, habitat associations, and occurrence of these invertebrates. As all seven species are Forest Service sensitive aquatic invertebrates, they are additionally addressed in the BE (appendix L).

Terrestrial

There are 10 BLM and Forest Service sensitive terrestrial invertebrates that may be present and potentially affected by the construction of the pipeline on federal land. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to these special status species within the Project area are presented in table O-3 in appendix O. As all 10 species are Forest Service sensitive terrestrial invertebrates they are additionally addressed in the BE (appendix L).

Four BLM and Forest Service sensitive mollusk species were located during surveys for the Project: Siskiyou hesperian, traveling sideband, evening fieldslug, and Chace sideband. The evening fieldslug and Chace sideband are also S&M species; potential impacts to these species are discussed below in section 4.7.4.3. Siskiyou hesperian and traveling sideband are discussed in the following paragraphs; these two species are additionally addressed in the BE (appendix L).

Field Survey Locations and Potential Impacts

Traveling sideband is a BLM and Forest Service sensitive species (ISSSSP 2011) and an Oregon endemic terrestrial snail. During surveys in 2007 and 2010, this species was observed at 8 locations on the Rogue River and Winema National Forests (between MP 154.9 and 175.3), and at 6 locations on BLM land in the Lakeview and Medford BLM Districts (MPs 116.5 to 176.9). Shells and live individuals were located within and outside the right-of-way, as well as within proposed TEWAs and UCSAs (SBS 2008a, 2011b). This species was not documented during

surveys in 2014. Direct mortality could occur to this species if they are within the right-of-way during Project clearing or construction due to their low mobility. Clearing of the right-of-way could affect habitat by removing forest overstory, potentially making the area unsuitable for this species. Indirect effects could result from the alteration of composition and structure of vegetation resulting in changes in microclimate. Realignments following the 2007 and 2010 surveys resulted in avoidance of some but not all of the sites observed during Project surveys. As currently proposed, Pacific Connector would directly affect 6 of the 14 sites observed during Project surveys. Indirect effects are expected to the traveling sideband sites observed even if direct effects to these sites are avoided because all the sites are within approximately 100 feet of Project disturbance, and thus would be affected by changes in microclimate conditions.

Siskiyou hesperian is a BLM and Forest Service Sensitive species (ISSSSP 2011) and a riparian associated terrestrial snail. During Project surveys in 2007 and 2010, this species was observed at 12 locations on the Rogue River and Umpqua National Forests (between MPs 110.18 and 164.69), and 10 locations in the Medford and Roseburg BLM Districts (MPs 79.9 to 151.5). In 2014, this species was observed at eight locations within the Rogue River and Winema National Forests (between MPs 154.8 and 168.7). Shells and live individuals were observed within and outside the right-of-way, as well as proposed TEWAs and UCSAs (SBS 2008, 2011b; April 27, 2015 response to FERC data request). Direct mortality to individuals could occur if they are located within the right-of-way during Project clearing or construction. Another potential direct effect is destruction or alteration of hydrology of riparian, wetland, or aquatic habitats used by this species. Indirect effects could result from the alteration of composition and structure of vegetation resulting in changes in microclimate. The increase in sun exposure could reduce moisture levels and potential decrease dispersal between populations or suitable habitat. As currently proposed, Pacific Connector would directly affect 115 of the 30 sites observed during Project surveys. Indirect effects are expected to the Siskiyou hesperian sites observed even if direct effects to these sites are avoided as most the sites are within approximately 100 feet of Project disturbance, and thus would be affected by changes in microclimate conditions.

Plants and Fungi

A total of 250 BLM and/or Forest Service sensitive bryophyte, lichen, fungus, and vascular plant species were identified as potentially occurring within the project area (see table O-5 in appendix O). Between 2007 and 2014, SBS surveyed for special status fungi and vascular and non-vascular plant species in suitable habitat within 100 feet (fungi) or 200 feet (plants) of the right-of-way, TEWAs, UCSAs, and access roads (note that surveys for survey and manage species will continue through 2016). Survey reports, including methodology and results, are provided in the Biological Survey Reports, which were submitted as part of the Pacific Connector and Jordan Cove application to FERC. Plant and fungus species documented on federal lands during surveys are described below. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project impacts to all species within the project area are presented in table O-5 in appendix O. Forest Service sensitive plants and fungi that would potentially be affected by the proposed action are additionally addressed in the BE (appendix L).

Bryophytes

Of the 38 BLM and/or Forest Service sensitive bryophytes identified as potentially occurring within the project area, only one was documented during surveys: the liverwort *Metzgeria violacea*. Potential Project effects to bryophytes include trampling or killing of individual plants.

This possible effect would be mitigated by fencing off and marking known occurrences of sensitive bryophyte species along the right-of-way and not disturbing them.

Field Survey Locations and Potential Impacts

Metzgeria violacea is a BLM sensitive coastal liverwort species and was observed during Project surveys in the BLM Coos Bay District, approximately 200 feet northeast of the right-of-way near MP 17.4. Plants were located on salmonberry (*Rubus spectabilis*) branches within a riparian forest wetland and were scattered within an area of approximately 0.14 acre. Prior to the discovery of this site there were no documented occurrences of this liverwort on BLM lands, but it was suspected on Coos Bay BLM District because of similar habitat and proximity to known sites (South Slough National Estuarine Research Reserve, Charleston). It is not expected that the plants at this site would be negatively affected by the pipeline because the overstory riparian habitat and substrate shrubs at this site would be maintained. Therefore, no avoidance or mitigation plan has been prepared.

Lichens

There are 20 BLM and/or Forest Service sensitive lichens identified as potentially occurring within the project area, none of which were documented during surveys. See table O-5 in appendix O for a list of these species, descriptions of expected habitat, and documented or suspected occurrences. Three BLM and/or Forest Service strategic lichen species (*Chaenotheca subroscida*, *Leptogium teretiusculum*, and *Leptogium platinum*) were observed during Project surveys; these species are also S&M species under the 2001 ROD list (Forest Service and BLM 2001a), and are discussed below under section 4.7.4.3, including proposed avoidance and minimization measures and potential site and species persistence, as well as table O-5 in appendix O.

Fungi

Of the 23 BLM and/or Forest Service sensitive fungi identified as potentially occurring within the project area, only 2 were documented during surveys: *Boletus pulcherrimus* and *Hygrophorus caeruleus*. Two Forest Service and BLM strategic fungi were also observed during surveys: *Otidea smithii* and *Sarcodon fuscoindicus*. These four species are S&M species and are discussed below under section 4.7.4.3, including proposed avoidance and minimization measures and potential site and species persistence. See table O-5 in appendix O for the locations of these observations in relation to the Project.

Vascular Plants

There are 169 BLM and/or Forest Service sensitive vascular plants identified as potentially occurring within the project area, 3 of which were documented during surveys on federal lands: Bensonia (*Bensoniella oregano*), Bellinger's meadowfoam, and Detling's microseris. Potential impacts to Bellinger's meadowfoam on NFS lands are additionally discussed in the BE (appendix L of this EIS).

Field Survey Locations and Potential Impacts

Bellinger's meadowfoam is associated with vernally wet meadows or vernal pools, and is generally found on basalt scablands at elevations between 1,000 and 4,000 feet in Jackson and Klamath Counties, Oregon, and Shasta County, California. Three Bellinger's meadowfoam

populations were located in the Project area. One population was located in 2007 on BLM land near MP 128.95 in the vicinity of Indian Creek. This site includes 15 plants in a 0.1-acre area and is located outside of the current construction footprint (near the old centerline location), and approximately 500 feet north of the pipeline centerline. The Bellinger's meadowfoam population is unlikely to be affected by construction of the pipeline. In 2008, approximately 2,300 plants were located within 0.5 acre in clay soils in a seasonally saturated rocky meadow at MP 154.1 (SBS 2008a) on the Rogue River National Forest; direct impacts to this site would not be expected as the TEWA proposed for that location was eliminated from consideration, and the site is now approximately 95 to 255 feet south of a TEWA at its closest distance to the Project.

In 2010, 30,000 plants within less than one acre were documented between MPs 154.8 and 154.7, in the vicinity of Heppsie Mountain (SBS 2011a), also within the Rogue River National Forest. Potential impacts to this site include removal of individuals, temporary disturbance, and permanent loss or alteration of habitat including changes in hydrology. The site is located in a vernally moist scabland meadow within the right-of-way and a TEWA and therefore would be disturbed by the Project (SBS 2011a; Rolle 2014). Measures to avoid this site considered but excluded in order to avoid a rare fungus, *Gymnomyces abietis*, which was also found at the same location on the north end of the meadow at MP 154.8. *Gymnomyces abietis* is an S&M species, discussed below in section 4.7.4.3. Although Project activities would affect the local population at MP 154.7, the species would not likely be eliminated from the site as it is able to grow on disturbed soil (Rolle 2014). Conservation measures at this site include recontouring, reseeding, and controlling for noxious weeds. Additionally, although the site that would be affected is one of only a few Bellinger's meadowfoam sites on NFS land, a large number of sites are known from BLM and private land in eastern Jackson County. More undocumented sites are likely to occur on unsurveyed private lands (Rolle 2014). Consequently, the expected loss of individuals and habitat at this site is not expected to affect the viability of Bellinger's meadowfoam over the broader geographic area of the low mountains and foothills of eastern Jackson County (Rolle 2014).

Detling's microseris is associated with open grasslands and rocky meadows, and grows in heavy clay soils below 2,000 feet in Jackson County, Oregon, in a band from near the California border and north to the Butte Falls area. Detling's microseris tends to grow in dense patches. Four Detling's microseris sites were located in the project area in the BLM Medford District. It was observed within the right-of-way near MP 129.3, approximately 62 feet north of a TEWA near MP 131.4, approximately 142 feet west of the right-of-way near MP 141.2, and approximately 80 feet west of the right-of-way near MP 141.5. Potential Project effects to these plants could include trampling of individuals, fragmentation of populations, disruption of pollinator species populations, alteration of habitat, and introduction and facilitation of spread of noxious and invasive weeds. These possible effects would be mitigated by fencing off, marking, and not disturbing sensitive plants found along the right-of-way; restoring disturbed areas to their preexisting condition; and following recommendations outlined in Oregon Aquatic Species Management Plan and the Oregon Noxious Weed Strategic Plan. Pacific Connector has developed an *Integrated Pest Management Plan* in consultation with the ODA (Butler 2006), BLM, and the Forest Service to minimize the potential spread and infestation of weeds along the construction right-of-way. This plan can be found in Appendix N to the POD, which was included in Pacific Connector's application to the FERC. See section 4.5.1.2 for more information on noxious weed control and mitigation.

Bensonia is found mainly within the Siskiyou Mountains of southwestern Oregon in Curry and Josephine Counties, with a few small disjunct populations in adjacent Humboldt County, California (NatureServe 2013). The rhizomatous species grows in wet meadows and edges near bogs and springs. Populations seem to be associated with cloud or fog banks that blanket the mountain tops at certain times of year. Most plants are in meadows on gentle slopes, and they thrive on partial shade. The species has been found at elevations between 2,000 to 4,750 feet (Hoover and Holmes 1998). One bensonia site was noted in the vicinity of the Project in 2011 in Roseburg BLM District, approximately 150 feet east of the existing Signal Tree Road Quarry at MP 47. Pacific Connector surveyed this area in 2013 and no special status species were observed, including bensonia. Due to the distance between this site and the Project, impacts to it are not anticipated.

4.7.4.3 Survey and Manage Species

S&M species were first identified by the BLM and Forest Service in 1994 as rare amphibians, mammals, bryophytes, mollusks, vascular plants, fungi, lichens, and arthropods that occupy LSOG forests in the range of the NSO (see Forest Service and BLM 1994a, the NWFP ROD). The agencies established standards and guidelines for management of these rare species in the *Standards and Guidelines for Management for Late-Successional and Old-Growth Related Species in the Range of the Northern Spotted Owl* (Forest Service and BLM 1994b). The NWFP ROD established overall objectives for managing S&M species populations that were referred to as "persistence objectives." These objectives were based on the Forest Service viability provision in the 1982 National Forest System Land and Resource Management Planning Regulation for the National Forest Management Act of 1976.

In 2001, the *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (2001 ROD; Forest Service and BLM 2001a) modified the management direction provided in the NWFP ROD for S&M species and amended BLM and Forest Service land management plans in the range of the NSO accordingly. The management direction for S&M species varies based on its assigned category, which establishes varying levels of surveys and management of known sites (refer to the 2001 ROD and appendix K to this EIS for additional details on the categories). For the S&M Standards and Guidelines, the major elements were retained with some restructuring for clarity, and the 1994 list of S&M species was modified to remove 72 species in all or part of their range because new information indicated they were secure or otherwise did not meet the basic criteria for S&M. Based on the history of the S&M rule, it should be noted that by definition, there is a general concern for persistence for any of the species listed in the 2001 ROD. That concern is the basic reason species are listed in the S&M Standards and Guidelines.

RODs to modify the S&M rule were published in 2004 and 2007; however, both of these RODs were set aside by the courts. As a result of a court-mandated settlement agreement in litigation on the 2007 ROD (*Conservation Northwest v Sherman* Case No. C08-1067-JCC (W.D. Wash. July 5, 2011)), modifications to the S&M Standards and Guidelines were again made; however, the 2011 Settlement Agreement was set aside by the Ninth Circuit Court of Appeals in 2013, and the 2001 ROD was reinstated. The judges in this case made no ruling regarding the Annual Species Reviews previously completed in 2001, 2002, and 2003.

As a result of the 2013 Court decision, this assessment was completed using the S&M Standards and Guidelines and species list of the 2001 ROD. The NWFP ROD and the 2001 ROD do not prescribe a well-defined process for evaluating impacts on species persistence or viability from a proposed activity. The 2001 ROD states "instead, common sense and agency expertise must be used in making determinations of compliance with the viability provision" (Standards and Guidelines). The BLM and Forest Service have embraced this approach for evaluating impacts of the project on the persistence of affected S&M species in the NSO range. The Standards and Guidelines and ROD are intended to "provide a reasonable assurance of species persistence" for all of the S&M species. If the project is constructed, it would affect numerous known sites of S&M species. This assessment seeks to determine, should the project be constructed, whether there would be a reasonable assurance of species persistence for those S&M species affected by the project in the NSO range. The evaluation of species persistence is presented in appendix K to this EIS, and this section summarizes the results of the evaluation. The 2001 S&M list used to identify species to consider in the persistence evaluation for the Project is included as attachment A to appendix K.

This section is organized by taxonomic group and includes a brief overview of the species considered in the persistence evaluation; a summary of the distribution of sites of the species in the NSO range; an analysis of the impacts of the project on the sites; and breakdowns of the number of sites of each species in the NSO range, the number of affected sites of each species across the analysis area, and the number of affected sites in the Klamath Falls Resource Area of the Lakeview BLM District; Coos Bay, Roseburg, and Medford BLM Districts; and on the Umpqua, Rogue River, and Winema National Forests. Details on the methodology used for the persistence evaluation (e.g., establishment of sites for each species, mapping of general habitat and site distribution, analysis of impacts on sites) and a glossary of key terms used in the evaluation are available in appendix K. The factors used to evaluate the project impacts are outlined in appendix K and were derived from the 2001 ROD criteria for species persistence and relative rarity. It should be noted that this persistence evaluation is not intended to serve as an annual species review or an evaluation of the relative rarity of the species. This analysis is focused only on the effects to the species that could result from implementation of the project and is intended to provide sufficient information to support subsequent findings by the BLM and Forest Service.

This assessment provides a conservative site-specific analysis of impacts to sites, which consist of the recorded observations of S&M species from agency geodatabases and a surrounding protection buffer, and generally assumes that site persistence would not be maintained following project implementation if a site falls within the analysis area. This conservative approach was considered sufficient if project-related effects on the sites would not substantially alter the distribution of the species across the NSO range (e.g., the species would still be well distributed or locally abundant in the vicinity of the project area). However, if the initial analysis revealed that remaining sites (i.e., those not affected by the project) may not provide a reasonable assurance of species persistence, a closer evaluation of the effects on each site was conducted to further assess impacts of the project and determine if site persistence would be maintained at any of the sites following project implementation or if measures were needed to protect or avoid the site(s). Additional details on the methodology used to evaluate impacts are presented in appendix K.

Incomplete or Unavailable Information

CEQ regulations 40 CFR 1502.22 require a discussion of incomplete or unavailable information. Information is incomplete or unavailable for:

- **Total populations of S&M species beyond those represented in the geodatabases of the agencies used in this report.** Although a statistically reliable region-wide survey has been done for most of the S&M species (Forest Service and BLM 2007: 142), the results of those surveys have not been biologically interpreted, and the final results have not yet been published. In absence of a published interpretation of the results of those regional surveys, this assessment relies on the known sites of affected species that have been inventoried and recorded in the known site geodatabases of the BLM and Forest Service. These data constitute "best available information" for populations of S&M species and provide sufficient information to make a reasoned choice between the alternatives and to make an informed decision related to the persistence standards of the 2001 Survey and Manage ROD. A total population estimate is not necessary to make a reasoned choice between the alternatives.
- **Total acres of the specialized microsites and habitats used by certain S&M species.** This analysis was completed using geodatabase records of observations (i.e., "known sites"), regionally available vegetation inventory data, and evaluation criteria developed from the 2001 ROD. In many cases, S&M species rely on specialized habitats that may not be catalogued in agency geodatabase records or vegetation inventories. This is one of the reasons why pre-project surveys are required for S&M species. Habitat requirements for each of the species considered are discussed in detail in appendix K. In this assessment, estimates are provided of the general areas where specialized habitats may be found, but these should not be interpreted as the actual acres of available specialized habitats; the actual acres of available specialized habitats are typically a fraction of the general habitat description. For example, some mollusks rely on moist microsites found in late-successional coniferous forests. A regional inventory of late-successional coniferous forests is available, but a regional inventory of moist microsites is not; there are many, many more acres of late-successional forests than there are acres of moist microsites within those forests. This assessment identifies known sites and broad habitat classifications such as "late-successional coniferous forests below 6,000 feet" where specialized habitats and the species in question may be found, but makes no estimates of, nor does the analysis rely on, estimates of specialized habitats that may exist within those broad vegetation categories. The cost of acquiring such an inventory of microsite environments over the entire area of the NWFP would be exorbitant and is not essential to making a reasoned choice between the alternatives. As noted in the Final Supplemental EIS for Survey and Manage Species, "the likelihood that an activity modifying late-successional forest will occur within the range of a truly rare or localized species population must be viewed in light of the relatively conservative degree of modification of late-successional forest projected to occur within the Northwest Forest Plan area. For example, management activities (timber harvest and prescribed fire) are projected to modify approximately 3 percent of the late-successional forest within the area over the next decade" (Forest Service and BLM 2000: 180). Pre-project survey data and existing known sites of S&M species within the area of the NWFP provide sufficient

information to determine whether there is a "reasonable assurance of species persistence," which is the standard of the 2001 Survey and Manage ROD.

- **Recovery of occupied sites after disturbance.** S&M species are by definition associated with LSOG forests. The construction corridor and TEWAs will be reforested and replanted with native vegetation similar to what occupied the project area prior to disturbance. It will be at least 80 years before those areas provide late-successional habitat. A 30-foot-wide maintenance corridor centered along the pipeline route would be maintained in low growing brush and grass vegetation (no trees) for the life of the project. When the project is decommissioned, it would be an additional 80 years before this strip provides late-successional stand characteristics. Information is not generally available as to how quickly, or if, the affected S&M species will reoccupy these areas. This analysis presumes that if the "site" is within the construction clearing or TEWAs, the project would result in a long-term loss of that site. This analysis does not speculate on when or if the affected species may reoccupy the site. Since sites are presumed lost if impacted, and that provides the basis for the impact assessment, data related to recovery or reoccupation of sites are not essential to the decision to be made or the choice between alternatives.

Project-Wide Distribution of S&M Species

Surveys conducted for the Project in and near the project area through fall 2014 resulted in numerous observations of S&M species on BLM and NFS lands. These survey results in combination with results from prior surveys conducted in the vicinity of the project area were used to identify the S&M species that could be affected by the project. Observation data stored in agency geodatabases were converted to "sites" or "known sites" using a standardized mapping protocol based on buffer distances described in the 2001 ROD. The species considered in the persistence evaluation include 66 fungi, 13 lichens, 1 bryophyte, 3 vascular plants, 2 mollusks, 1 mammal, and 1 bird. A review of the site data in and near the project area identified several areas where greater concentrations of S&M species, particularly fungi, have been found. BLM and NFS lands are distributed across the project area and are not contiguous, and the distribution of sites follows the land ownership pattern, with the majority of the sites being on BLM or NFS lands where surveys have been conducted. Based on the survey findings for this Project, site distributions, and background information on the S&M species, it is reasonable to conclude that additional sites of many of the species are likely extant on non-federal lands in and near the project area, as well as on BLM and NFS lands outside the surveyed areas. Persistence evaluations in this analysis were, however, based on known sites, not speculation about sites that may potentially exist.

The greatest concentration of sites in the project area is on BLM lands managed by the Roseburg and Medford Districts and NFS lands managed by the Umpqua National Forest between MPs 95.2 and 117.1. This area contains 280 total sites of 37 fungi species, three lichens, one bryophyte, one plant, and one mammal (red tree vole). A smaller group of sites is located on BLM lands managed by the Roseburg District between MPs 75.5 and 86.7. This area contains 98 total sites of nine fungi, 10 lichens, one bryophyte, one plant, one mollusk, one mammal (red tree vole), and one bird (great gray owl). Another group of sites that are more scattered, with several clusters of sites, is located on NFS lands managed by the Rogue River and Winema National Forests between MPs 154.2 and 173.8. This area contains 176 total sites of 36 fungi species, one lichen, and one mollusk.

Fungi

The diverse fungi of the Pacific Northwest include several hundred saprobic (decomposers), parasitic, and symbiotic (mutualistic) macro- and microfungi species. The 2001 list included with the S&M ROD includes 209 species of fungi under the S&M Standards and Guidelines. Of these species, 66 are considered in this evaluation of the project because they have been documented in or near the project area. Appendix K of this EIS presents additional details on each species, and the key information used to evaluate project-related impacts is summarized in this section.

The fungi considered in this analysis consist primarily of mycorrhizal or symbiotic species, which include truffles, false truffles, chanterelles, boletes, coral fungi, and gilled mushrooms. Some of the species are saprobic gilled mushrooms or parasitic fungi. The mycorrhizal fungi form symbiotic relationships with vascular plants to exchange nutrients and water for photosynthate. The saprobic species are found on dead or decaying wood, including snags. One species (*Sparassis crispa*) is found as a parasite on tree roots, and another species (*Collybia racemosa*) is mycoparasitic on fleshy mushrooms. The fungi fruit at different times of year, and many do not fruit annually, although they may still be present in the soil. Although surveys have been conducted across the project area and in other parts of the NSO range, the difficulty in detecting fungi when fruiting bodies are not present has limited the ability to fully describe the range and distribution of many species within the NSO range. The fungi species considered in this analysis are listed in table 4.7.4.3-1 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table. Many of these species are likely more abundant than currently documented, and more survey effort would be expected to locate additional sites of the species.

TABLE 4.7.4.3-1

Regional Site Count of Fungi Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on BLM/NFS Lands in NSO Range b/	Sites in Reserves in NSO Range c/
Albatrellus ellisii	90	86	33 (38%)
Albatrellus flettii	81	73	24 (33%)
Arcangeliella crassa	19	19	2 (11%)
Boletus pulcherrimus	47	39	22 (56%)
Bondarzewia mesenterica	159	146	50 (34%)
Cantharellus subalbidus	309	293	149 (51%)
Choiromyces alveolatus	16	13	6 (46%)
Chromosera cyanophylla	349	331	120 (36%)
Clavariadelphus ligula	77	69	19 (28%)
Clavariadelphus occidentalis	157	140	58 (41%)
Clavariadelphus sachalinensis	134	132	26 (20%)
Clavariadelphus truncatus	236	221	91 (41%)
Collybia bakerensis	140	136	59 (43%)
Collybia racemosa	64	41	23 (56%)
Cortinarius olympianus	29	29	8 (28%)
Craterellus tubaeformis	56	53	31 (59%)
Galerina vittaeformis	31	31	3 (10%)
Gastroboletus subalpinus	312	298	177 (59%)
Gomphus clavatus	88	87	65 (75%)
Gomphus kauffmanii	131	131	88 (67%)
Gymnomyces abietis	97	88	21 (24%)
Gyromitra esculenta	167	144	69 (48%)
Gyromitra infula	129	108	60 (56%)
Gyromitra melaleucoides	20	17	10 (59%)
Gyromitra montana	290	279	95 (34%)
Helvella maculata	107	98	39 (40%)
Hydnum umbilicatum	134	122	62 (51%)

TABLE 4.7.4.3-1

Regional Site Count of Fungi Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on BLM/NFS Lands in NSO Range b/	Sites in Reserves in NSO Range c/
Hygrophorus caeruleus	665	658	160 (24%)
Leucogaster citrinus	100	87	18 (21%)
Mycena overholtsii	170	151	73 (48%)
Neournula pouchetii	48	47	13 (28%)
Nivatogastrium nubigenum	75	69	40 (58%)
Otidea onotica	109	105	30 (29%)
Phaeocollybia attenuata	182	181	85 (47%)
Phaeocollybia fallax	82	75	34 (45%)
Phaeocollybia kauffmanii	188	180	64 (36%)
Phaeocollybia olivacea	962	947	142 (15%)
Phaeocollybia piceae	12	11	3 (27%)
Phaeocollybia scatesiae	214	177	75 (42%)
Phaeocollybia sipei	148	113	55 (49%)
Phaeocollybia spadicea	132	111	46 (41%)
Pithya vulgaris	204	184	88 (48%)
Plectania melastoma	79	69	26 (38%)
Plectania milleri	40	39	20 (51%)
Polyozellus multiplex	135	132	57 (43%)
Ramaria araiospora	126	106	49 (46%)
Ramaria celerivirescens	188	184	26 (14%)
Ramaria rubrievanescens	162	155	85 (55%)
Ramaria rubripermanens	222	219	36 (16%)
Ramaria stuntzii	85	83	42 (51%)
Rhizopogon truncatus	150	143	50 (35%)
Sarcodon imbricatus	143	140	45 (32%)
Sarcosphaera coronaria	26	24	7 (29%)
Sedecula pulvinata	19	18	2 (11%)
Sparassis crispa	113	104	55 (53%)
Spathularia flavida	215	199	47 (24%)
Tremiscus helvelloides	131	127	42 (33%)

a/ Total site count reflects the number of sites generated by the 11/8/13 FME extract combined with NRIS and GeoBOB observation data from March/April 2014 and survey data from fall 2012 through fall 2014 on all lands across the NSO range.
b/ Site count reflects only those sites on BLM or NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on BLM or NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on BLM and NFS lands.

The distribution of each species and its range in the NSO range vary greatly; some species are widely distributed and relatively abundant, whereas others have a limited distribution with few sites. Based on the information presented in appendix K, the species were grouped into four categories based on their distributions across the NSO range and using the distribution categories presented in the 2000 Final SEIS (Forest Service and BLM 2000).

The species listed below is known only from a few sites in the NSO range and has little potential for gene flow between other sites inside or outside the NSO range.

Sedecula pulvinata

The species listed below have patterns of distribution with limited potential for connectivity between isolated sites or site clusters. These species are not well distributed within their ranges in the NSO range.

Arcangeliella crassa
Choiromyces alveolatus
Cortinarius magnivelatus
Cortinarius verrucisporus
Gymnomyces abietis
Otidea smithii
Ramaria coulterae
Ramaria rubribrunnescens
Tricholoma venenatum

The species listed below are distributed as groups or clusters of sites with potential for gene flow among subpopulations within the groups and little potential for gene flow between isolated groups. These species may be well distributed within a part of their ranges in the NSO range.

Boletus pulcherrimus
Clavariadelphus sachalinensis
Collybia bakerensis
Collybia racemosa
Cortinarius olympianus
Hygrophorus caeruleus
Mycena monticola
Mycena overholtsii
Neournula pouchetii
Nivatogastrium nubigenum
Phaeocollybia scatesiae
Pithya vulgaris
Plectania milleri
Sarcosphaera coronaria

The species listed below have multiple sites or clusters of sites that are nested within a web of potential interconnections. These species may be well distributed within a part of their ranges in the NSO range.

Albatrellus ellisii
Albatrellus flettii
Bondarzewia mesenterica
Cantharellus subalbidus
Chromosera cyanophylla
Clavariadelphus ligula
Clavariadelphus occidentalis
Clavariadelphus truncatus
Craterellus tubaeformis
Galerina atkinsoniana
Galerina vittaeformis
Gastroboletus subalpinus
Gomphus clavatus
Gomphus kauffmanii
Gyromitra esculenta
Gyromitra infula
Gyromitra melaleucoides
Gyromitra montana
Helvella maculata
Hydnum umbilicatum
Leucogaster citrinus
Otidea onotica
Phaeocollybia attenuata
Phaeocollybia fallax
Phaeocollybia kauffmanii
Phaeocollybia olivacea
Phaeocollybia piceae
Phaeocollybia sipei
Phaeocollybia spadicea
Plectania melastoma
Polyozellus multiplex
Ramaria araiospora
Ramaria celerivirescens
Ramaria rubrievanescens
Ramaria rubripermanens
Ramaria stuntzii
Rhizopogon truncatus
Sarcodon fuscoindicus
Sarcodon imbricatus
Sparassis crispa
Spathularia flavida
Tremiscus helvelloides

Habitat for these species varies and has generally been classified as coniferous, mixed hardwood-coniferous, and/or hardwood forests, including the LSOG component of these forests. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The data are the best available data on forest types across the NSO range but likely overestimate the amount of potential habitat available in the region for many of the species

considered in this analysis, particularly those with particular microsite conditions that have not been mapped at a regional scale. The extent of potential habitat for each species varies based on its distribution across the NSO range and its habitat preferences, and additional details on habitat are presented in appendix K.

The Project could affect site persistence of 66 S&M fungi at one or more sites in or near the project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could result in the removal of populations or individuals of fungi. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase, although not all species are affected by open corridors or change in forest age (e.g., *P. fallax, P. piceae, P. sipei*, and *P. spadicea*). The removal of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, and disturbance to soil, understory substrate (e.g., rocks, downed logs), and roots of trees could negatively affect the fungi in adjacent areas by removing their habitat, disturbing soil or duff around trees or roots of trees, and affecting mycorrhizal associations with the trees or other relationships between the fungi and their hosts, potentially affecting site persistence even if the entire site is not disturbed. For some species that are found in more open habitats (e.g., *C. olympianus*, *H. maculata*, *H. caeruleus*, *S. flavida*), these microclimate changes may not affect site persistence. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for the species. Road improvements and establishment could remove habitat and extant populations or individuals of the fungi. The specific impacts on sites in and near the project area vary by species and depend on where the sites are located in proximity to the corridor and other activities. Table 4.7.4.3-2 presents a summary of the number of sites of each species that would be affected by the project; additional details for each species are included in appendix K.

TABLE 4.7.4.3-2

Fungi Sites Potentially Affected by the Project

Species	Total Affected Sites a/	Affected Sites in Reserves	Remaining Sites on BLM/NFS Lands in NSO Range
Albatrellus ellisii	11	3	75
Albatrellus flettii	1	1	72
Arcangeliella crassa	1	—	19 b/
Boletus pulcherrimus	7	4	36 b/
Bondarzewia mesenterica	6	—	140
Cantharellus subalbidus	1	—	292
Choiromyces alveolatus	1	—	12
Chromosera cyanophylla	27	12	304
Clavariadelphus ligula	1	1	68
Clavariadelphus occidentalis	19	15	121
Clavariadelphus sachalinensis	18	5	114
Clavariadelphus truncatus	33	19	188
Collybia bakerensis	2	—	134
Collybia racemosa	3	—	38
Cortinarius olympianus	3	—	26
Craterellus tubaeformis	5	5	48
Galerina vittaeformis	4	—	27
Gastroboletus subalpinus	16	7	282
Gomphus clavatus	2	—	85

TABLE 4.7.4.3-2

Fungi Sites Potentially Affected by the Project

Species	Total Affected Sites a/	Affected Sites in Reserves	Remaining Sites on BLM/NFS Lands in NSO Range
Gomphus kauffmanii	9	6	122
Gymnomyces abietis	2	—	86
Gyromitra esculenta	5	2	139
Gyromitra infula	8	7	100
Gyromitra melaleucoides	1	1	16
Gyromitra montana	23	11	256
Helvella maculata	10	7	88
Hydnum umbilicatum	48	32	74
Hygrophorus caeruleus	31	16	627
Leucogaster citrinus	1	1	86
Mycena overholtsii	5	—	146
Neournula pouchetii	6	1	46 b/
Nivatogastrium nubigenum	2	—	67
Otidea onotica	2	—	103
Phaeocollybia attenuata	2	1	179
Phaeocollybia fallax	10	8	65
Phaeocollybia kauffmanii	7	—	173
Phaeocollybia olivacea	14	6	933
Phaeocollybia piceae	1	—	10
Phaeocollybia scatesiae	3	1	174
Phaeocollybia sipei	1	—	112
Phaeocollybia spadicea	1	1	110
Pithya vulgaris	1	—	183
Plectania melastoma	1	—	68
Plectania milleri	1	—	39 b/
Polyozellus multiplex	1	—	131
Ramaria araiospora	1	—	105
Ramaria celerivirescens	5	4	179
Ramaria rubrievanescens	3	1	152
Ramaria rubripermanens	7	3	212
Ramaria stuntzii	1	1	82
Rhizopogon truncatus	3	—	140
Sarcodon imbricatus	1	1	139
Sarcosphaera coronaria	1	—	23
Sedecula pulvinata	1	—	17
Sparassis crispa	3	1	101
Spathularia flavida	10	1	189
Tremiscus helvelloides	1	—	126

a/ Affected sites are those on BLM or NFS land that would be directly or indirectly affected by project activities based on the analyses presented in appendix K. Direct impacts are those that would take place within the project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect impacts are those that would take place outside of the project area, such as from edge impacts or increased open canopy. Using the spatial analysis process described in appendix K, these sites may be clipped by the project area or fall outside the project area, but within the analysis area.

b/ Although one or more sites would be affected by the project, individuals within some of the sites would not be affected, and site persistence would be maintained for those sites following project implementation. The remaining site count includes sites that may be affected, but for which site persistence is expected to be maintained. Only sites for which site persistence would be affected were removed from the remaining site count.

The species listed below appear to be more common than previously documented or are relatively common across the NSO range based on new information available from surveys for the project and/or other sources since these species were listed in the 2001 ROD. For these species, the Project would affect individuals or habitat at one or more sites and could affect site persistence, but the remaining sites in the NSO range would continue to provide a reasonable assurance of species persistence:

Albatrellus ellisii
Albatrellus flettii
Nivatogastrium nubigenum
Otidea onotica

Bondarzewia mesenterica
Cantharellus subalbidus
Chromosera cyanophylla
Clavariadelphus ligula
Clavariadelphus occidentalis
Clavariadelphus sachalinensis
Clavariadelphus truncatus
Collybia bakerensis
Cortinarius magnivelatus
Cortinarius olympianus
Cortinarius verrucisporus
Craterellus tubaeformis
Galerina atkinsoniana
Galerina vittaeformis
Gastroboletus subalpinus
Gomphus clavatus
Gomphus kauffmanii
Gyromitra esculenta
Gyromitra infula
Gyromitra melaleucoides
Gyromitra montana
Helvella maculata
Hydnum umbilicatum
Leucogaster citrinus
Mycena overholtsii
Mycena monticola
Neournula pouchetii
Phaeocollybia attenuata
Phaeocollybia fallax
Phaeocollybia kauffmanii
Phaeocollybia olivacea
Phaeocollybia piceae
Phaeocollybia sipei
Phaeocollybia spadicea
Pithya vulgaris
Plectania melastoma
Plectania milleri
Polyozellus multiplex
Ramaria araiospora
Ramaria celerivirescens
Ramaria coulterae
Ramaria rubribrunnescens
Ramaria rubrievanescens
Ramaria rubripermanens
Ramaria stuntzii
Rhizopogon truncatus
Sarcodon fuscoindicus
Sarcodon imbricatus
Sarcosphaera coronaria
Sparassis crispa
Spathularia flavida
Tremiscus helvelloides
Tricholoma venenatum

The species listed below are not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the project and/or other sources since these species were listed in the 2001 ROD. For these species, the Project would affect individuals or habitat at one or more sites and could affect site persistence, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence:

Arcangeliella crassa
Boletus pulcherrimus
Collybia racemosa
Hygrophorus caeruleus
Phaeocollybia scatesiae

The species listed below are not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the project and/or other sources since these species were listed in the 2001 ROD. For these species, the Project would affect site persistence at one or more sites, and the remaining sites in the NSO range may not provide a reasonable assurance of species persistence. These species are known from a low number of sites within a part of the NSO range, have specialized or somewhat limited habitat requirements, and have a distribution pattern in which every site may be important for dispersal opportunities to ensure the persistence of the species in the NSO range:

Choiromyces alveolatus	*Otidea smithii*
Gymnomyces abietis	*Sedecula pulvinata*

For these four species, route modifications are necessary to avoid direct impacts on individuals within the construction corridor or adjacent activity areas and protect the sites. The following route modifications are recommended:

- For *Choiromyces alveolatus*, the segment of the construction corridor, along with associated TEWAs and UCSAs, should be moved at least 125 feet (40 meters) to the north of the currently proposed alignment, such that most of the work area is shifted outside the site boundary (see figure 4.7-1 for reference). Based on field assessments, Forest Service botanists have determined that a no-disturbance buffer of at least 60 meters should be provided between the *C. alveolatus* observation point (centroid of site) and the outside edge of disturbance caused by clearing and construction activities. An existing dirt road about 200 feet (60 meters) north of the site may be an option for the realignment because it is at a sufficient distance to avoid the site.
- For *Gymnomyces abietis*, the segment of the construction corridor, along with associated TEWAs and UCSAs, should be moved at least 180 feet (55 meters) to the south of the currently proposed alignment, such that most of the work area is shifted outside the site boundary (see figure 4.7-2 for reference). Based on field assessments, Forest Service botanists have determined that a no-disturbance buffer of at least 60 meters should be provided between the *G. abietis* observation point (centroid of site) and the outside edge of disturbance caused by clearing and construction activities.
- For *Otidea smithii*, the segment of the construction corridor along with associated TEWAs and UCSAs between MPs 61.2 and 61.4, should be moved at least 110 feet (33 meters) to the south of the currently proposed alignment, such that all of the work area is shifted outside the site boundaries (see Figure 4.7-3 for reference). However, based on field assessments, BLM botanists have determined that a no-disturbance buffer of at least 40 meters between the *O. smithii* observation point (centroid of site) and the outside edge of the disturbance caused by clearing and construction activities would be sufficient to protect the site. This adjustment is necessary to comply with S&M standards and guidelines to maintain persistence of the species.
- For *Sedecula pulvinata*, the segment of the construction corridor, along with associated TEWAs and UCSAs, should be moved at least 130 feet (40 meters) to the south of the currently proposed alignment, such that most of the work area is shifted outside the site boundary (see figure 4.7-4 for reference). Based on field assessments, Forest Service botanists have determined that a no-disturbance buffer of at least 60 meters should be provided between the nearest observation point and the outside edge of disturbance caused by clearing and construction activities.

In addition to the route modifications listed above, measures incorporated into the Project as design features would be implemented to minimize soil and vegetation disturbance in the project area and restore areas following construction, which could minimize adverse impacts on all S&M fungi in and near the project area. The BLM and Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

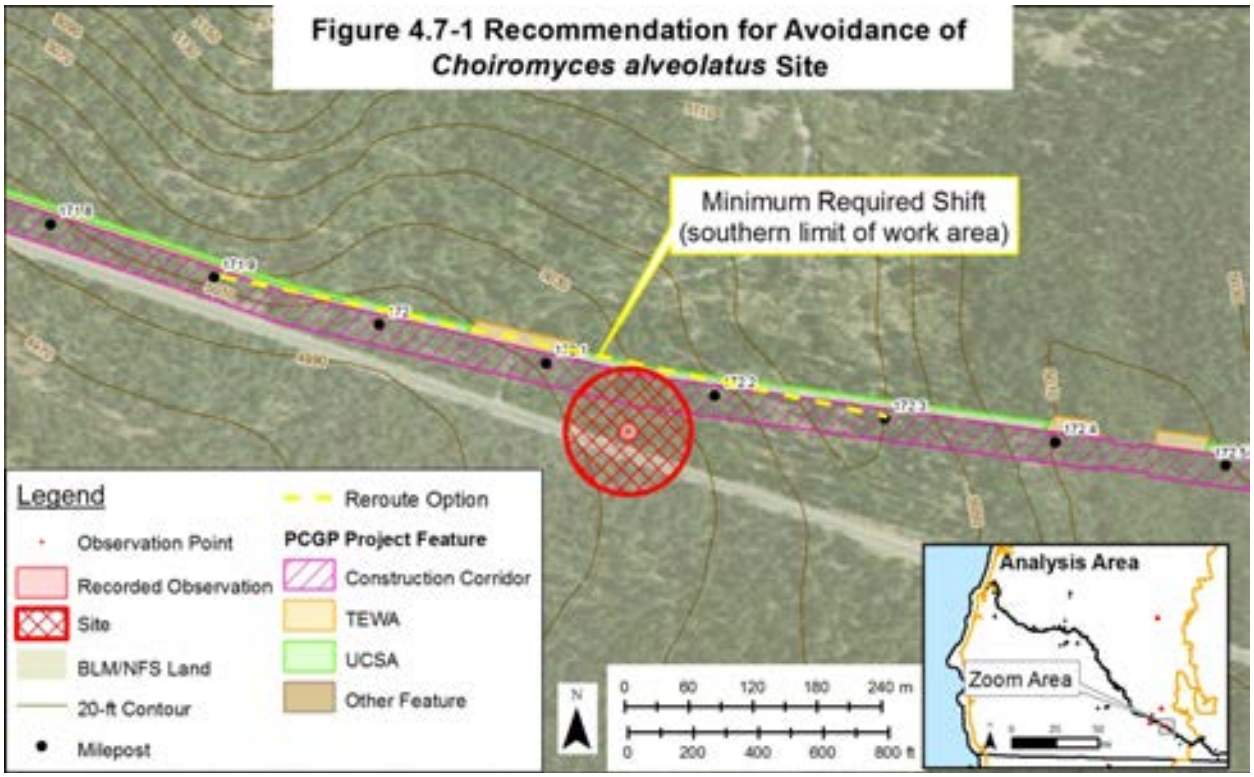


Figure 4.7-1 Recommendation for Avoidance of
Choiromyces alveolatus Site
Minimum Required Shift
(southern limit of work area)
Legend
Observation Point
Recorded Observation
Site
BLM/NFS Land
20-ft Contour
Milepost
Reroute Option
PCGP Project Feature
Construction Corridor
TEWA
UCSA
Other Feature
N
0 60 120 180 240 m
0 200 400 600 800 ft
Analysis Area
Zoom Area

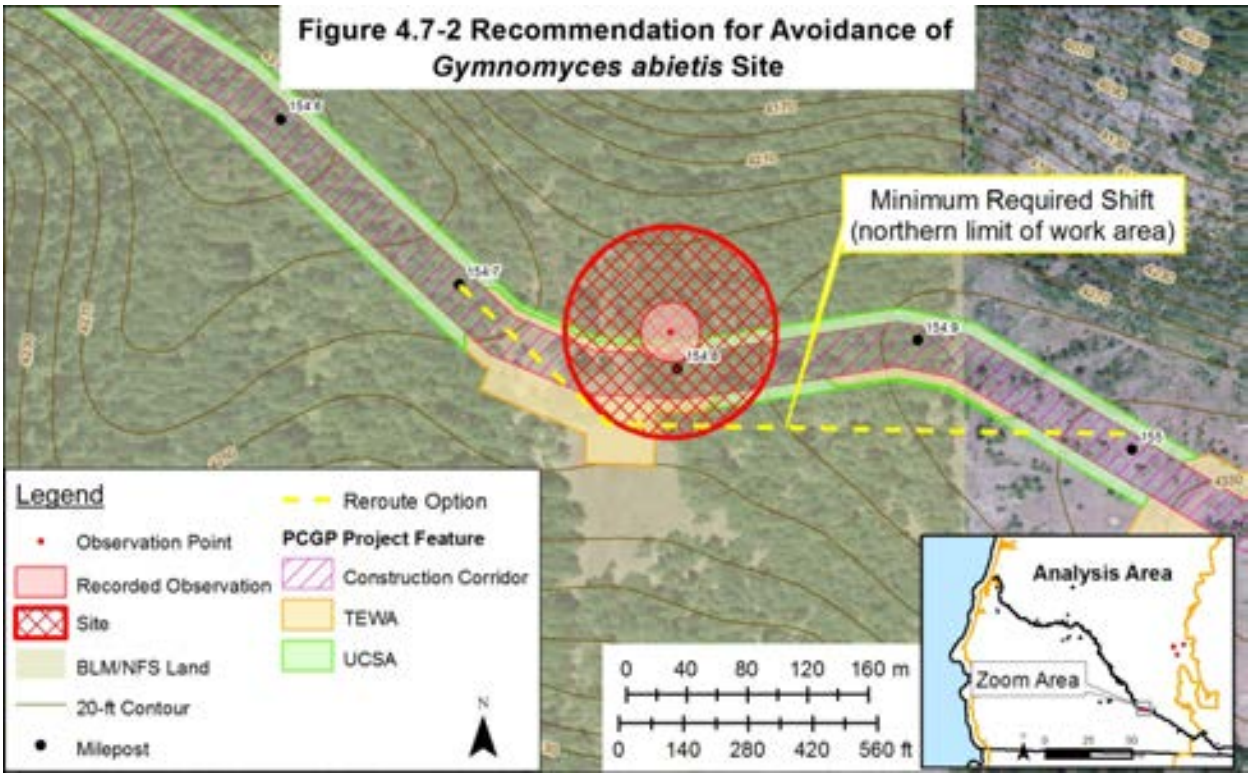


Figure 4.7-2 Recommendation for Avoidance of
Gymnomyces abietis Site
Minimum Required Shift
(northern limit of work area)
Legend
Observation Point
Recorded Observation
Site
BLM/NFS Land
20-ft Contour
Milepost
Reroute Option
PCGP Project Feature
Construction Corridor
TEWA
UCSA
N
0 40 80 120 160 m
0 140 280 420 560 ft
Analysis Area
Zoom Area

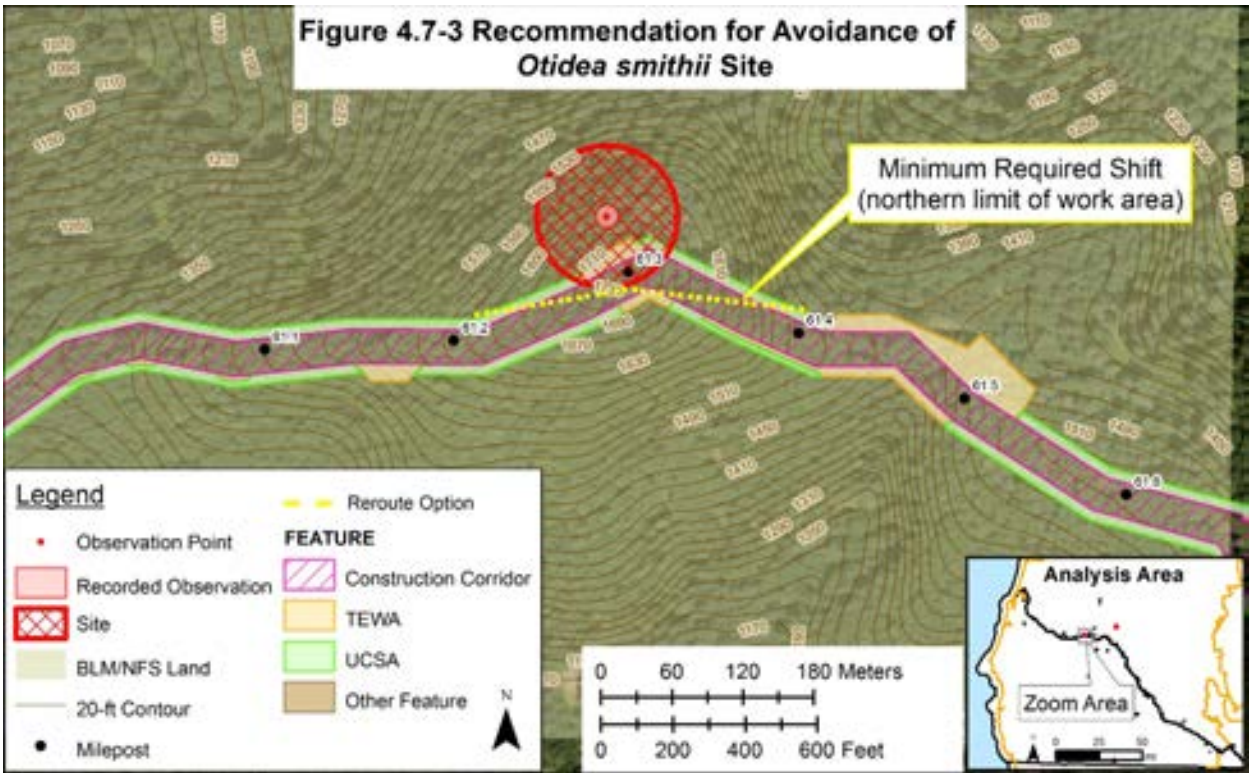


Figure 4.7-3 Recommendation for Avoidance of *Otidea smithii* Site
Minimum Required Shift (northern limit of work area)
Legend
Observation Point
Recorded Observation
Site
BLM/NFS Land
20-ft Contour
Milepost
Reroute Option
FEATURE
Construction Corridor
TEWA
UCSA
Other Feature
N
0 60 120 180 Meters
0 200 400 600 Feet
Analysis Area
Zoom Area

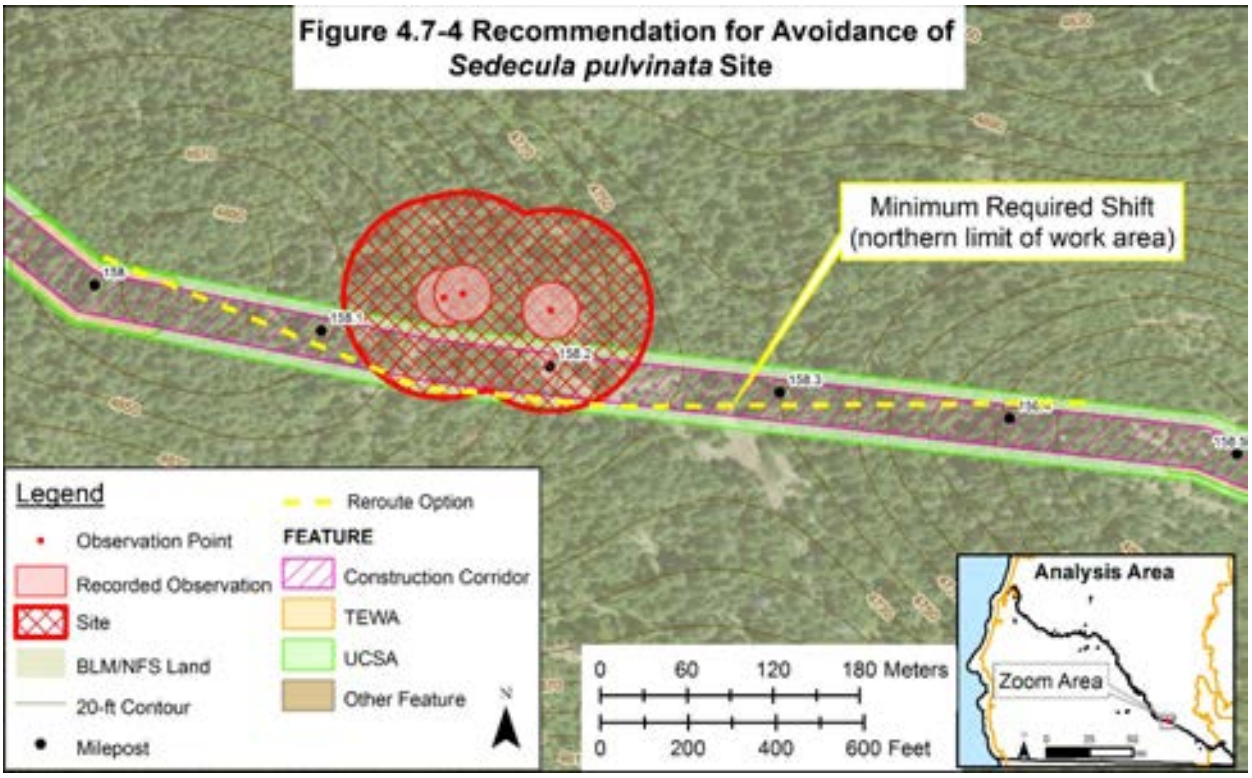


Figure 4.7-4 Recommendation for Avoidance of *Sedecula pulvinata* Site
Minimum Required Shift (northern limit of work area)
Legend
Observation Point
Recorded Observation
Site
BLM/NFS Land
20-ft Contour
Milepost
Reroute Option
FEATURE
Construction Corridor
TEWA
UCSA
Other Feature
N
0 60 120 180 Meters
0 200 400 600 Feet
Analysis Area
Zoom Area

The Forest Service requested that the applicant realign the pipeline construction corridor to provide the no-disturbance buffers specified for *C. alveolatus*, *G. abietus*, and *S. pulvinata*. These buffers were determined to be necessary to protect these sites in order to comply with the 2001 S&M ROD to maintain the persistence of the affected species within the range of the NSO. Pacific Connector has made minor adjustments to the pipeline route to avoid these species. A revised analysis of impacts on S&M species will be completed once all pre-disturbance surveys for S&M species are complete and prior to the BLM and Forest Service making decisions on the Project.

For lands directly affected by the Project, the BLM and Forest Service would waive implementation of Management Recommendations for S&M species through amendment of the land management plans for the BLM Districts and National Forests that encompass the project area, except for the species for which there is not reasonable assurance of species persistence in the NSO range. In those cases, the agencies would require avoidance of sites where the species is found or would decline to adopt the LMP amendment. Therefore, **we recommend that:**

- **Prior to construction, Pacific Connector should file with the Secretary a pipeline route realignment to create a buffer distance to avoid impacts on BLM and Forest Service sensitive fungi at MP 61.3, and documentation of BLM and Forest Service approval of this route modification.**

Table 4.7.4.3-3 lists the fungi species and the number of affected sites in each District or National Forest. For *C. alveolatus*, *G. abietis*, and *S. pulvinata*, direct impacts to these species' sites must be avoided as defined in the recommendations listed above.

TABLE 4.7.4.3-3

Affected Fungi Sites by BLM District and National Forest

Species	Number of Sites Affected a/						
	Lakeview	Coos Bay	Roseburg	Medford	Umpqua	Rogue River	Winema
Albatrellus ellisii	—	—	1	—	2	3	5 (1)
Albatrellus flettii	—	—	—	—	—	1	—
Arcangeliella crassa	—	—	—	—	—	—	1
Boletus pulcherrimus	—	—	—	—	—	4	1 (2)
Bondarzewia mesenterica	—	—	1	0 (1)	4	—	—
Cantharellus subalbidus	—	—	—	—	—	—	1
Choiromyces alveolatus	—	—	—	—	—	—	1 b/
Chromosera cyanophylla	—	—	1	1	10	9	5 (2)
Clavariadelphus ligula	—	—	1	—	1	—	—
Clavariadelphus occidentalis	—	1	12 (3)	0 (2)	5	—	—
Clavariadelphus sachalinensis	—	—	1	7 (1)	6	3	—
Clavariadelphus truncatus	—	—	13	4 (1)	12	4	1
Collybia bakerensis	—	—	—	—	—	—	2
Collybia racemosa	—	—	—	—	3	—	—
Cortinarius magnivelatus	—	—	—	—	—	—	2 (1)
Cortinarius olympianus	—	—	—	—	1	4	—
Cortinarius verrucisporus	—	—	—	—	—	—	4
Craterellus tubaeformis	—	2	5	—	10	—	—
Galerina atkinsoniana	—	—	—	—	2	—	—
Galerina vittaeformis	—	—	6	—	1	2	—
Gastroboletus subalpinus	—	—	—	—	—	—	2
Gomphus clavatus	—	—	—	—	5	—	—
Gomphus kauffmanii	—	—	—	—	—	6 (1)	1
Gymnomyces abietis	—	—	—	—	—	1 b/	—
Gyromitra esculenta	—	—	1	—	13	9	—
Gyromitra infula	—	—	4	—	3	3	—

TABLE 4.7.4.3-3

Affected Fungi Sites by BLM District and National Forest

Species	Number of Sites Affected a/						
	Lakeview	Coos Bay	Roseburg	Medford	Umpqua	Rogue River	Winema
Gyromitra melaleucoides	—	—	6	—	23	19	1 (1)
Gyromitra montana	1 (1)	—	—	—	2	16	9 (2)
Helvella maculata	—	—	—	—	1	—	—
Hydnum umbilicatum	—	1	1	—	3	—	—
Hygrophorus caeruleus	—	—	—	—	—	1	3 (2)
Leucogaster citrinus	—	—	—	—	1	—	1
Mycena monticola	—	—	—	—	—	—	2
Mycena overholtsii	—	—	—	—	—	1	2
Neournula pouchetii	—	—	4	—	7	—	—
Nivatogastrium nubigenum	—	—	—	—	—	—	6 (1)
Otidea onotica	—	3	9	—	2	—	—
Otidea smithii	—	—	1 b/	—	—	—	—
Phaeocollybia attenuata	—	2	1	—	—	—	—
Phaeocollybia fallax	—	1	—	—	—	—	—
Phaeocollybia kauffmanii	—	1	—	—	—	—	—
Phaeocollybia olivacea	—	1	—	—	—	—	—
Phaeocollybia piceae	—	0 (1)	—	—	—	—	—
Phaeocollybia scatesiae	—	1	—	—	—	—	—
Phaeocollybia sipei	—	0 (1)	—	—	—	—	—
Phaeocollybia spadicea	—	0 (1)	—	—	—	—	—
Pithya vulgaris	—	—	—	—	1	4	1
Plectania melastoma	—	—	—	—	3	—	—
Plectania milleri	1	—	—	—	3	3	—
Polyozellus multiplex	—	—	—	—	—	1	—
Ramaria araiospora	—	2	—	—	1	—	—
Ramaria celerivirescens	—	1	—	—	—	—	—
Ramaria coulterae	—	—	—	—	—	—	1
Ramaria rubribrunnescens	—	—	—	—	1	—	—
Ramaria rubrievanescens	—	—	—	—	3	—	—
Ramaria rubripermanens	—	—	—	0 (1)	6	—	2 (1)
Ramaria stuntzii	—	1	—	—	—	—	—

a/ Site counts for each species are not additive because some sites occur on both BLM and NFS lands. For sites that would only be indirectly affected (i.e., those not in the project area, but in the analysis area), the count is shown in parentheses (e.g., (1)).
b/ Site(s) must be avoided through a re-route of the project alignment, or Management Recommendations would not be waived.

Lichens

Lichens are distinct symbiotic organisms that consist of a fungus and an algae or cyanobacterium, which make them members of two or three biological kingdoms. They play a major ecological role, particularly in old-growth forests, by cycling nutrients and producing biomass. Lichens tend to be dispersal limited and grow slower than vascular plants. More than 150 species of macrolichens were evaluated in 1993 as being closely associated with LSOG forests (FEMAT 1993), and 81 of those were included on the 1994 S&M list (Forest Service and BLM 1994b). The 2001 list included with the S&M ROD includes 49 species of lichens under the S&M Standards and Guidelines. Of these species, 13 are considered in this evaluation of the project because they have been documented in or near the project area. Appendix K presents additional details on each species, and the key information used to evaluate project-related impacts is summarized in this section.

The lichens considered in this analysis consist primarily of epiphytic lichens, which grow directly on trees or shrubs. The epiphytic lichens, *Leptogium teretiusculum* and *Usnea longissima*, may be associated with riparian habitat. Four *Chaenotheca* species are pin lichens that have minute stalked fruiting bodies resembling a pin; these species are difficult to survey

for. Three of the *Chaenotheca* species are found on the bark of trees, and the fourth species is found in the soil or on understory substrate around trees. One of the epiphytic lichens, *Fuscopannaria saubinetii*, has been recently discovered to be the more common *F. pacifica* (Stone 2012) and may no longer belong on the S&M list, pending an annual species review (because the species is on the 2001 list, it is evaluated like other S&M species on the list in this assessment). A cyanolichen, *Dendriscocaulon intricatulum*, grows on lower branches of trees in association with other cyanolichens, such as *Lobaria* spp. and *Nephroma* spp. A pelt lichen, *Peltigera pacifica*, is a nitrogen-fixing lichen that grows on soil or other understory substrate around trees.

Although surveys have been conducted across the project area and in other parts of the NSO range, the difficulty in detecting some lichens because of their size has limited the ability to fully describe the range and distribution of some species within the NSO range. The lichen species considered in this analysis are listed in table 4.7.4.3-4 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table. Some of these species are likely more abundant than currently documented, and more survey effort would be expected to locate additional sites of the species.

TABLE 4.7.4.3-4

Regional Site Count of Lichen Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on BLM/NFS Lands in NSO Range b/	Sites in Reserves in NSO Range c/
Bryoria tortuosa	610	579	23 (4%)
Calicium glaucellum	89	88	60 (68%)
Calicium viride	147	145	58 (40%)
Chaenotheca chrysocephala	125	123	37 (30%)
Chaenotheca ferruginea	365	362	60 (17%)
Chaenotheca furfuracea	363	359	120 (33%)
Chaenotheca subroscida	177	177	36 (20%)
Dendriscocaulon intricatulum	639	633	58 (9%)
Fuscopannaria saubinetii	124	107	61 (57%)
Leptogium teretiusculum	178	178	22 (12%)
Peltigera pacifica	466	453	143 (32%)
Ramalina thrausta	410	387	195 (50%)
Usnea longissima	587	519	272 (52%)

a/ Total site count reflects the number of sites generated by the 11/8/13 FME extract or similar method derived from NRIS and GeoBob observation data on all lands across the NSO range.
b/ Site count reflects only those sites on BLM or NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on BLM or NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on BLM and NFS lands.

The distribution of each species and its range within the NSO range vary greatly; some species are widely distributed and relatively abundant, whereas others have a limited distribution. Species abundance ranges from 633 sites on BLM and NFS lands for *Dendriscocaulon intricatulum* to 88 sites for *Calicium glaucellum*. Based on the information presented in appendix K, the species were grouped into two categories based on their distributions across the NSO range and using the distribution categories presented for fungi in the 2000 Final SEIS (Forest Service and BLM 2000).

The species listed below are distributed as groups or clusters of sites with potential for gene flow among subpopulations within the groups and little potential for gene flow between isolated groups. These species may be well distributed within a part of their ranges in the NSO range.

Bryoria tortuosa
Dendriscocaulon intricatulum

The species listed below have multiple sites or clusters of sites that are nested within a web of potential interconnections. These species are well distributed within a part of their ranges in the NSO range.

Calicium glaucellum
Calicium viride
Chaenotheca chrysocephala
Chaenotheca ferruginea
Chaenotheca furfuracea
Chaenotheca subroscida
Fuscopannaria saubinetii
Leptogium teretiusculum
Peltigera pacifica
Ramalina thrausta
Usnea longissima

Habitat for these species varies and has generally been classified as coniferous, mixed hardwood-coniferous, and/or hardwood forests, including the LSOG component of these forests. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for each species varies based on its distribution across the NSO range and habitat preferences. Additional details on habitat are presented in appendix K.

The Project could affect site persistence of 13 S&M lichens at one or more sites in or near the project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could result in the removal of populations or individuals of lichens. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, and disturbance to soil, understory substrate (e.g., rocks, downed logs), and roots of trees could negatively affect the lichens in adjacent areas by removing their habitat, disturbing soil or substrate around trees or roots of trees, and affecting associations with the trees or other substrate, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for some of the species. Road improvements and establishment could remove habitat and extant populations or individuals of the lichens. The specific impacts on sites in and near the project area vary by species and depend on where the sites are located in proximity to the corridor and other activities. Table 4.7.4.3-5 presents a summary of the number of sites of each species that would be affected by the project; additional details for each species are included in appendix K.

TABLE 4.7.4.3-5

Lichen Sites Potentially Affected by the Project

Species	Total Affected Sites a/	Affected Sites in Reserves	Remaining Sites on BLM/NFS Lands in NSO Range
Bryoria tortuosa	11	0	568
Calicium glaucellum	1	0	87
Calicium viride	1	0	144
Chaenotheca chrysocephala	12	6	111
Chaenotheca ferruginea	8	0	354
Chaenotheca furfuracea	4	1	355
Chaenotheca subroscida	8	2	169
Dendriscocaulon intricatulum	5	0	628
Fuscopannaria saubinetii	1	1	107 b/
Leptogium teretiusculum	1	0	177
Peltigera pacifica	1	0	452
Ramalina thrausta	1	0	386
Usnea longissima	3	0	516

a/ Affected sites are those that would be directly or indirectly affected by project activities based on the analyses presented in appendix K. Direct impacts are those that would take place within the project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect impacts are those that would take place outside of the project area, such as from edge impacts or increased open canopy. Using the spatial analysis process described in appendix K, these sites may be clipped by the project area or fall outside the project area, but within the analysis area.

b/ Part of one *Fuscopannaria saubinetii* site would be subject to minimal disturbance from rock removal activities, but no other disturbance from project activities would take place in or near the site, and site persistence would be maintained following project implementation.

The species listed below appear to be more common than previously documented or are relatively common across the NSO range based on new information available from surveys for the project and/or other sources since these species were listed in the 2001 ROD. For these species, the Project would affect site persistence at one or more sites, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence:

Bryoria tortuosa
Calicium glaucellum
Calicium viride
Chaenotheca chrysocephala
Chaenotheca ferruginea
Chaenotheca furfuracea
Chaenotheca subroscida
Dendriscocaulon intricatulum
Leptogium teretiusculum
Peltigera pacifica
Ramalina thrausta
Usnea longissima

The species listed below has been documented near the project area, but the Project is not expected to affect site persistence at any sites based on the proximity and nature of proposed activities in the site:

Fuscopannaria saubinetii

Measures incorporated into the project as design features would be implemented to minimize soil and vegetation disturbance in the project area and restore areas following construction, which could minimize adverse impacts on all S&M lichens in and near the project area. The BLM and Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the BLM and Forest Service would waive implementation of Management Recommendations for S&M species through amendment of the land management plans for the BLM Districts and National Forests that encompass the project area. Table 4.7.4.3-6 lists the lichen species and the number of affected sites in each District or National Forest.

TABLE 4.7.4.3-6

Affected Lichen Sites by BLM District and National Forest

Species	Number of Sites Affected a/					
	Coos Bay	Roseburg	Medford	Umpqua	Rogue River	Winema
Bryoria tortuosa	—	—	10 (1)	—	—	—
Calicium glaucellum	—	—	1	—	—	—
Calicium viride	—	—	1	—	—	—
Chaenotheca chrysocephala	3	8	1	—	—	—
Chaenotheca ferruginea	—	8	—	—	—	—
Chaenotheca furfuracea	1	3	—	—	—	—
Chaenotheca subroscida	—	5	—	—	2	1
Dendriscocaulon intricatulum	—	—	4 (1)	—	—	—
Fuscopannaria saubinetii	1	—	—	—	—	—
Leptogium teretiusculum	—	—	1	—	—	—
Peltigera pacifica	—	1	—	—	—	—
Ramalina thrausta	—	1	—	—	—	—
Usnea longissima	3	—	—	—	—	—

a/ For sites that would only be indirectly affected (i.e., those not in the project area, but in the analysis area), the count is shown in parentheses (e.g., (1)). Dash indicates no sites.

Bryophytes

Bryophytes include mosses, liverworts, and hornworts and are small, green, non-vascular, spore-bearing plants. These non-vascular plants contribute to the species diversity, primary productivity, and biomass of LSOG forests. More than 100 species of bryophytes were evaluated in 1993 as being closely associated with LSOG forests (FEMAT 1993), and 23 of those were included on the 1994 S&M list (Forest Service and BLM 1994b). The 2001 list included with the S&M ROD includes 17 species of bryophytes under the S&M Standards and Guidelines. Of these species, one is considered in this evaluation of the Project because it has been documented in or near the project area. Appendix K presents additional details on the species, and the key information used to evaluate project-related impacts is summarized in this section.

One bryophyte, *Buxbaumia viridis*, has been documented in and near the project area. This species is found on decaying wood, organic soil, or acidic rocks, primarily in old-growth riparian forests on floodplains and stream terraces.

Although surveys have been conducted across the project area and in other parts of the NSO range, the difficulty in detecting some bryophytes because of their size and growth form has limited the ability to fully describe the range and distribution of some species within the NSO range. *Buxbaumia viridis* was the only bryophyte species considered in this analysis. The currently known number of sites in the NSO range is 720,[115] 713[116] of which are on BLM/NFS lands. A total of 146 (20 percent)[117] of the total sites within the NSO range are in reserves.

[115] Total site count reflects the number of sites generated by the 11/8/13 FME extract on all lands across the NSO range.
[116] Site count reflects only those sites on BLM or NFS lands using land ownership data for the NSO range (dated October 2011).
[117] Site count reflects only those sites on BLM or NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on BLM and NFS lands

Based on current site locations, *B. viridis* has a wide distribution across the NSO range with most sites found in the Cascade Range and Klamath Mountains in Oregon. Scattered sites are found in the Olympic Peninsula of Washington and in California. This species has multiple sites or clusters of sites that are nested within a web of potential interconnections and appears to be well distributed in the Klamath Mountains in Oregon and Cascade Range in Oregon and Washington.

General habitat for *B. viridis* consists of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, across the NSO range. This species may prefer a subcomponent of the forests in Riparian Reserves. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). Additional details on habitat are presented in appendix K.

The project could affect site persistence of one S&M bryophyte at one or more sites in or near the project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation, soil, and rocks within sites and could result in the removal of populations or individuals of bryophytes. Construction of the project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, and disturbance to soil, rocks, and decaying logs could negatively affect *B. viridis* in adjacent areas by removing its habitat, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for the species. The specific impacts on sites in and near the project area depends on where the sites are located in proximity to the corridor and other activities. A total of 10[118] *Buxbaumia viridis* sites would be affected by the Project, none of which are in reserves. The number of remaining sites on BLM and NFS lands in the NSO range is 703. Additional details are included in appendix K.

The bryophyte species *Buxbuamia viridis* is much more common than previously determined when placed into management category D in the 2001 ROD. Although Category D does not require pre-disturbance surveys, many sites were discovered incidentally or through other efforts since the 2001 ROD. For the species, the project would affect site persistence at more than one site, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the project as design features would be implemented to minimize soil and vegetation disturbance in the project area and restore areas following construction, which

[118] Affected sites are those that would be directly or indirectly affected by project activities based on the analyses presented in appendix K. Direct impacts are those that would take place within the project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect impacts are those that would take place outside of the project area, such as from edge impacts or increased open canopy. Using the spatial analysis process described in appendix K, these sites may be clipped by the project area or fall outside the project area, but within the analysis area.

could minimize adverse impacts on S&M bryophytes in and near the project area. The BLM and Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the BLM and Forest Service would waive implementation of Management Recommendations for S&M species through amendment of the land management plans for the BLM Districts and National Forests that encompass the project area. All 10 *Buxbaumia viridis* sites that would be affected by the Project are in the Medford BLM District; 4 of these sites would only be indirectly affected (i.e., they are not in the project area, but are in the analysis area).

Vascular Plants

Vascular plants are the most dominant organism in LSOG forests and serve an essential role by providing a food source and cover or shelter for animals and influencing microclimate conditions for other species, such as fungi and lichens. Vascular plants include seed-bearing plants, such as flowering plants and conifer trees, and spore-bearing forms, such as ferns, horsetails, and clubmosses. More than 120 species of vascular plants were evaluated in 1993 as being closely associated with LSOG forests (FEMAT 1993), and 16 of those were included on the 1994 S&M list (Forest Service and BLM 1994b). The 2001 list included with the S&M ROD includes 12 species of plants under the S&M Standards and Guidelines. Of these species, three are considered in this evaluation of the project because they have been documented in or near the project area. Appendix K presents additional details on each species, and the key information used to evaluate project-related impacts is summarized in this section.

The vascular plants considered in this analysis include clustered lady's-slipper (*Cypripedium fasciculatum*), mountain lady's-slipper (*C. montanum*), and wayside aster (*Eucephalus vialis*). *C. fasciculatum* is a long-lived perennial orchid that appears to be strongly associated with Douglas-fir (*Pseudotsuga menziesii*) (Vance 2005). *C. montanum* is also a long-lived perennial orchid that is often found in association with Douglas-fir and is more tolerant of drier conditions than most other members of the *Cypripedium* genus (Seevers and Lang 1998). *E. vialis* is a perennial forb that is found in all stages of coniferous forests.

Surveys for vascular plants have been conducted in much of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the plants in the NSO range. Surveys for the project targeted the three species, but only one population of *E. vialis* was observed in the surveyed area. Prior survey results in agency databases included observations of the other species in or near the project area. The plant species considered in this analysis are listed in table 4.7.4.3-7 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table. The ranges of these species in the NSO range are relatively well known, and more survey effort would be expected to locate additional sites of the species within their currently known ranges.

TABLE 4.7.4.3-7

Regional Site Count of Plant Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on BLM/NFS Lands in NSO Range b/	Sites in Reserves in NSO Range c/
Cypripedium fasciculatum	1,504	1,465	313 (21%)
Cypripedium montanum	756	731	168 (23%)
Eucephalus vialis	299	283	46 (16%)

a/ Total site count reflects the number of sites generated by the 11/8/13 FME extract on all lands across the NSO range.
b/ Site count reflects only those sites on BLM or NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on BLM or NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on BLM and NFS lands.

The distribution of each species and its range within the NSO range vary to some extent, but all of the plants are well distributed across most of their known ranges in the NSO range. The *Cypripedium* species are distributed as groups or clusters of sites with potential for gene flow among subpopulations within the groups and little potential for gene flow between isolated groups. *C. fasciculatum* sites are distributed in three general groups in the Klamath Mountains in Oregon and California, southern Klamath Mountains in California, and eastern Cascade Range in Washington. *C. montanum* sites are distributed in two general groups in the Klamath Mountains in Oregon and California and eastern Cascade Range in Washington, with several scattered sites in other parts of the species' range. Both *Cypripedium* species appear to be well distributed in the Klamath Mountains in California and Oregon and eastern Cascade Range in Washington.

E. vialis has multiple sites or clusters of sites that are nested within a web of potential interconnections. *E. vialis* sites are distributed across southwestern Oregon, from the Klamath Mountains near the California border north to the Willamette Valley. The species appears to be well distributed in its range in Oregon.

General habitat for these species consists of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, across each species' currently known range. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for each species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix K.

The Project could affect site persistence of three S&M vascular plants at one or more sites in or near the project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could result in the removal of populations or individuals of plants. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, and disturbance to soil could negatively affect the plants in adjacent areas by removing their habitat, potentially affecting site persistence even if the entire site is not disturbed. For plants that prefer openings or edge conditions, the corridor may improve habitat conditions. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make

habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for some of the species. Road improvements and establishment could remove habitat and extant populations or individuals of the plants. The specific impacts on sites in and near the project area vary by species and depend on where the sites are located in proximity to the corridor and other activities. Table 4.7.4.3-8 presents a summary of the number of sites of each species that would be affected by the project; additional details for each species are included in appendix K.

TABLE 4.7.4.3-8

Vascular Plant Sites Potentially Affected by Project

Species	Total Affected Sites a/	Affected Sites in Reserves	Remaining Sites on BLM/NFS Lands in NSO Range
Cypripedium fasciculatum	2	1	1,463
Cypripedium montanum	1	—	730
Eucephalus vialis	1	—	282

a/ Affected sites are those that would be directly or indirectly affected by project activities based on the analyses presented in appendix K. Direct impacts are those that would take place within the project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect impacts are those that would take place outside of the project area, such as from edge impacts or increased open canopy. Using the spatial analysis process described in appendix K, these sites may be clipped by the project area or fall outside the project area, but within the analysis area.

The three plant species discussed above appear to be more common than previously documented based on new information available from surveys for the project and/or other sources since these species were listed in the 2001 ROD. *Cypripedium fasciculatum* has many sites in southwest Oregon that have been documented since the 2001 ROD was published. Many of these sites consist of very few individuals, and small sites are often not relocated in subsequent visits such that the numbers of occurrences may not be an adequate representation of numbers of viable populations (Massatti et al. 2008; Richard Helliwell, pers. communication). Notwithstanding that information, a large number of sites of this species remain. Should the project be constructed, it is unlikely that the loss of two sites from project impacts would affect the status of *C. fasciculatum* in the NSO range. For these species, the project would affect site persistence at one or more sites, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the project as design features would be implemented to minimize soil and vegetation disturbance in the project area and restore areas following construction, which could minimize adverse impacts on S&M plants in and near the project area. The BLM and Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the BLM and Forest Service would waive implementation of Management Recommendations for S&M species through amendments to the land management plans for the BLM Districts and National Forests that encompass the project area. Table 4.7.4.3-9 lists the plant species and the number of affected sites in each District or National Forest.

TABLE 4.7.4.3-9

Affected Vascular Plant Sites by BLM District and National Forest

Species	Number of Sites Affected					
	Coos Bay	Roseburg	Medford	Umpqua	Rogue River	Winema
Cypripedium fasciculatum	—	—	1	1	—	—
Cypripedium montanum	—	—	1	—	—	—
Eucephalus vialis	—	1	—	—	—	—

Mollusks

Approximately 350 species of mollusks, including land snails, aquatic snails, slugs, and clams, are found in the Pacific Northwest (Forest Service and BLM 2000). Slugs and snails are found in colonies, which may consist of hundreds to many thousands of individuals. Most mollusks are found in moist forests and riparian areas near streams, springs, and seeps. More than 100 species of mollusks were evaluated in 1993 as being closely associated with LSOG forests (FEMAT 1993), and 43 of those were included on the 1994 S&M list (Forest Service and BLM 1994b). The 2001 list included with the S&M ROD includes 45 species of mollusks under the S&M Standards and Guidelines. Of these species, two are considered in this evaluation of the project because they have been documented in or near the project area. Appendix K presents additional details on each species, and the key information used to evaluate project-related impacts is summarized in this section.

The mollusk species considered in this analysis include evening fieldslug (*Deroceras hesperium*) and Chace sideband (*Monadenia chaceana*). *D. hesperium* is a land slug that requires high moisture environments and is found along the forest floor. A recent study on the molecular characteristics of *D. hesperium* revealed that the mollusk is likely a variant of the more common *D. laeve* (Roth et al. 2013), and *D. hesperium* may no longer belong on the S&M list, pending an annual species review (because the species is on the 2001 list, it is evaluated like other S&M species on the list in this assessment). *M. chaceana* is a land snail that is found in talus or under rocks in moist forests. Both mollusks may be associated with riparian areas or Riparian Reserves.

Surveys for mollusks have been conducted in parts of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the mollusks in the NSO range. Surveys for the project targeted the two species, and resulted in multiple observations of *M. chaceana* and one observation of *D. hesperium* in the surveyed area. The mollusk species considered in this analysis are listed in table 4.7.4.3-10 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table. The ranges of these species in the NSO range are relatively well known, and more survey effort would be expected to locate additional sites of the species within their currently known ranges.

The distribution of the species and their ranges within the NSO range vary. *D. hesperium* has a pattern of distribution with limited potential for connectivity between isolated sites or site clusters. Sites are found in four general areas in Oregon, including a cluster of sites in the southern Cascade Range, a small cluster of sites in the southern Coast Range, a scattered group of sites in the northern Cascade Range, and an isolated site in the northern Coast Range. *M. chaceana* has multiple sites or clusters of sites that are nested within a web of potential interconnections. Sites are primarily found in a large group of several clusters in the eastern Klamath Mountains and southern Cascade Range in Oregon and extreme northern California.

TABLE 4.7.4.3-10

Regional Site Count of Mollusk Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on BLM/NFS Lands in NSO Range b/	Sites in Reserves in NSO Range c/
Deroceras hesperium	34	26	9 (35%)
Monadenia chaceana	258	246	34 (14%)

a/ Total site count reflects the number of sites generated by the 11/8/13 FME extract on all lands across the NSO range.
b/ Site count reflects only those sites on BLM or NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on BLM or NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on BLM and NFS lands.

General habitat for these species consists of a subcomponent (e.g., moist riparian areas, shaded rocky areas) of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, across each species' currently known range. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for the species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix K.

The Project could affect site persistence of two S&M mollusks at one or more sites in or near the project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soils within sites and could result in injury or mortality to individuals of mollusks. Construction of the project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of forests and understory components could negatively affect the mollusks in adjacent areas by removing their habitat, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor could make habitat within sites no longer suitable for the species. Material storage within UCSAs could disturb understory habitat in sites, which could remove rocks, logs, or woody debris, potentially making the habitat unsuitable for the species or injuring individuals.

The specific impacts on sites in and near the project area vary by species and depend on where the sites are located in proximity to the corridor and other activities. Table 4.7.4.3-11 presents a summary of the number of sites of each species that would be affected by the Project; additional details for each species are included in appendix K.

TABLE 4.7.4.3-11

Mollusk Sites Potentially Affected by the Project

Species	Total Affected Sites a/	Affected Sites in Reserves	Remaining Sites on BLM/NFS Lands in NSO Range
Deroceras hesperium	1	—	25
Monadenia chaceana	5	—	241

a/ Affected sites are those that would be directly or indirectly affected by project activities based on the analyses presented in appendix K. Direct impacts are those that would take place within the project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect impacts are those that would take place outside of the project area, such as from edge impacts or increased open canopy. Using the spatial analysis process described in appendix K, these sites may be clipped by the project area or fall outside the project area, but within the analysis area.

D. hesperium is not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the project and/or other sources since this species was listed in the 2001 ROD. The Project would affect site persistence at one site, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence. Although this species has a somewhat limited distribution in the NSO range, the affected site is part of a large cluster of sites in the southern Cascade Range in Oregon, and within this area, the distribution and connectivity of the species would likely remain.

M. chaceana appears to be more common than previously documented based on new information available from surveys for the project and/or other sources since this species was listed in the 2001 ROD. The Project would affect site persistence at five sites, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the project as design features would be implemented to minimize soil and vegetation disturbance in the project area and restore areas following construction, which could minimize adverse impacts on S&M mollusks in and near the project area. The BLM and Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the project, the BLM and Forest Service would waive implementation of Management Recommendations for S&M species through amendments to the land management plans for the BLM Districts and National Forests that encompass the project area. Table 4.7.4.3-12 lists the mollusk species and the number of affected sites in each District or National Forest.

TABLE 4.7.4.3-12

Affected Mollusk Sites by BLM District and National Forest

	Number of Sites Affected a/					
Species	**Coos Bay**	**Roseburg**	**Medford**	**Umpqua**	**Rogue River**	**Winema**
Deroceras hesperium	—	—	—	—	—	1
Monadenia chaceana	—	—	2 (3)	—	—	—

a/ For sites that would only be indirectly affected (i.e., those not in the project area, but in the analysis area), the count is shown in parentheses (e.g., (1)).

Vertebrates

A diverse array of vertebrate species, including mammals, birds, amphibians, and reptiles, inhabit the forests of the Pacific Northwest and provide essential functions in the ecosystem, such as dispersing fungal spores and lichens and serving as a food source for predators. Fifteen species of mammals, excluding bats, and 36 species of birds were evaluated in 1993 as being closely associated with LSOG forests (FEMAT 1993), and 14 of the mammals and all of the birds were included on the 1994 S&M list (Forest Service and BLM 1994b). The 2001 list included with the S&M ROD includes 7 species of vertebrates, including 1 mammal and 1 bird, under the S&M program. Two vertebrate species (the mammal and bird) are considered in this evaluation of the Project because they have been documented in or near the project area. Appendix K presents additional details on each species, and the key information used to evaluate project-related impacts is summarized in this section.

The vertebrate species considered in this analysis include red tree vole (*Arborimus longicaudus*) and great gray owl (*Strix nebulosa*). *A. longicaudus* is a small arboreal rodent that lives in tree canopies of coniferous and mixed hardwood-coniferous forests and seldom goes to the forest floor (Forest Service and BLM 2001b). It is a primary prey item of the northern spotted owl, as well as other predators found in coniferous forests. *S. nebulosa* is a forest owl that uses existing stick nests constructed by other raptors and large corvids and nests between March 1 and July 31 (Williams 2012). It forages in natural forest openings, typically larger than 10 acres, and nests in coniferous and mixed hardwood-coniferous forests.

Surveys for the vole and owl have been conducted across much of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the species in the NSO range. Surveys for the Project targeted the two species, and resulted in multiple observations of both species in the surveyed areas. The vertebrate species considered in this analysis are listed in table 4.7.4.3-13 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table. The ranges of these species in the NSO range are relatively well known, and more survey effort would be expected to locate additional sites of the species within their currently known ranges.

TABLE 4.7.4.3-13

Regional Site Count of Vertebrate Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on BLM/NFS Lands in NSO Range b/	Sites in Reserves in NSO Range c/
Arborimus longicaudus	3,909	3,886	673 (17%)
Strix nebulosa	230	217	16 (7%)

a/ Total site count reflects the number of sites generated by the 11/8/13 FME extract on all lands across the NSO range.
b/ Site count reflects only those sites on BLM or NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on BLM or NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on BLM and NFS lands.

The distribution of the species and their ranges within the NSO range vary. Both species have multiple sites or clusters of sites that are nested within a web of potential interconnections. Most *A. longicaudus* sites are found in the Klamath Mountains in Oregon, where sites are abundant and close together in large clusters or groups, and sites are more scattered in the western Cascade Range in Oregon, although they are still relatively abundant. *A. longicaudus* appears to be well distributed within its range in Oregon. Most *S. nebulosa* sites are found in a large group in the southern Cascade Range and eastern Klamath Mountains, where the species appears to be well distributed.

General habitat for *A. longicaudus* consists of LSOG coniferous and mixed hardwood-coniferous forests across the species' currently known range in Oregon. General habitat for *S. nebulosa* consists of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, with a subcomponent of natural forest openings that are used for foraging. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for the species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix K.

The project could affect site persistence of two S&M vertebrates at more than one site or habitat area in or near the project area. Vegetation removal in the construction corridor and TEWAs and along roads could result in the removal of trees that support *A. longicaudus* nests or cause injury or mortality to individuals. Construction of the project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of forests and potential nest trees could negatively affect *A. longicaudus* in adjacent areas by removing its habitat and opening the tree canopy, potentially affecting site persistence at the habitat areas even if the entire habitat area is not disturbed. In particular, modification of shading and habitat conditions as a result of the corridor, TEWAs, and roads could make entire habitat areas no longer suitable for the species because of the preference for closed canopy habitats. Activities within the corridor and TEWAs would result in extensive noise disturbance during vegetation clearing, grading, and pipeline installation and could result in *S. nebulosa* nest abandonment and loss of young during the nesting season. No active *S. nebulosa* nest sites were documented in the project area; therefore, direct impacts on the owl (e.g., removal of active nests, injury to owls) are not anticipated. Vegetation removal across the project area would also result in a long-term loss of habitat that may be suitable for the species. Conversely, if constructed, the construction corridor would also create an early seral plant community suitable for foraging by great grey owls.

The specific impacts on sites in and near the project area vary by species and depend on where the sites are located in proximity to the corridor and other activities. Table 4.7.4.3-14 presents a summary of the number of sites (habitat areas for *A. longicaudus*) of each species that would be affected by the Project; additional details for each species are included in appendix K.

Both species appear to be more common than previously documented based on new information available from surveys for the project and/or other sources since these species were listed in the 2001 ROD. The Project would affect site persistence at multiple sites or habitat areas of each species, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

TABLE 4.7.4.3-14

Vertebrate Sites Potentially Affected by the Project

Species	Total Affected Sites a/	Affected Sites in Reserves	Remaining Sites on BLM/NFS Lands in NSO Range
Arborimus longicaudus	56 (103) b/	22 (43)	3,783 c/
Strix nebulosa	11 d/	5	206

a/ Affected sites are those that would be directly or indirectly affected by project activities based on the analyses presented in appendix K. Direct impacts are those that would take place within the project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect impacts are those that would take place outside of the project area, such as from edge impacts or increased open canopy. Using the spatial analysis process described in appendix K, these sites may be clipped by the project area or fall outside the project area, but within the analysis area.

b/ *A. longicaudus* sites are habitat areas (103 sites were converted to 56 habitat areas in the analysis area), as mapped in accordance with the management recommendations for the species (Forest Service and BLM 2001b).

c/ The total of remaining sites is based on site data, not habitat areas. Habitat areas were not produced for the entire regional area, just the analysis area.

d/ Two *S. nebulosa* sites are on private land, but are included in the total affected site count.

Measures incorporated into the Project as design features would be implemented to minimize vegetation disturbance in the project area and restore areas following construction, which could minimize adverse impacts on S&M vertebrates in and near the project area. The BLM and

Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the BLM and Forest Service would waive implementation of Management Recommendations for S&M species through amendments to the land management plans for the BLM Districts and National Forests that encompass the project area. Table 4.7.4.3-15 lists the vertebrate species and the number of affected sites or habitat areas in each District or National Forest.

TABLE 4.7.4.3-15

Affected Vertebrate Sites by BLM District and National Forest

	Number of Sites Affected a/					
Species	**Coos Bay**	**Roseburg**	**Medford**	**Umpqua**	**Rogue River**	**Winema**
Arborimus longicaudus b/	9	23	9 (1)	17	—	—
Strix nebulosa	—	0 (1)	0 (7)	—	0 (1)	—

a/ For sites that would only be indirectly affected (i.e., those not in the project area, but in the analysis area), the count is shown in parentheses (e.g., (1)).
b/ *A. longicaudus* sites are habitat areas, as mapped in accordance with the management recommendations for the species (Forest Service and BLM 2001b). Habitat area counts are not additive because some habitat areas occur on both BLM and NFS lands.

4.7.5 Conclusions and Recommendations for Threatened, Endangered, and Other Special Status Species

Based on informal consultations with the FWS, 39 federally listed and proposed species were identified as potentially occurring in the vicinity of the JCE & PCGP Project. In compliance with Section 7 of the ESA, we prepared a BA and EFH Assessment (FERC 2015) for the Project submitted to the FWS and NMFS in February 2015, with a request to initiate formal consultation. The FWS and NMFS would prepare BOs as to whether or not the federal actions associated with the Project would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat. The applicant is working with the FWS to ensure that impacts to ESA-listed species are mitigated across both federal and non-federal lands. The FERC would only authorize the Project to proceed if the FWS' and NMFS' BOs find the Project, as described, would not jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. Further, to ensure compliance with the ESA, **we recommend that:**

- **Jordan Cove and Pacific Connector <u>should not construct or use</u> any of their facilities, including related ancillary areas for staging, storage, temporary work areas, and new or to-be-improved access roads, <u>until</u>:**

  a. the Commission staff completes formal consultations with the NMFS and FWS; and

  b. Jordan Cove and Pacific Connector have received written notification from the Director of OEP that construction and/or implementation of conservation measures may begin.

4.8 RECREATION AND VISUAL RESOURCES

4.8.1 Recreation and Public Use Areas

4.8.1.1 Jordan Cove LNG Terminal

Parks and Other Recreational Use Areas

The Jordan Cove LNG terminal would be located on the North Spit of Coos Bay, a narrow strip of land between the Pacific Ocean and the bay. Land on the North Spit is managed and owned by several public agencies, including the COE, BLM, Forest Service, State of Oregon, and the Port, as well as private entities such as Roseburg Forest Products, D.B. Western, and Southport. The COE manages 245 acres on the Spit, including the North Jetty at the mouth of Coos Bay. The BLM administers 1,864 acres on the Spit, with 725 acres classified as an ACEC and the remainder designated as a Special Recreation Management Area (SRMA). The Forest Service manages the ODNRA within the Siuslaw National Forest at the north end of the Spit. The Oregon Parks and Recreation Department (OPRD) controls the Pacific Ocean beaches below the high tide mark on the west side of the Spit, while the ODSL possesses the beach land below mean low tide, including submerged lands (BLM 2005).

The Jordan Cove LNG terminal would be on private land, and no recreational activities would be allowed within the facility boundaries. However, undeveloped recreational areas are located in close proximity to the terminal, including the BLM's SRMA, the Forest Service's ODNRA, and the North Spit's Pacific Ocean beaches. These recreation areas are shown in relation to the terminal on figure 4.8-1.

According to the BLM's *Final North Spit Plan*, the public lands managed by the BLM on the North Spit are designed to become the largest and most accessible tract of public green space available for the Coos Bay area communities (BLM 2005). In recognition of the area's value for outdoor recreation, the BLM designated the North Spit as a Shorelands SRMA in its Coos Bay District Resource Management Plan. The BLM counted 27,100 visits to the North Spit between October 1, 2003, and September 31, 2004. The SRMA includes 1,600 acres for OHV use along designated sand roads. These roads are also available to hikers and equestrians. In a typical year, the BLM estimated that about 460 OHVs traveled on the sand road to the North Jetty. The closest developed recreational facility to the Jordan Cove terminal within the SRMA is the BLM boat dock located about 0.8 mile southwest. According to the BLM, about 13,100 vehicles visited the boat dock in a single year, and about 420 boats were launched (BLM 2005).

A survey conducted by the OPRD found that the 15-mile stretch of beach along the ocean from Ten Mile Creek to the mouth of Coos Bay was visited by an average of 38 people on a weekday, and 60 people total on a weekend day (Shelby and Tokarczyk 2002). The main activities of beach visitors in this segment include OHV use (54 percent), relaxing (21 percent), walking (16 percent), and recreational activities with dogs (4 percent). The high OHV use reflects that the northern portion of this segment is within the ODNRA.

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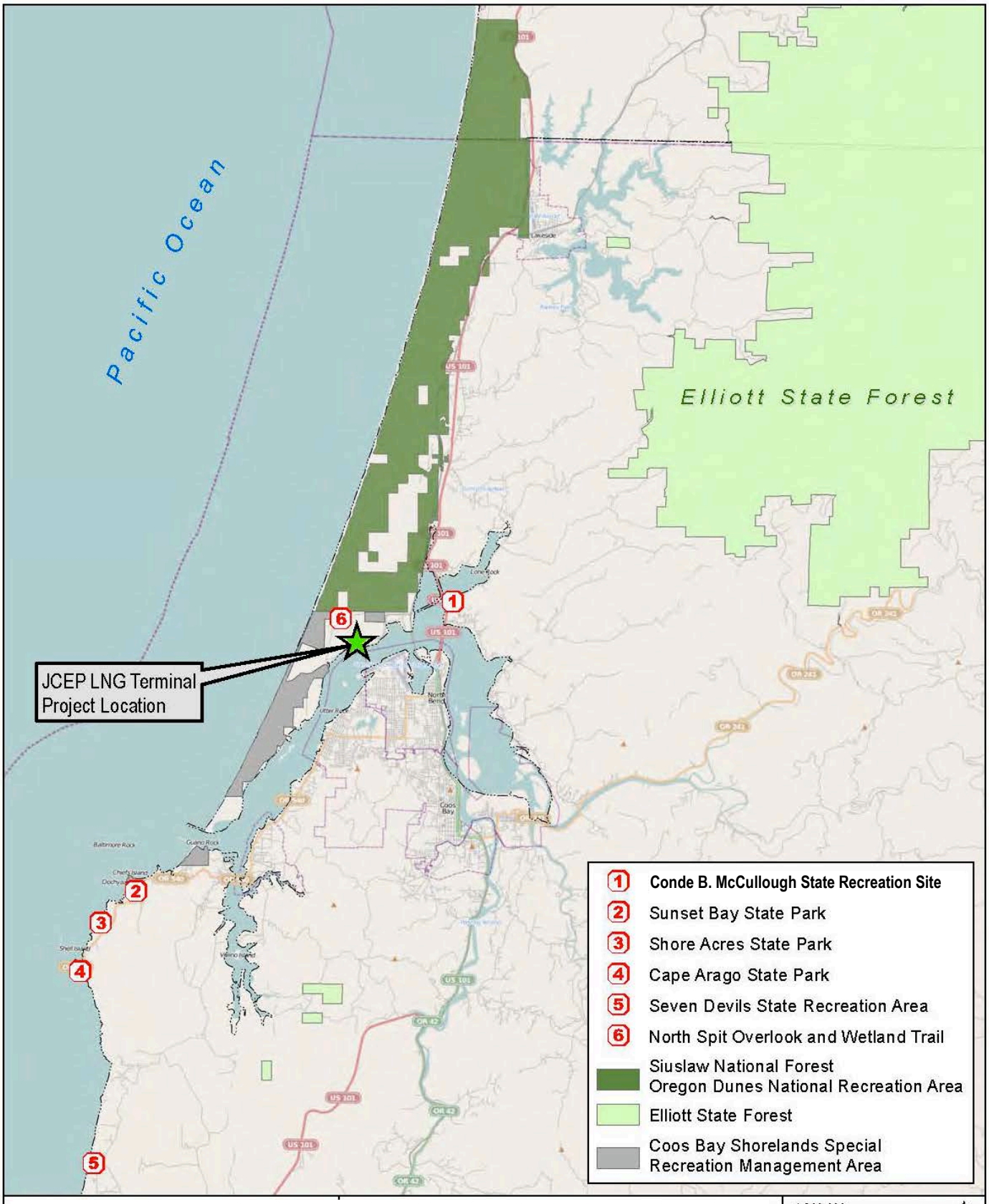


Figure 4.8-1

Recreation Areas in the Vicinity of the Jordan Cove LNG Terminal

1:200,000

0 0.5 1 2 mi

Sources:
ESRI, ODF, USFS, Oregon GEO

13

4-733

The Siuslaw National Forest administers the ODNRA. It extends approximately 45 miles along the Oregon Coast between Florence and Coos Bay. The ODNRA contains the largest expanse of coastal sand dunes in North America, as well as a coastal forest and over 30 lakes and ponds. Recreational opportunities at the ODNRA include OHV use, hiking, camping, horseback riding, angling, canoeing, sailing, waterskiing, and swimming. There are approximately 34 miles of designated OHV routes open to all classes of OHVs, and roughly 135 miles of unofficial user-developed routes that are technically closed (Forest Service 2012a). The ODNRA south of Horsfall Road is closed to OHV travel, except along the beach. Day use and overnight camping facilities within the ODNRA are visited by approximately 1.0 to 1.5 million people each year (Forest Service 2009, 2012b). The southern boundary of the ODNRA is about 100 feet north of the Jordan Cove LNG terminal tract, across the Trans-Pacific Parkway. The Horsfall Campground is located about 0.5 mile northeast of the South Dunes Power Plant.

The North Spit Overlook and nature trail are located about 0.5 mile west of the LNG terminal, on the north side of the Trans-Pacific Parkway. These facilities are maintained by Weyerhaeuser to provide the public an opportunity to observe wildlife and birds in the vicinity of its former wastewater lagoon on the North Spit. The overlook and trails are open to the public for nature studies, birding, walking, and photography. Jordan Cove is considering acquiring the Weyerhaeuser lagoon as part of its habitat mitigation program.

The Jordan Cove LNG terminal would be within 0.5 mile of the Oregon Coastal Trail where it follows Horsfall Beach Road and joins the Trans-Pacific Parkway. The Oregon Coastal Trail is a 360-mile-long hiking trail from the Columbia River to the California border. The trail was created by the Oregon Recreation Trails Advisory Council and is managed by the OPRD as part of the state park system. The trail crosses beaches, follows roads, passes through forests, and hugs coastal headlands. North of Coos Bay the trail leaves the coastal beach and follows Horsfall Beach Access Road southward where it eventually connects with Highway 101, passes through the cities of North Bend and Coos Bay, and reaches the Pacific again near Cape Arago (OPRD 2001).

Jordan Cove's temporary NPWHC would be within 0.3 mile of three city parks: Ferry Road, Winsor, and Simpson. The NPWHC would be adjacent to Simpson Park, which is mostly forested land for day-use low intensity recreation. Winsor Park is located to the east, separated from the camp by Highway 101. Winsor Park is mostly forested, with an open field for additional sport recreational activities. Farthest east is Ferry Road Park, which has the most developed recreational facilities compared to the other parks, with restrooms, a pavilion available for rental from the North Bend Parks Department, and a baseball diamond.

On the north side of the McCullough Bridge, along the southern shore of Haynes Inlet to the east of the highway, is the Conde B. McCullough State Recreation Site. This narrow shoreline recreation site is largely forested, with a small parking lot near a boat ramp at its eastern end. Only day-use recreation is permitted.

Hunting activities are managed by the ODFW. Big game, waterfowl, and fur-bearing animals are hunted in the public areas of the North Spit and within the Siuslaw National Forest during the legal seasons.

The influx of Jordan Cove workers to the area could add to the number of people who would hunt on public lands in the region during the permissible seasons. However, the potential increase in hunters related to construction of the LNG terminal would be temporary and short term. The total construction period would be about 42 months and the average construction worker would be employed at the terminal for about 10 months. Workers could only hunt on their free time when they are not on the job; such as on weekends and vacations. It is not possible to calculate the number of additional hunters related to the Jordan Cove Project. Not all Jordan Cove employees would hunt.

Jordan Cove workers could also add to the number of recreational users of the BLM's Shorelands SRMA, ODNRA, the beach along the North Spit, and North Bend city parks. This influx of additional recreationalists would be temporary and short term. Workers could only use recreation areas on their free time when they are not on the job; such as on weekends and vacations. Again, it is not possible to calculate the additional number of recreational users of public lands related to the Jordan Cove Project as not all of the employees would use nearby recreational areas or facilities. Given the large amount of public lands in the region, and the low density of current use of those lands for recreational activities, we conclude that additional recreational use from Jordan Cove employees would not result in significant impacts.

There may be some conflicts between recreational drivers on the Trans-Pacific Parkway and construction traffic to the LNG terminal. Jordan Cove developed a transportation analysis that considered impacts on users of the ODNRA because of terminal construction traffic at the intersection of the Trans-Pacific Parkway and Horsfall Beach Road.[119] Average daily traffic during 2008 at the intersection of the Trans-Pacific Parkway and Horsfall Beach Road was about 275 vehicles (Coos County 2011). Jordan Cove estimated that during peak construction there would be almost 42,300 total yearly trips for crew buses to the terminal. In addition, there would also be almost 49,000 deliveries by trucks to the terminal during the peak construction year. However, with the implementation of mitigation measures, Jordan Cove could reduce its impact on local traffic, as more fully discussed in section 4.10.

There may be temporary and short-term impacts from construction noise on people recreating in the immediate vicinity of the LNG terminal, including users of the North Spit Overlook, coastal beach, Shorelands SRMA, and ODNRA. People within 1 mile of the terminal may experience increases in the ambient sound environment from both construction and operational noise from the Jordan Cove terminal. Noise modeling (discussed in more detail in section 4.12 of this EIS) indicates that expected Project construction noise levels at the closet noise sensitive area (NSA, a house about 1.4 miles from the terminal) would range from 32 to 42 dBA.

OHVs that are allowed on the beach would also contribute to the ambient noise levels on the North Spit. The noise limit for OHVs in the ODNRA is 93 decibels (Forest Service 2013b), which exceeds the predicted LNG terminal construction noise levels. Distance, topography, and vegetation would help to minimize terminal construction and operational noise in the portions of the ODNRA where OHVs are not allowed (between the Trans-Pacific Parkway and Horsfall Beach Access Road).

[119] David Evans and Associates. July 2012. *Jordan Cove Energy Project Transportation Impact Analysis Updat*e. Filed as Appendix B.5 attached to Resource Report 5 in Jordan Cove's application to the FERC.

During construction, Jordan Cove intends to comply with the City of North Bend's noise ordinance that prohibits the "making of unnecessary noise," although the ordinance has no specific numerical limits (North Bend City Code, Section 9.04.030). Daytime construction noise between the hours of 7:00 a.m. to 6:00 p.m. is exempt. Coos County does not have a noise ordinance. The State of Oregon noise ordinance limits noise to not more than 55 dBA for 50 percent of the period between 7:00 a.m. and 10:00 p.m. With construction noise below state levels at any NSAs, other noise sources in the area, and given the temporal nature of construction, we conclude that Project related noise would not have significant impacts on recreational users of public lands near the Jordan Cove terminal.

Clamming and Crabbing in Coos Bay

Recreational clamming and crabbing activities occur in Coos Bay near the Jordan Cove terminal. These activities are conducted on a year-round basis, and brings revenue to the region (see section 4.9 for further discussion). All species of "bay clams" are found in Coos Bay, including butter, cockle, gaper, and native littleneck clams. Clamming is conducted on the mud flats on the bay side of the North Spit up to NCM 6, in the northern reaches of South Slough, on the eastern side of the bay between Charleston and the Southwest Oregon Regional Airport, in Haynes Inlet, and eastern side of the bay above the McCullough Bridge from Glasgow to the mouth of the Coos River. Butter clams (about 24 percent of the harvest) are found on high sandy bars, in areas with little algae, and are most common at Pigeon Point. Cockle clams (about 10 percent of the harvest) are found near the surface in areas with oxygenated sediment and plentiful algae, must abundant in South Slough and Pigeon Point. Native littleneck clams (about 1 percent of the harvest) are present in South Slough and Pigeon Point in low tidal areas with eelgrass and oxygenated sediments. Gaper clams (about 66 percent of the harvest) are found in low tidal areas with eelgrass, and are most abundant at Clam Island. ODFW regulations limit the amount a person can catch in a day to 20 clams; of which 12 may be gaper clams. Between March and September of 2008, a total of about 33,700 kilograms of clams were harvested in Coos Bay, making it the third most productive clamming estuary in the state, after Tillamook Bay and Netarts Bay (Ainworth and Vance 2008).

While done year-round, shore crabbing in Coos Bay is most productive during fall and winter. Crabbing is conducted from docks in Charleston and Empire, and from boats, particularly to the west of the navigation channel in the lower bay, on the bay side of the North Spit below NCM 7. Crabs are caught using traps, rings, or snares. While recreational crabbers in Oregon also harvest red rock crabs and Pacific rock crabs, Dungeness crabs are far more popular. A study collecting crabs near the Roseburg Forest Products tract found that 98 percent were Dungeness crabs, with far lesser counts of hairy shore crabs, red rock crabs, and non-native European green crabs (Yamada 2014, filed with the FERC as Accession No. 2014208-5116 on December 7, 2014). ODFW regulations limit individual daily catches of crabs to 12 male Dungeness larger than 146 mm across and 24 red crabs of any sex and size. Another study by ODFW found that between 2008 and 2011 an average of 158,650 pounds per year of Dungeness crabs were harvested from Coos Bay. During that same period, an average of 14,710 yearly recreational crabbing trips were taken to Coos Bay. The vast major of the recreational crabbers (76 percent) came from 100 miles or less away (Ainworth et al. 2012).

Recreational clamming and crabbing is done outside of the Coos Bay navigation channel, and therefore there would be no direct impacts from LNG vessel traffic in the waterway to from the

Jordan Cove LNG terminal on individuals conducting those activities. Use of the crabbing and clamming areas in Coos Bay should not be any more affected by the passage of LNG vessels than they are currently affected by the passage of other deep-draft ships. However, if crabbing and clamming activities were to occur within the established security zones, those activities would be required to cease and temporarily move out of the way. Crab pots outside of the navigation channel should not be affected by LNG vessel traffic in the waterway. Passive equipment, such as crab pots, would be permitted to remain within the security zone while an LNG vessel is present, though the attending crabbing vessels would be required to vacate (Berg 2008).

However, there could be indirect impacts on clams and crabs from shoreline erosion or bottom sediment disturbed by LNG vessel traffic in the waterway. Those impacts are addressed in sections 4.4.2.1 and 4.6.2.1 of this EIS. We concluded that wakes from LNG vessels in the navigation channel would not cause major shoreline erosion much beyond natural waves, and propeller wash from LNG vessels would not greatly disturb the channel bottom.

There would also be impacts from the dredging in the bay to create the access channel for the Jordan Cove terminal. Those impacts have been addressed in sections 4.4.2.1 and 4.6.2.2 in this EIS. We concluded that dredging of the access channel would only have temporary impacts on bay water quality, and increased sedimentation from the dredging would be limited in extent. For example, if a hydraulic dredge was used, turbidity would be estimated to increase about 14 mg/l at 200 feet from the cutterhead under high water conditions. The limited time and extent of dredging siltation should not result in long-term or population wide impacts on clams and crabs near the Jordan Cove terminal. In fact, as mitigation for wetland impacts, Jordan Cove would be creating new eelgrass beds in Coos Bay that could serve as nursery habitat for crabs, would also be creating new wetlands at Kentuck Slough, and would be acquiring 3 acres of unvegetated sand as part of its habitat mitigation program. Therefore, we conclude that the Project would not have significant adverse impacts on recreational clamming and crabbing activities in Coos Bay.

Boating and Fishing

The waterway for LNG vessel traffic to and from the terminal, Jordan Cove's access channel to its marine slip, and the proposed eelgrass mitigation area would be within Coos Bay. Coos Bay is utilized for recreational boating, angling, clamming and crabbing, as well as commercial fishing, oyster farming, and commercial shipping. The Coos Bay estuary is discussed in more detail in section 4.4.1. Aquatic resources are addressed in more detail within section 4.6, and commercial shipping and fishing are discussed in section 4.9. Recreational resources located along the waterway for LNG vessel marine traffic were discussed in section 4.7.1.3 in the FERC's May 2009 FEIS for Docket Nos. CP07-441-000 and CP07-444-000. Recreational clamming and crabbing activities are discussed above, while recreational boating and fishing in Coos Bay is discussed below.

According to a 2008 study by the Oregon State Marine Board (OSMB), recreational boaters in Coos Bay took a total of 31,560 boat trips the previous year. Nearly 90 percent of the boat use-days involved fishing (including angling, crabbing, and clamming), 9 percent was for pleasure cruising, and the remainder was for sailing and water skiing. Sixty-eight percent of the boating activities in Coos Bay originated from the Charleston Marina and the Empire ramp, 19 percent at the California Avenue boat ramps, and 4 percent at the North Spit ramps. Most of the recreational boating activities in Coos Bay occur during the summer.

The most popular fish species caught by recreational anglers out of Coos Bay include coho and Chinook salmon. Other recreational catch species include various species of perch, rockfish, flatfish, sturgeon, Pacific herring, and California halibut.

Much of the recreational angling for salmon in Coos Bay occurs in late summer and fall. It usually begins in late summer at jetty areas and moves up the bay as fish move upstream. Bank angler access on the North Spit is limited. Boat angling occurs throughout the bay, but angling is limited in some areas at times by exposure to winds. For example, the Roseburg Forest Products dock area gets less boat angling use due to exposure to wind and tidal action. Much of the boat angling for Chinook and coho salmon in the fall is concentrated around the railroad bridge and downstream. Marshfield Channel can be an area of concentrated angling for fall salmon.

Perch fishing begins in Coos Bay in late February to early March, depending on freshwater runoff into the bay, and can continue through July. Rocks around bridge abutments are targeted by anglers on the outgoing tide.

Recreational fishing for sturgeon in Coos Bay generally occurs between the railroad bridge and McCullough Bridge (U.S. Highway 101), just east of the Jordan Cove terminal, and also above the McCullough Bridge. White sturgeon can be taken year-round, but the best angling is during December through March, and when there is a heavy freshwater plume in the bay.

Recreational boating in the bay would be redirected away from the access channel and terminal slip during the construction period that includes dredging within Coos Bay. Notices would be provided to boaters by the Coast Guard and the OSMB to avoid this area during the dredging activities. Signs would be posted at the shoreline as well as at the boat ramps and marinas, and on buoys in the bay, in advance of this final task to notify boaters of the planned construction activity and the duration of the activity. If the signage and notices are not sufficient to prevent recreational boating from avoiding the construction areas, some form of physical barrier, like a continuous string of highly visible soft material floats, may be extended across the mouth of the slip or around the construction area. Construction safety inspectors would also be responsible to warn any recreational boaters who progress into the construction area. Boaters could avoid the construction area by moving to the south and east side of the bay.

During construction of the terminal, material deliveries would be made by marine transit in the existing Coos Bay navigation channel. This would include visits by about 82 break bulk cargo ships and 18 barges over a two-year period in total. As discussed below, we do not believe that the equipment delivery vessels coming to the terminal would have adverse impacts on recreational bay users much beyond current commercial cargo ship and barge traffic. Currently, the Port is visited by about 60 deep-draft cargo ships and 50 barges per year.

During operation of the LNG terminal, recreational boaters would have to avoid LNG vessels in transit within the waterway. Jordan Cove believes that up to 90 LNG vessels per year would visit its terminal. Recreational boaters using the bay at the same time as an LNG vessel is in transit within the waterway may encounter delays due the moving security zone requirements around an LNG vessel, as specified in Jordan Cove's WSA and the Coast Guard's WSR and LOR. Jordan Cove estimated that it may take an LNG vessel up to 90 minutes to transit the waterway from the buoy to the terminal at speeds between 4 and 10 knots. The maximum waiting period for an LNG vessel to pass a given point would be 30 minutes. The sum of the

periods in which LNG vessels would have a potential impact on recreational and other boating activity is about 1.3 percent of all daylight hours (ECONorthwest 2012a). Pilots guiding commercial ships in the Coos Bay navigation channel currently encounter approximately six recreational boats during the transit into and out of the Port. These numbers are typically lower in winter and on weekdays than during the summer and on weekends. The Coast Guard and OSMB would continue to remind boaters of their obligation not to impede deep draft ships, regardless of the cargo.

Other Public and Special Use Areas

The LNG terminal would be approximately 0.9 mile from the Southwest Oregon Regional Airport. Potential impacts of the LNG terminal on the airport are addressed in sections 4.9 and 4.10.

4.8.1.2 Pacific Connector Pipeline

Parks and Recreational Areas or Facilities on Non-Federal Lands

Overall, the pipeline route does not cross any non-federal park lands or developed recreational facilities, and construction and operation of the pipeline should not adversely impact park users. However, construction-related activities would temporarily increase traffic on local roads used to access the parks, and park users may be able to hear construction noise while workers and equipment move through the area to install the pipeline. In addition, the pipeline route does cross a water trail, the Haynes Inlet Water Trail, as discussed below. Construction-related impacts would be temporary and short term, and should not significantly affect recreational use of parks or other recreational areas.

State Lands

Oregon Coast Trail

The Oregon Coast Trail was previously discussed above in section 4.8.1.1. The pipeline route would be within one-quarter mile of the trail where it follows Horsfall Beach road and joins the Trans-Pacific Parkway north of MP 1.5R.

Recreational users of the Oregon Coast Trail would be exposed to pipeline construction traffic along the Trans-Pacific Parkway, which is the only access road to the North Spit and the Jordan Cove Meter Station. Pacific Connector developed *Transit Management Plans* (TMP) to reduce impacts on other road travelers (see section 4.10.2). Project construction activities could be visible and audible to hikers on the Oregon Coast Trail where it joins with the Trans-Pacific Parkway, but these impacts would be temporary and short term. Furthermore, this area is adjacent to a large-scale industrial plant (i.e., Roseburg Forest Products), a railroad, and a road. There are other current noise sources such as OHVs in the ODNRA that are much louder than pipeline construction noise. Therefore, pipeline construction should not significantly affect the trail use or experience.

Haynes Inlet

Coos Bay is used for recreational boating, canoeing, kayaking, angling, clamming, and crabbing, as discussed above in section 4.8.1.1. The Pacific Connector pipeline route would cross the Haynes Inlet portion of Coos Bay between about MPs 1.7R and 4.1R. Coos Bay is a Water of the State, with the bottom managed by ODSL. The pipeline crossing of Haynes Inlet is discussed in detail in section 4.4.2.

The closest developed recreational facility to the pipeline crossing of Coos Bay would be the Conde B. McCullough boat launch, located east of Highway 101 on the south side of Haynes Inlet, about one-quarter mile west of where the pipeline reaches land at MP 4.1R.

The Coos Regional Trails Partnership, a consortium of land management agencies and economic development groups, mapped Coos Bay's water trails for kayakers and other paddlers (CRTP 2004). Portions of two water trails are in close proximity to the pipeline alignment. The North Slough Trail begins at the west end of the North Spit Causeway, about 0.3 mile north of where the pipeline enters Haynes Inlet, and follows the North Slough northward. The pipeline would not cross this water trail. The Haynes Inlet Trail begins at the boat launch at the Conde B. McCullough State Wayside, about 0.4 mile south of where the pipeline leaves Haynes Inlet, and heads northeast. The pipeline crosses the Haynes Inlet Trail at about MP 3.9R.

Pacific Connector produced a *Recreational Management Plan* as Appendix S of its POD that applies to the entire length of its pipeline, regardless of land ownership. That plan included measures related to crossing recreational sites in Coos Bay. Those measures include:

- providing a schedule for construction in the bay to local governments, ODFW, OPRD, Coos County Sheriff, area recreation groups, and the CRTP; and
- posting signs at the Conde B. McCullough boat launch to inform people boating, canoeing, and kayaking of the pipeline location and construction schedule.

Pacific Connector indicated that it would file documentation of consultations with appropriate agencies and interested parties after it has selected its construction contractor. Because Pacific Connector has not yet communicated with stakeholders about potential impacts and mitigation measures for the crossing of the Haynes Inlet Water Trail, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary documentation of consultations with the Oregon International Port of Coos Bay, Coos County, City of North Bend, ODSL, ODPR, CRTP, and other interested parties regarding potential impacts on the Haynes Inlet Water Trail and users of the boat ramp along North Bay Drive. The documentation shall include their comments on Pacific Connector's Recreation Management Plan.**

Klamath Wildlife Area

The Klamath Wildlife Area is managed by ODFW to provide habitat for wintering and nesting waterfowl, upland game birds, and a variety of other wildlife. Bald eagles, white pelicans, and ospreys are among the bird species that are present in this area during certain times of the year. The area, along the Klamath River south of West Klamath, also serves as a recreation spot for fishing, hunting, and boating (ODFW 2004). The pipeline route would pass within one-quarter mile along the north side of the Klamath Wildlife Area near MP 199.15. To reduce impacts on the Klamath Wildlife Area, Pacific Connector would install its pipeline in this area during the ODFW-recommended work period of July 1 through January 31. See also section 4.6.

State Parks

There are no Oregon State Parks within 1 mile of the pipeline alignment. Some USGS maps show a Camas Mountain State Park in Section 9, T. 29S., R. 8W near MP 51.7. However, the

OPRD records do not show that there is, or historically has been, a state park or any state land ownership at this location (Teal 2006).

County Lands

There are five county parks located near the pipeline route. These five parks include the Middle Creek Park, Ham Bunch-Cherry Creek Park, Frona County Park, Ben Irving Reservoir day park, and the Carl C. Hill Wayside.

Three of the five county parks discussed above are located in Coos County and are accessed by the Coos Bay Wagon Road. Middle Creek Park lies approximately 0.5 mile west of the pipeline alignment at about MP 27.5. Middle Creek is an unimproved, day use park. Ham Bunch-Cherry Creek Park, with about eight primitive campsites and fishing on Cherry Creek, is located about 1 mile northwest of the pipeline alignment at MP 28.5. Frona County Park, which offers a primitive group campground and fishing area along the East Fork of the Coquille River, is less than 0.5 mile northwest of the pipeline alignment at MP 29.9 (CBN 2006; CCPR 2006).

In Douglas County, the Ben Irving Reservoir, located about 1.5 miles south of the pipeline alignment near the town of Tenmile and State Highway 42 (near MP 55.8), is a large man-made water body used for fishing, boating, and other water related recreation. The day use park has a picnic site and boat launch. The reservoir could be a source of water for pipeline hydrostatic testing (see section 4.4). Project water use would be allowed by the reservoir owner, and is not expected to significantly draw down the reservoir or impact boating or other day-use activities.

In Douglas County, near Milo, the Carl C. Hill Wayside provides a picnic area and fishing along the South Umpqua River. This day use area is approximately 0.7 mile southwest of the pipeline alignment at MP 94.7, where the pipeline route crosses the South Umpqua River.

Other Non-Federal Public Recreation Areas

Keno Recreation Area

Pacific Power's Keno Recreation Area consists of a developed campground, boat launch, and picnic area along the Keno Reservoir of the Klamath River. Fishing and water sports are common activities at this recreation site near the town of Keno. The pipeline alignment passes less than 0.5 mile north of the reservoir at MP 192.5 where it would be adjacent to an existing powerline corridor.

Recreation and access to the Keno Recreation Area would not be affected by construction and operation activities. Additionally, the reservoir could be a source of water for pipeline hydrostatic testing. The water impoundment is not expected to significantly draw down the reservoir or impact boating or other day-use activities. Hydrostatic testing is more fully discussed in section 4.4.2.

OHV Controls and Limited Access to the Right-of-Way

We received comments during public scoping that were concerned with the potential increase in OHV use where the pipeline right-of-way could create new access points. There was also concern about the effectiveness of control methods proposed by Pacific Connector. The pipeline right-of-way could increase unauthorized OHV, snowmobile, and dispersed motorized access and associated resource access. Pacific Connector's *Recreation Management Plan* describes

measures to be employed on both public and private lands to control unauthorized OHV use. Pacific Connector would prefer to limit OHV use of its pipeline right-of-way by installing barriers, made of natural or constructed materials, particularly at road crossings. OHV control measures could include:

- dirt of rock berms, sometimes coupled with erosion control devices;
- strategically placed non-merchantable logs, slash, or tree stumps;
- large rocks or boulders partly buried along the right-of-way;
- signs;
- fencing and locked gates; and
- vegetative screening to disguise the existence of the right-of-way.

Pacific Connector would coordinate with landowners during construction and restoration to finalize site-specific OHV control measures. In addition, following construction, the effectiveness of the site-specific measures would be assessed on a periodic basis. Pacific Connector would be responsible for monitoring and managing unauthorized OHV use during the full life of the pipeline project and would implement additional measures as necessary.

Federal Parks, Recreation Areas, and Other National Designations

As discussed throughout this EIS, portions of the Pacific Connector pipeline route would cross through parts of three National Forests (Umpqua, Rogue River, and Winema) and four BLM Districts (Coos Bay, Roseburg, Medford, Lakeview). Within the BLM's Coos Bay District, a small segment of the route would cross the Rock Creek ACEC. The proposed route for the Pacific Connector pipeline would not cross any national parks, developed federal recreation areas, national monuments, national landmarks, wilderness areas, wildlife preserves, wild and scenic river segments, or reservoirs. The route would, however, cross several federally designated scenic byways, rivers on the national inventory, and national trails, as detailed below.

National Parks and Monuments

The closest national park to the Pacific Connector pipeline is Crater Lake National Park, located approximately 26 miles northeast of MP 132. The Cascade-Siskiyou National Monument is the closest monument to the pipeline at approximately 10 miles southwest of MP 175.

Because of their distance from the pipeline route, no national parks or monuments would be directly affected by the Pacific Connector Pipeline Project. However, indirect impacts may include air quality effects on Class I areas (see section 4.12.1), and construction traffic on roads leading to the parks and monuments.

National Scenic Byways

Three National Scenic Byways would be crossed by the Pacific Connector pipeline: the Pacific Coast Scenic Byway (U.S. Highway 101), the Rogue-Umpqua Scenic Byway (State Highway 62), and the Volcanic Legacy Scenic Byway (U.S. Highway 97). Generally, installation of a pipeline across a road may have direct impacts through a temporary halt to traffic, and removal of vegetation which may affect visual quality. However, in the case of these three National Scenic Byways, as discussed below, the highways would be open during pipeline construction and no vegetation would be removed in the vicinity of the crossings.

Following Highway 101 from Astoria to Brookings, many locations along the Pacific Coast Scenic Byway host spectacular views of the rugged Oregon coast. The Pacific Connector pipeline would cross under the Pacific Coast Scenic Byway within the waters of Coos Bay (MP 2.6R).

The only impact on viewers along the Pacific Coast Scenic Byway would be during pipeline construction. Travelers on Highway 101 may be able to see construction in Coos Bay while driving over the McCullough Bridge. However, those visual impacts would be temporary. Pacific Connector would complete its crossing of Haynes Inlet within three weeks. The bridge and Highway 101 would not be directly affected by the Pacific Connector Project, and the byway would be kept open to traffic during pipeline construction. Once installed beneath the waters of Haynes Inlet, the pipeline would be undetectable to observers traveling on Highway 101.

Following State Routes 138, 62, and 234, the Rogue-Umpqua Scenic Byway forms a semi-circle route through the Umpqua and Rogue National Forests between the cities of Roseburg and Gold Hill. The Pacific Connector pipeline would cross the Rogue-Umpqua Scenic Byway between the towns of Trail and Shady Grove (MP 125.9) adjacent to the Rogue River. Pacific Connector proposes to use an HDD to cross under State Highway 62 and the Rogue River, between about MPs 122 and 123. Impacts would be temporary during pipeline installation, as travelers on the Rogue-Umpqua Scenic Byway may briefly be able to see construction off in the distance. The HDD under Highway 62 and the Rogue River would be completed within a two month period. Highway 62 would not be directly affected by installation of the pipeline, and the byway would be kept open to traffic. Because an HDD would be deep underground, after construction, the pipeline would not be visible to travelers along the Rogue-Umpqua Scenic Byway; therefore, the pipeline should not impact the byway's scenic qualities.

The third National Scenic Byway crossed by the pipeline route would be the Volcanic Legacy Scenic Byway, which creates a touring route of south-central Oregon and northeastern California. The Oregon portion of the Volcanic Legacy Scenic Byway begins on U.S. Highway 97, north of Crater Lake, circles Crater Lake, and then continues south on State Routes 62 and 140 through Klamath Falls and into California. The Pacific Connector pipeline would cross the Volcanic Legacy Scenic Byway just south of Klamath Falls (MP 199.6) near its crossing of the Klamath River. Pacific Connector proposes to use an HDD to cross under Highway 97 and the Klamath River between MPs 199 and 200. Impacts would be temporary, as travelers on Highway 97 may be able to briefly glimpse pipeline construction activities off in the distance. The HDD under Highway 97 and the Klamath River would be completed within a two month period. The Pacific Connector Pipeline Project would have no direct impacts on the Volcanic Legacy Scenic Byway, and the highway would be kept open to traffic during construction. After installation of the pipeline deep underground, it would not be visible to travelers using the Volcanic Legacy Scenic Byway; therefore, the pipeline should not impact the scenic qualities of this byway.

National Wild and Scenic Rivers and Nationwide Rivers Inventory

Wild and Scenic Rivers

The Rogue River, which the pipeline would cross near the community of Trail, is a designated Wild and Scenic River from the Crater Lake National Park boundary downstream to Prospect, approximately 20 miles north of the pipeline crossing. Additionally, an 84-mile section of the Rogue River is designated as Wild and Scenic starting about 7 miles west of the city of Grants

Pass and proceeding west toward the town of Gold Beach (NPS 2005). The Pacific Connector pipeline route would not cross the Rogue River within either portion where it has been designated as a National Wild and Scenic River. Further, the Forest Service confirmed that because there is no potential effect to free-flow, scenery, recreation, fish, or wildlife values present within the Rogue Wild and Scenic River corridor near Prospect, a determination under Section 7 of the Wild and Scenic Rivers Act is not required. Pacific Connector would use an HDD to cross under the Rogue River at MP 122.6, thus avoiding any direct effects on the river and its related aquatic resources (see section 4.4.2 for a further discussion of water resources).

Indirect impacts could occur if the work areas associated with the HDD pipeline crossing were to cause sedimentation that could run downstream and affect water quality of the federally designated Wild and Scenic River portion of the Rogue River. Also, while this segment of the Rogue River was found eligible by the BLM Medford District (BLM 1995f), its river-related values are only protected on BLM-managed lands, which are approximately 1 mile downstream from the pipeline crossing. The values for which the river was found eligible are not expected to be impacted by the pipeline construction and operation.

The Upper Klamath River, from ¼ mile downstream of the J.C. Boyle powerhouse to the Oregon-California Stateline (11.0 miles), is a designated Scenic River segment in the federal Wild and Scenic Rivers (WSR) system. The Pacific Connector pipeline would cross a number of unnamed tributaries of Spencer Creek, and Clover Creek, tributaries of the Upper Klamath, 15-20 miles upstream of the WSR segment. Additionally, the pipeline would cross the Upper Klamath River at about MP 199.4, near Oregon Highway 66, approximately 20 miles upstream of the WSR segment. While there may be a possibility of sediment input to the river from pipeline construction activities, project design features such as HDD under the river, and work periods restricted to the dry season for open trenching through the creeks and tributaries, would minimize this risk. The free-flow, scenery, recreation, fish, or wildlife values within the Upper Klamath WSR corridor are not expected to be impacted by the pipeline construction and operation.

Rivers on the Nationwide Inventory

The Nationwide Rivers Inventory is a listing of more than 3,400 free-flowing river segments in the United States thought to have outstanding natural or cultural values. Under a 1979 Presidential Directive, federal agencies were instructed to consider rivers on the Nationwide Inventory during their environmental review process, avoid or mitigate adverse impacts on rivers on the Inventory, and consult with the NPS' Rivers, Trails & Conservation Assistance Program prior to taking any actions that may preclude the future designation of wild, scenic, or recreational status of rivers on the Inventory.

The Pacific Connector pipeline route would cross two river systems listed on the Nationwide Inventory: the Coquille River and the Umpqua River. About 42 miles of the North Fork of the Coquille River is listed on the Inventory from its headwaters to its confluence with the South Fork. About 32 miles of the East Fork of the Coquille River is listed from its headwaters to its confluence with the North Fork. About 15 miles of the South Umpqua River is on the Inventory from Tiller to its confluence with the North Umpqua River. The Pacific Connector pipeline route would cross the North Fork of the Coquille River at about MP 23.1, and would cross the East Fork of the Coquille River at about MP 29.9. The pipeline route would cross the South Umpqua River twice, at about MP 71.3 and about MP 94.7.

The CEQ promulgated procedures for interagency consultations to avoid or mitigate adverse effects on rivers listed on the Nationwide Inventory. The CEQ procedures allow the environmental document that discloses potential impacts on rivers listed on the Nationwide Inventory to constitute consultation with the NPS. A copy of the draft EIS was sent to the NPS; however, the NPS did not submit comments regarding wild or scenic rivers or rivers on the Nationwide Inventory. Previously, we sent the NPS a copy of our NOI issued for this Project on August 2, 2012, and the NPS responded on August 20, 2012, but did not mention rivers on the Nationwide Inventory in that letter to the FERC.

Our assessment of impacts on the Coquille and Umpqua Rivers, and measures that would be implemented to avoid, reduce, or mitigate those impacts are discussed in detail in section 4.4.2.2. Both the North Fork and East Fork of the Coquille River would be crossed using dry open cut methods. The South Umpqua River at MP 71.3 would be crossed using DP technology, while the crossing at MP 94.7 would be a diverted open cut. While construction would have temporary and short-term impacts on waterbodies, use of Pacific Connector's ECRP would minimize those impacts to non-significant levels. Therefore, the Pacific Connector Pipeline Project should not have long-term adverse effects on segments of rivers listed on the Nationwide Inventory.

National Wildlife Refuges, Natural Landmarks, and Wilderness Areas

Sky Lakes Wilderness and Mountain Lakes Wilderness

There are several federally designated Wilderness Areas in the Umpqua, Rogue River, and Winema National Forests, but none of them would be crossed by the Pacific Connector pipeline. However, two Wilderness Areas are in the general vicinity of the pipeline alignment (i.e., the Sky Lakes Wilderness and the Mountain Lakes Wilderness). The Sky Lakes Wilderness (113,590 acres) is in both the Winema and Rogue River National Forests and its southern tip is approximately 3.7 miles north of the pipeline alignment at MP 162.0. The Mountain Lakes Wilderness (23,071 acres), in the Winema National Forest, is approximately 2.3 miles north of MP 173.0. These distances, over forested land, are far enough removed from the pipeline so as to not be affected by pipeline construction or operation.

Round Top National Natural Landmark (NNL)

Between MPs 134.7 and 137.1 the Pacific Connector pipeline route would be in close proximity to, on the east side of, the Round Top NNL. The Secretary of the Interior designated Round Top Butte a NNL on June 15, 2011. Geologically, the NNL includes a basaltic butte and volcanic plains. Biologically, the NNL encompasses a unique mixture of grasslands, ponderosa pine, white oak, and buck brush vegetation. The NNL is administered as two parcels: 747 acres managed by the BLM as a Research Natural Area (RNA), and a private preserve managed by The Nature Conservancy. In a letter to the Commission dated July 8, 2013, the NPS indicated concerns that the nearby pipeline corridor could result in the proliferation of non-native weed species. The NPS recommended an approximately 0.8-mile buffer between the pipeline and the NNL boundary.

In an August 16, 2013, data request from the FERC to Pacific Connector, we asked if it was possible to find an alternative route that would increase the distance away from the Round Top NNL. In its response filed September 6, 2013, Pacific Connector indicated that an alternative route to avoid the NNL would not be practicable or reasonable. The proposed route is across a saddle between Round Top Butte and Obenchain Mountain, along relatively gentle slopes. An

alternative route to the east to increase the buffer away from the NNL would put the pipeline on steeper slopes of Obenchain Mountain and would affect at least five new parcels. For the complete analysis, see section 3.4.1.13.

At its closest point, the proposed route would be about one-quarter mile away from the BLM boundary to the NNL. Where the pipeline would be closest to the NNL boundary, between about MPs 135.3 and 135.7, it would be located on private land through previously harvested and thinned forest. The BLM did not indicate any concerns related to the pipeline's proximity to the NNL, and as a cooperating agency in the development of this EIS, the BLM assisted in route selection across lands they administer. The pipeline route does not cross the NNL, and would have no direct impacts on it. Pacific Connector would minimize the spread of weeds by following its ECRP and its *Integrated Pest Management Plan*.

Klamath Basin National Wildlife Refuges

There is a complex of six National Wildlife Refuges in the Klamath Basin region of Southern Oregon and Northern California. At MP 204.0, the pipeline would be approximately 5.7 miles north of the Lower Klamath National Wildlife Refuge and approximately 3.2 miles northeast of the Bear Valley National Refuge at MP 192.56. Some USGS topographic maps show old Lower Klamath Refuge boundaries on lands that were withdrawn from consideration in the 1920s (Coles 2006). Pacific Connector confirmed with the FWS in June 2006 that the pipeline would not impact any lands within the Klamath Basin Refuge boundaries.

Construction and operation of the Pacific Connector Pipeline Project should have no direct impacts on National Wildlife Refuges, Wilderness Areas, or Natural Landmarks. Because the pipeline route does not actually cross these areas, Pacific Connector did not propose and we did not require any site-specific mitigation measures.

Inventoried Roadless Areas

The pipeline route and related facilities would not be located in any Inventoried Roadless Areas (IRAs). The nearest IRA is the Brown Mountain IRA, located on the Rogue River National Forest approximately 0.6 mile north of MP 162.0. On the Winema National Forest, the West Boundary IRA is about 2.2 miles northeast of MP 172.25.

Construction and operation of the Pacific Connector Pipeline Project would have no direct impacts on IRAs. However, Pacific Connector did develop a general TMP for federal lands (see section 4.10.2). An evaluation of IRAs and Wilderness Areas in terms of consistency with federal LMPs can be found below in section 4.8.1.3.

National Recreational Areas and Trails

BLM Shorelands SRMA and Forest Service ODNRA

BLM's Shorelands SRMA on the North Spit is located at its closest point about 0.5 mile northwest of the terminus of the Pacific Connector pipeline at the Jordan Cove Meter Station. The southern boundary of the Siuslaw National Forest's ODNRA is located about 0.5 mile north of the pipeline terminus. The BLM's Shorelands SRMA and Forest Service's ODNRA are discussed above in relationship to the Jordan Cove LNG terminal.

It is possible that Pacific Connector Pipeline Project construction traffic along the Trans-Pacific Parkway could affect recreational users of the BLM's Shorelands SRMA and the Forest

Service's ODNRA. Those transportation impacts should be temporary and short term. Pacific Connector has developed a TMP to reduce impacts on other road users during pipeline construction activities. This is further discussed in section 4.10.2.

Recreational users of the Shorelands SRMA and the ODNRA may also be exposed to noise from construction of Pacific Connector's Jordan Cove Meter Station and related pipeline. Again, that noise should be temporary and short-term. In part, the volume of the pipeline construction noise should be mitigated by distance, topography, vegetation, and ambient noise levels from other sources, including non-project related traffic on the Trans-Pacific Parkway, OHVs, and other industries on the North Spit. Noise is more fully discussed in section 4.12.2.

The Pacific Connector pipeline would have no direct impacts on the Shorelands SRMA and ODNRA because it does not cross those areas. We conclude that recreational use of the Shorelands SRMA and ODNRA would not be adversely affected by construction or operation of the Pacific Connector Pipeline Project.

Pacific Crest National Scenic Trail

The PCT is a 2,650-mile-long hiking and equestrian trail stretching from the Canadian border in Washington to the Mexican border in California. With the passage of the National Trails System Act of 1968, as amended, Congress designated the PCT as one of the first scenic trails in the nation (Forest Service 1982). Thousands of hikers, horse riders, cross-country skiers, and snowshoers use the trail each year (Forest Service 2006d). Approximately 430 miles of the PCT runs through the Cascade Mountain Range in Oregon. The PCT in Oregon is very popular among hikers of all abilities and is considered to contain many of the easiest sections of the trail (PCTA 2002). The pipeline route crosses the PCT at approximately MP 167.8.

Northeast of the pipeline route near MP 162.0, the PCT skirts the western flank of Brown Mountain and the lava beds to its south in the Rogue River National Forest. Trail users can access the trail in several locations near the pipeline route area, including a registered trailhead on the Dead Indian Memorial Highway (County Road 533). This trailhead is about 1.3 miles west of where the pipeline would cross this road (MP 168.8). The trail can also be accessed using Forest Road 700, or using the Brown Mountain trail accessed by Forest Road 3705.

On October 26, 2013, a representative of the Pacific Crest Trail Association (PCTA) wrote a letter to the FERC in response to our NOI. The PCTA believes that the language in the Forest Service's proposed LMP amendment RRNF-3 is confusing. The PCTA objects to allowing 15 to 20 years for the Visual Quality Objective (VQO) of Modification to be attained. The PCTA requested that specific mitigation measures be considered in this EIS, including narrowing the pipeline construction right-of-way, feathering the edges of the corridor, and planting native vegetation.

Following issuance of the DEIS, we received additional comments from the PCTA, as well as comments from the Forest Service PCT Program Manager and other individuals, expressing dissatisfaction with the language in the proposed amendment RRNF-3. The comments were focused on the length of time it would take to attain the VQO, and suggested additional mitigation measures to shorten the time frame specified in the amendment. These mitigation measures include increasing the length of the construction corridor that would be narrowed from a 95-foot wide to a 75-foot wide construction right-of-way on both sides of the crossing, planting

larger trees, and managing existing vegetation in the corridor. Additionally, the commenters recommended avoiding construction during the peak hiking season, which is considered to be June to August. Finally, it was strongly suggested that on-site interpretation of the Project during construction and initial recovery period would be critical to explain the disturbance and visual restoration to trail users. The discussion below addresses how the Project took these concerns into account.

Installation of the pipeline would affect PCT users for a short duration of time. Pacific Connector proposes to construct the portion of the pipeline across the trail as a "tie-in" to reduce the period when trail users are inconvenienced. While the tie-in is being constructed, for up to 48-hours, trail users would be redirected along a detour. Pacific Connector also included site-specific mitigation measures in its *Recreation Management Plan* (Appendix S of the POD), which adopts most of the suggestions made by the PCTA. This plan will be updated to include additional mitigation measures identified by new analysis described below. Measures in the plan that would reduce impacts on the PCT include:

- providing advance notice of construction to the Forest Service and PCTA;
- providing advance notice about the trail detour, and installing detailed detour route signs;
- constructing the PCT crossing outside of the busiest season of trail use (June to August), preferably in September;
- necking-down, or narrowing the pipeline construction right-of-way from 95 feet to 75 feet wide for 300 feet on both sides of the PCT crossing;
- establishing a roughed-in trailhead within 24 hours of crossing completion, with temporary directional signs posted at each end of the crossing;
- restoring the trail to full design standards within 2 weeks of completing the trail crossing (weather permitting);
- installing standard Nordic ski trail markers as needed post-construction;
- using a combination of rocks, logs, slash, and gates to deter motorized vehicles and OHVs from gaining access to the PCT during restoration;
- revegetating the right-of-way using native trees and shrubs; and
- installing on-site interpretive signs as directed by the authorized Forest Service representative.

Pacific Connector intends to use a "dog-leg" segment to avoid a perpendicular crossing of the trail. This bend in the route should reduce the visibility of the pipeline corridor to trail users (see section 4.8.2.3 for an assessment of visual resources on federal lands). A straight line perpendicular crossing of the PCT is discussed as an alternative route in section 3.4.2.11.

The Forest Service proposes to amend the LMP of the Rogue River National Forest so that the VQO at the Pacific Connector pipeline crossing of the PCT is changed from Foreground Partial Retention to Modification. In the DEIS, this amendment stated that the period necessary to achieve this new VQO would be extended from three years to up to 20 years, to take into account the time necessary for newly planted trees to mature. Based on comments received for the DEIS, the PCT visual management issue was reanalyzed and the language of this amendment was revised to only allow up to five years for the VQO to be attained. The Forest Service LMP amendment RRNF-3 (as revised) is more fully explained in section 4.8.2.4.

The new analysis incorporated key observation points for the trail crossing, which were not used for the DEIS (see appendix R). This methodology, to simulate vegetation recovery over time, is described in section 4.8.2.2. It also incorporated additional project design features and mitigation as described below. These treatments intend to reduce the amount of construction-related disturbance to soils and vegetation in order to shorten the recovery time for visuals. They will be added to Pacific Connector's *Aesthetics Management Plan*, *Leave Tree Protection Plan*, and Forest Service compensatory mitigation package, as applicable. The reanalysis found that implementation of these measures would shorten vegetative recovery to achieve a VQO of Modification within five years. This analysis is contained in appendix R. The list of site-specific design features includes:

- no grading of the corridor within the 75-foot neck-down segments to retain topsoil and shrubs;
- use of timber mats within the 300-foot neck-down segments during construction on the working side of the 10-foot-wide ditch zones to protect soils and retained shrubs;
- retention of shrubs within the neck-down segments by mowing to six inches in height and protecting vegetation with timber mats;
- hydro-mulch seeding of all disturbed soils;
- on-site shrubs and ground cover plants dug from the 10-foot-wide ditch zone, heeled-in root balls in a safe storage location and transplanted back into the ditch zone;
- topsoil (the duff layer and A horizon) of the ditch zone collected or stripped, segregated and stored, and laid down after backfilling the trench;
- duff placed with rubber-tracked equipment to avoid compaction, and raked by hand onto the trench zone;
- nursery trees planted along the edges in scalloped arrangement;
- root prune large trees in areas designated by Forest Service Silviculturist one year in advance, and transplant root pruned trees with tree spade to the right-of-way edge;
- use drip irrigation system for five years after completion of the construction;
- replant if mortality exceeds 30 percent;
- place logs in corridor; and
- scallop adjacent edges of timber as directed by Forest Service landscape architect.

Because the revised analysis is dependent on implementation of these additional project design features and mitigation, **we recommend that:**

- **<u>Prior to construction,</u> Pacific Connector should file with the Secretary a revised *Recreation Management Plan, Aesthetics Management Plan, and Leave Tree Protection Plan* that address the Forest Service requirements for the pipeline crossing of the PCT near MP 167.8, and documentation that the revised plans were found acceptable by the Forest Service.**

South Brown Mountain Shelter

The South Brown Mountain Shelter is a small, fully enclosed log cabin about 200 yards off the PCT in Section 32, T.37S, R.5E. The shelter, located in the Rogue River National Forest near its boundary with the Winema National Forest, is used year-round by hikers, cross-country skiers, snowmobilers, and others. The cabin contains a wood stove, primitive storage facilities, and counter spaces. In the fall of 2005, it was significantly repaired and updated by a group of volunteers (PCTA

2006). Potable well water is also available using a hand pump that is operational from mid-May to late October.

The South Brown Mountain Shelter is approximately 600 feet north of the pipeline route near MP 167.7; and would not be directly affected by construction or operation of the pipeline. Temporary noise from pipeline construction may be audible at the shelter, but visitors would not be able to see the pipeline because of the existing vegetation screening that is located between the shelter and the right-of-way. Distance, topography, and vegetation would reduce pipeline construction noise at the shelter. The impacts from pipeline construction noise would be temporary, and should not adversely affect users of the shelter.

Brown Mountain Trail

The Brown Mountain Trail is a path for non-motorized users on the Winema and Rogue River National Forests. The trail is linked by two short sections of forest roads and circles Brown Mountain. One access point is near the pipeline at a trailhead on Forest Road 3705, near South Fork Little Butte Creek about a mile north of MP 165.0. In addition to summer recreational activities, cross-country skiing and snowmobiling are popular winter sports along the Brown Mountain multi-use trail system between about MPs 160 and 170.

The Brown Mountain Trail and access on Forest Road 3705 are not expected to be affected by pipeline construction or operation. However, the Forest Service has noticed that a relatively new housing development has allowed snowmobilers to access the PCT between Dead Indian Memorial Highway and Forest Road 700. The Forest Service is concerned that the Pacific Connector pipeline right-of-way could become another unwanted point of access. We discuss measures to discourage unauthorized OHV and snowmobile use of the right-of-way below and in section 4.10.2.

Applegate Branch of the California National Historic Trail

The Applegate Trail was opened in 1846 by Jesse and Lindsey Applegate and their associates to link the Oregon-California Trail from Fort Hall, Idaho to southern Oregon and the Willamette Valley. About 3,500 people used this route in 1853. The U.S. Congress designated it a National Historic Trail in 1992 as part of the California National Historic Trail system. In a letter to the Commission dated August 20, 2012, the NPS indicated that the Pacific Connector pipeline route was likely to cross the Applegate Branch of the California National Historic Trail in two places: north of the Klamath Compressor Station (near MP 227.8) and along Dole Road (near MP 71.6). These crossings would be on non-federal lands. Pacific Connector consulted with the NPS, and provided information that at both crossing locations modern roads have removed traces of the historic trail. In a letter to Pacific Connector, the NPS concurred that the Project would have no adverse visual impacts on intact segments of the Applegate Trail. This is further discussed in section 4.11.

Federal Recreational Lakes and Reservoirs

Lake of the Woods

The Lake of the Woods is located on NFS lands managed by the Winema National Forest, about 4.5 miles away from the Pacific Connector pipeline at about MP 171. A private resort at the lake provides year-round lodging and service, as well as a marina. During the summer, the lake is

used for boating, fishing, and camping activities. During the winter cross-country skiing and snowmobiling are popular recreational activities in this area.

The pipeline route does not cross the Lake of the Woods. However, Pacific Connector proposes to use the lake as a potential source of hydrostatic test water. The water would be withdrawn during late summer or fall, from the east side of the lake near the Sunset Campground and boat launch. Water trucks would use Forest Service Road 3700240, and Dead Indian Memorial Highway to reach the pipeline right-of-way. Decontamination strategies for water trucks involved in hydrostatic test water transfer are provided in the POD. Use of these roads is addressed in Pacific Connector's TMP for federal lands. Pacific Connector indicated that after it has selected a construction contractor for the pipeline, it would submit a water withdrawal plan to the ODWR, which manages water rights for Lake of the Woods. The water withdrawal plan would outline measures to minimize impacts on recreational users and encumbrances at the lake. Hydrostatic testing is also discussed in section 4.4.2.

Fish Lake

Fish Lake is located on NFS lands managed by the Rogue River National Forest near the crest of the Cascades about 2.5 miles away from the pipeline route at about MP 162. The lake itself is managed by Reclamation. The Fish Lake Recreation Area included a privately-operated resort with cabins, a trailer park, campgrounds, picnic spots, a marina, and a boat-launching ramp. During the summer the lake supports water related activities, including fishing and boating. During the winter, ice-fishing, cross-country skiing, and snowmobiling are popular in the area.

The pipeline route does not cross the Fish Lake Recreational Area. However, Pacific Connector proposes to withdraw hydrostatic test water from Fish Lake. Water would be withdrawn from two places around the lake: one located at the lower end of the lake near the dam; and the other at the upper end of the lake in the vicinity of the Fish Lake Campground and boat ramp. No roads or recreational facilities would be closed because of the hydrostatic test water withdrawals from the lake; however, water trucks would use Forest Service Roads 2800700, 2800706, and 2800800. Use of these roads is addressed in Pacific Connector's TMP for federal lands. Pacific Connector indicated that after it has selected a construction contractor for the pipeline, it would submit to the authorized agency a water withdrawal plan for Fish Lake that outlines measures to minimize impacts on recreational users and encumbrances at the lake. Hydrostatic testing is also discussed in section 4.4.2.

John C. Boyle Reservoir

The John C. Boyle Reservoir is operated by PacifiCorp as part of a FERC-licensed hydropower project. It is located on the Klamath River, about 2.3 miles southwest of the Pacific Connector pipeline route at about MP 186. The BLM provides facilities for camping, picnicking, fishing, boating, and swimming at the reservoir, and operates boat launches and the Topsy Recreation site.

The proposed pipeline route does not cross the John C. Boyle Reservoir and associated recreation area. However, construction-related traffic may cause congestion or delays on Highway 66 and the Keno Access Road that may affect recreational users of the reservoir for a temporary period. Potentially, the reservoir could be a source of water for pipeline hydrostatic testing. Section 4.4.2.5 includes a discussion of pipeline hydrostatic testing.

ACECs

North Spit ACEC

The North Spit ACEC is located about 3.5 miles southwest of the Jordan Cove Meter Station, where the pipeline would terminate. The North Spit ACEC would not be directly affected by construction or operation of the Pacific Connector Pipeline Project.

Upper Rock Creek ACEC

The BLM's Coos Bay District designated 472 acres in Section 5, T.29S., R.9W., Douglas County, Oregon as the Upper Rock Creek ACEC. The purpose of this ACEC is to maintain, protect, and restore the area's natural systems and botanical values, which include western red cedar and western hemlock, and skunk cabbage, as well as sedge-dominated wetlands. The area also fills Oregon Natural Heritage Program Coast Range Ecological Cell 108 (ONHP 2003).

The pipeline route would cross about 300 feet of the Upper Rock Creek ACEC at about MP 43.5. Pacific Connector indicated that it cannot totally avoid crossing into the ACEC because of constructability issues. The pipeline route in this area generally follows BLM Road 30-10-3 (North Rock Creek Road), which is the eastern boundary of the ACEC. However, when the road turns south, the pipeline route would continue along a stable ridgeline to avoid a steep side slope. The alignment would affect about 1 acre of regenerating forest (about 30 years of age) within the ACEC. The BLM has found that this crossing would not adversely affect Relevant and Important values of the ACEC and would not conflict with management of this area (BLM 2009b, 2013b). Pacific Connector developed an *Upper Rock Creek ACEC Crossing Plan* as Appendix AA of its POD. To reduce impacts on the ACEC, Pacific Connector would:

- minimize the number and size of temporary workspaces along the construction right-of-way, including TEWAs and UCSAs;
- mark, avoid, and protect trees along the edge of the construction right-of-way;
- restore the right-of-way after pipeline installation according to the ECRP, including reestablishing topographic contours and drainage patterns, ripping to relieve soil compaction, preparing a proper seedbed, and replanting trees to within 15 feet of the centerline; and
- monitor restoration to make certain that erosion control and revegetation were successful and treat any noxious weed infestations where necessary.

Pacific Connector identified an LSR in Section 5 of the ACEC. It would locate all TEWAs outside the LSR. Section 4.1.3.3 contains a discussion of federal land allocations under the NWFP and their management.

Biological surveys conducted by Pacific Connector identified a NSO Nest Patch (2188A) on the eastern side of the ACEC and an occupied MAMU stand (GS05) on the west side. Pacific Connector designed its currently proposed route to avoid the NSO core area and to avoid old-growth forest habitat with a one-quarter-mile buffer area around the MAMU stand. Effects on federally listed threatened and endangered species are more fully described in section 4.7.

OHVs and Right-of-Way Access on Federal Lands

Federal land managers have raised concerns that the pipeline right-of-way could be used to increase unauthorized OHV, snowmobile, and dispersed motorized access to federal lands.

Locations where unauthorized access could be exacerbated by the pipeline right-of-way include the area around the PCT near MPs 167.0-169.0; the Camel Hump area between MPs 123 and 128; the Obenchain area between MPs 132 and 137.2; along the Clover Creek Road between MPs 168.9 and 175.4 (on NFS land); and MPs 176.2 to 177 and 179.6 to 179.7 (on BLM lands). In the Obenchain area, four-wheel drive vehicles have caused extensive resource damage. The Camel Hump and Obenchain areas are located within the Jackson Access and Cooperative Travel Management Area, which encompasses both private and BLM lands, and is generally closed to motorized use from mid-October through April. In the area along the Clover Creek Road, the pipeline would closely parallel the road for 18 miles (on public and private lands); thus, the pipeline right-of-way could potentially turn into an OHV thoroughfare without appropriate barriers and mitigation.

OHV controls were addressed in Pacific Connector's *Recreational Management Plan*. The general measures Pacific Connector would use to limit OHV access to its right-of-way on federal lands would be the same as those discussed for non-federal lands above in section 4.8.1.2.

4.8.1.3 Recreation, Public Interest, and Special Use Areas Specific to Consistency with Federal LMPs

Forest Service Potential Wilderness Evaluation

Wilderness Areas, IRAs, and PWAs are discussed together here because they share a set of terminology and interrelated history. A wide range of terms and references have been used by respondents, the courts, and the Forest Service when referring to these topics such as roadless, unroaded, uninventoried roadless, undeveloped areas, and roadless expanse. The terms and definitions as stated below are used in this site-specific analysis. They are based on current law, regulation, agency policy, and the LRMPs, as amended, for the Umpqua, Rogue River and Winema National Forests.

Wilderness

A Wilderness Area is designated by congressional action under the Wilderness Act of 1964 and other wilderness acts. The Wilderness Act of 1964, Section 2(c) defines wilderness, in part, as:

> *[A]n area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements of human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; …*

Two Wilderness Areas are in proximity to the pipeline alignment: Sky Lakes Wilderness (113,590 acres) is in both the Winema and Rogue River National Forests and its southern tip is approximately 3.7 miles north of the pipeline alignment at MP 162.0; and Mountain Lakes Wilderness (23,071 acres), in the Winema National Forest, is approximately 2.3 miles north of MP 172.

No project activities would occur within or adjacent to a wilderness area. There would be no effects on designated wilderness or wilderness characteristics because the closest wilderness (Mountain Lakes) is over 2 miles away. Because of this distance, project activities would

typically not be seen or heard by anyone recreating in the wilderness. The exceptions could be short duration views of smoke during burning activities. Smoke management mitigation measures would minimize the risk of smoke drifting into the wilderness.

IRAs

IRAs were identified in the 2001 Roadless Area Conservation Rule in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation Final Environmental Impact Statement, volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps (36 CFR 294.11). These areas were set aside through administrative rulemaking and have provisions, within the context of multiple use management, for the protection of inventoried roadless areas.

The nearest IRA is the Brown Mountain IRA, located on the Rogue River National Forest approximately 0.6 mile north of MP 162.0. On the Winema National Forest, the West Boundary IRA is about 2.2 miles northeast of MP 172. No activities associated with the Pacific Connector Pipeline Project would occur within or adjacent to an IRA; therefore, there would be no project-related effects on IRAs.

PWAs

This is not an official inventory. Official inventories of potential wilderness areas are completed during forest planning. This analysis considers PWAs only for purposes of assessing potential effects of the Pacific Connector pipeline activities on wilderness characteristics. PWAs are not a land designation decision (e.g., does not change current land management allocations), they do not imply or impart any particular level of management direction or protection, they are not an evaluation of potential wilderness (Forest Service Handbook [FSH] 1909.12, Chapter 72), and they are not preliminary administrative recommendations for wilderness designation (FSH 1909.12, Chapter 73). The inventory of PWAs does not change the administrative boundary of any IRA or any congressionally designated wilderness. The original designated management area (*e.g.*, Matrix) would remain the land designation even if areas in the project planning area meet the handbook criteria for PWAs. PWAs are evaluated (regarding making recommendations to Congress for inclusion in the National Wilderness Preservation System) during the development or revision of land management plans, in other words at the forest planning level and not at the project planning level.

PWAs qualify for placement on the inventory if they meet one or more of the following criteria (FSH 1909.12, Chapter 71):

1. The area contains 5,000 acres or more.
2. Areas contain less than 5,000 acres, but can meet one or more of the following criteria:
   a. Area can be preserved due to physical terrain and natural conditions.
   b. Areas are self-contained ecosystems, such as an island, that can be effectively managed as a separate unit of the National Wilderness Preservation System.
   c. Areas are contiguous to existing wilderness, primitive areas, Administration endorsed wilderness, or potential wilderness in other Federal ownership, regardless of their size.

3. Areas do not contain forest roads (36 CFR 212.1) or other permanently authorized roads, except as permitted in areas east of the 100th meridian.

Areas may meet either criteria 1 and 3, or criteria 2 and 3. If the criteria in section 71.1 of the FSH are met, criteria in section 71.11 of the FSH (criteria for including improvements) must also be met. This analysis used the following project-specific criteria to delineate areas characterized as undeveloped and roadless, yet included improvements:

- Roads (as defined in 36 CFR 212.1) were excluded per FSH 1909.12, section 71.1. Mapped areas were at least 300 feet from NFS roads. This distance was selected because tree harvest is commonly permitted within 300 feet of open forest roads for personal-use firewood. In addition, danger tree removal occurs at various distances from open forest roads depending on tree height, topographic slope, and other factors.
- Timber harvest areas where logging, as evidenced by stumps, and prior skid trails or roads are substantially unrecognizable, or areas where clearcuts have regenerated to the degree that canopy closure is similar to surrounding uncut areas per FSH 1909.12, section 71.11.

No undeveloped areas greater than 5,000 acres would be crossed by the Pacific Connector pipeline route. All of the undeveloped areas crossed by the pipeline are less than 5,000 acres in size, are not contiguous to existing Wilderness or IRAs, and do not meet the PWA criteria for areas less than 5,000 acres. As a result, the Project would not affect any PWAs.

Other Undeveloped Areas

Other undeveloped areas refer to those areas that do not meet inventory criteria as PWAs, and are not an IRA or designated Wilderness area. There are no forest-wide or management area standards and guidelines specific to other undeveloped areas in the Umpqua, Rogue River, and Winema National Forest LRMPs. All lands, including undeveloped areas, are managed consistent with forest-wide standards and guidelines and by designated LRMP management area allocations. Other undeveloped areas are identified because they may contain special resource values that warrant an evaluation differently than other parts of the project area.

There are approximately 3,747 acres of other undeveloped lands not meeting PWA criteria that would be crossed by the pipeline on NFS lands. Approximately 1,792 acres of these areas are within the Umpqua National Forest, and approximately 1,955 acres are within the Rogue River National Forest (see appendix R for maps and additional information). The portion of the pipeline route within the Winema National Forest is on or adjacent to existing roads and would not impact "other undeveloped areas." Other undeveloped areas may have intrinsic ecological and social values because they do not contain roads (or the roads are no longer system roads) or evidence of past timber harvest. These values can include intrinsic physical and biological resources (e.g., soil, water, wildlife, recreation, fisheries, etc.), and intrinsic social values (e.g., apparent naturalness, solitude, remoteness).

Human influences have had limited impact to long-term ecological processes within these other undeveloped areas. Disturbances by insects and fire have likely been the factors with the most potential to have affected the area. Opportunities for primitive recreation include camping, hiking, hunting, wildlife watching, and photography. Opportunities for a feeling of solitude, the spirit of adventure and awareness, serenity, and self-reliance are limited by the size and shape of

the areas, as well as by distance to roads and topographic screening. The size of the area necessary to feel a sense of solitude varies by individual; however, areas that are long and narrow offer less opportunity for solitude due to less distance from noise at their midpoint. Nearby sounds of roads, timber harvest, and other management activities can often be heard and the activities sometimes seen from within these undeveloped areas because they are all within approximately 1 mile or less of the nearest road from their midpoints.

The Pacific Connector Pipeline Project would directly impact approximately 8 acres of other undeveloped areas on the Umpqua National Forest and approximately 22 acres on the Rogue River National Forest. These impacts include the areas cleared by the right-of-way construction, the TEWAs, and the acres used as UCSAs.

For these other undeveloped areas within the pipeline project area where construction and operation would occur the impacts to soil; water quality; air quality; forage; plant and animal communities; habitat for threatened, endangered, and sensitive species; developed recreation; noxious weeds; and cultural resources are essentially the same as disclosed above for recreation and in other sections of chapter 4 of this EIS and are not reiterated here.

The Pacific Connector Pipeline Project would impact the apparent naturalness and solitude within these areas. Pipeline construction would alter the apparent naturalness on approximately 30 acres of these areas. The increase in the number of visible stumps, and the linear nature of the pipeline corridor clearing would be the most apparent visual change resulting from implementation. The linear nature of the cleared corridor would likely adversely affect the visual recreational experience of anyone using these areas for dispersed recreation. This impact would be long term due to a portion of the right-of-way being maintained as a low vegetation area for the life of the pipeline project. Although the pipeline construction and operation would adversely affect visual resources in these areas, they would not be inconsistent with the standards and guidelines for visual quality in the respective LRMPs.

Activities associated with the construction of the pipeline in and adjacent to these other undeveloped areas would reduce the sense of solitude and remoteness during construction activities. Other sights and sounds of ongoing and previously approved activities in areas adjacent to these other undeveloped areas would continue to have short-term effects on opportunities for solitude and remoteness. Overall, there would be little change to the current availability of solitude or primitive recreation within these areas because only a very small portion (approximately 0.8 percent) would be affected by the Pacific Connector Pipeline Project.

BLM Lands with Wilderness Character

In the fall of 2012, the BLM updated its inventory of lands with wilderness character. These updates were part of the Analysis of the Management Situation process associated with the RMPs for western Oregon. The inventory covered BLM lands in the Salem, Eugene, Roseburg, Coos Bay, and Medford Districts, as well as the Klamath Falls Resource Area of the Lakeview District. The results of this most recent inventory were compared to the proposed route, and no areas of overlap were discovered. Figure 4.8-2 shows this inventory, and the proposed route of the Pacific Connector Pipeline Project. The pipeline would not impact BLM land with wilderness character.

4.8.2 Visual Resources

Procedures for describing the existing visual condition of the landscape and visual impact assessment used for the Project are consistent with methodologies developed by the BLM (1981), Forest Service (1973, 1995b), the FHWA (1981), and the COE (Smardon et al. 1986). This section describes the techniques for assessing potential visibility of the Project facilities and their visual effects on the landscape.

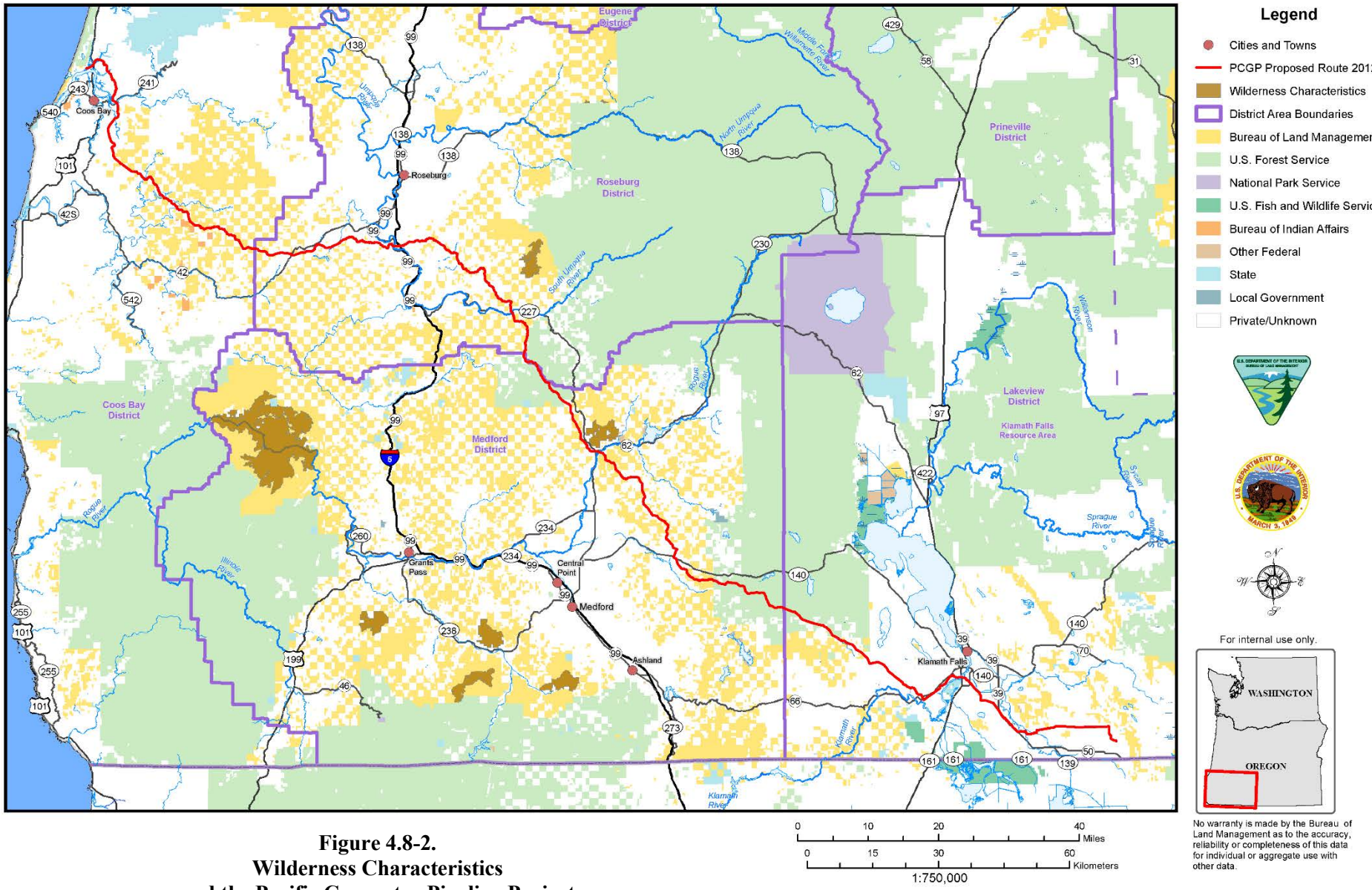


Figure 4.8-2.
Wilderness Characteristics
and the Pacific Connector Pipeline Project

4.8.2.1 Jordan Cove LNG Terminal

The Jordan Cove LNG terminal and associated South Dunes Power Plant facilities would be located on privately owned, mostly open industrial-zoned land. Between the LNG terminal and the South Dunes Power Plant site is the existing Roseburg Forest Products wood chip facility, which includes a dock for mooring ships, infrastructure for loading ships, such as a 190-foot-tall loading tower, large wood chip piles with associated heavy equipment, two large buildings, several small outbuildings, and two large water tanks. Other existing industrial facilities on the bay side of the North Spit include Southport lumber mill and the D.B. Western manufacturing plant. However, these plants are located about 1.2 miles southwest of the LNG terminal site, with undeveloped land in between. The existing industrial facilities would be a visible part of the landscape for viewers of the LNG terminal from points within the Shorelands SRMA and ODRA on the North Spit, and from the cities of Coos Bay and North Bend on southern and eastern shores of Coos Bay.

Topography on the west side of the LNG terminal parcel is relatively flat, where fill material has been covered by brush and grasses. The east side of the LNG terminal tract includes forested sand dune ridges reaching elevations that exceed 100 feet AMSL. The site of the South Dunes Power Plant is also relatively flat and has previously been used for industrial purposes. Between 1961 and 2003 that area contained a mill that has since been dismantled.

Once constructed, the largest aboveground structures within the Jordan Cove terminal would be the two LNG storage tanks, which would each be approximately 267 feet wide and 180 feet tall. At the South Dunes Power Plant, the tallest structures would be the HRSG stacks, which would be approximately 100 feet tall.

Key Observation Point Selection

A visual impact assessment was conducted to determine the potential impacts on the visual resources associated with the LNG terminal. Representative viewing points (hereafter referred to as key observation points or KOPs) were identified within the terminal viewshed, or the area from which the terminal would be potentially visible. Objects typically become apparent to the viewer when they are seen in the foreground, at a distance of one-half mile or less, but may affect viewers when they are present in the middleground (up to 4 miles from the viewer) depending on the extent of landscape modification and other visual factors. In the case of the LNG export terminal, the viewshed for the terminal extends to a distance of approximately 2 miles from the terminal site and was defined using aerial and ground photography, local planning documents, computer modeling, and field reconnaissance. Site visits to document existing visual conditions in the terminal area and to identify potentially affected sensitive viewing locations were conducted in April 2006, and were updated in May 2013 to include the non-jurisdictional South Dunes Power Plant. These KOPs were selected to characterize the visibility of the proposed facility and its impact on potential viewers and the landscape in which it would be constructed and operated. From much of the terminal viewshed, it is anticipated that views of the LNG terminal would be partially or fully screened by existing trees, landforms, or intervening man-made development.

The viewing points included in the assessment consisted of locations with concentrations of viewers, such as major roadways or housing developments, visually sensitive land uses such as parks and recreation areas, culturally sensitive locations such as historic sites, and places

designated as having scenic importance such as highways and overlooks. Figure 4.8-3 indicates the locations of the KOPs used for visual assessment of the LNG terminal, and the location of the most prominent features at the LNG terminal and South Dunes Power Plant sites. Each of the KOPs is described in detail below.

Analyzing potential visual impacts from a series of viewing points allows the experience of actual viewers to be taken into account. Potential impacts from these locations can then be evaluated by superimposing the LNG terminal structures and other developmental impacts (e.g., vegetation removal) as viewed from these locations.

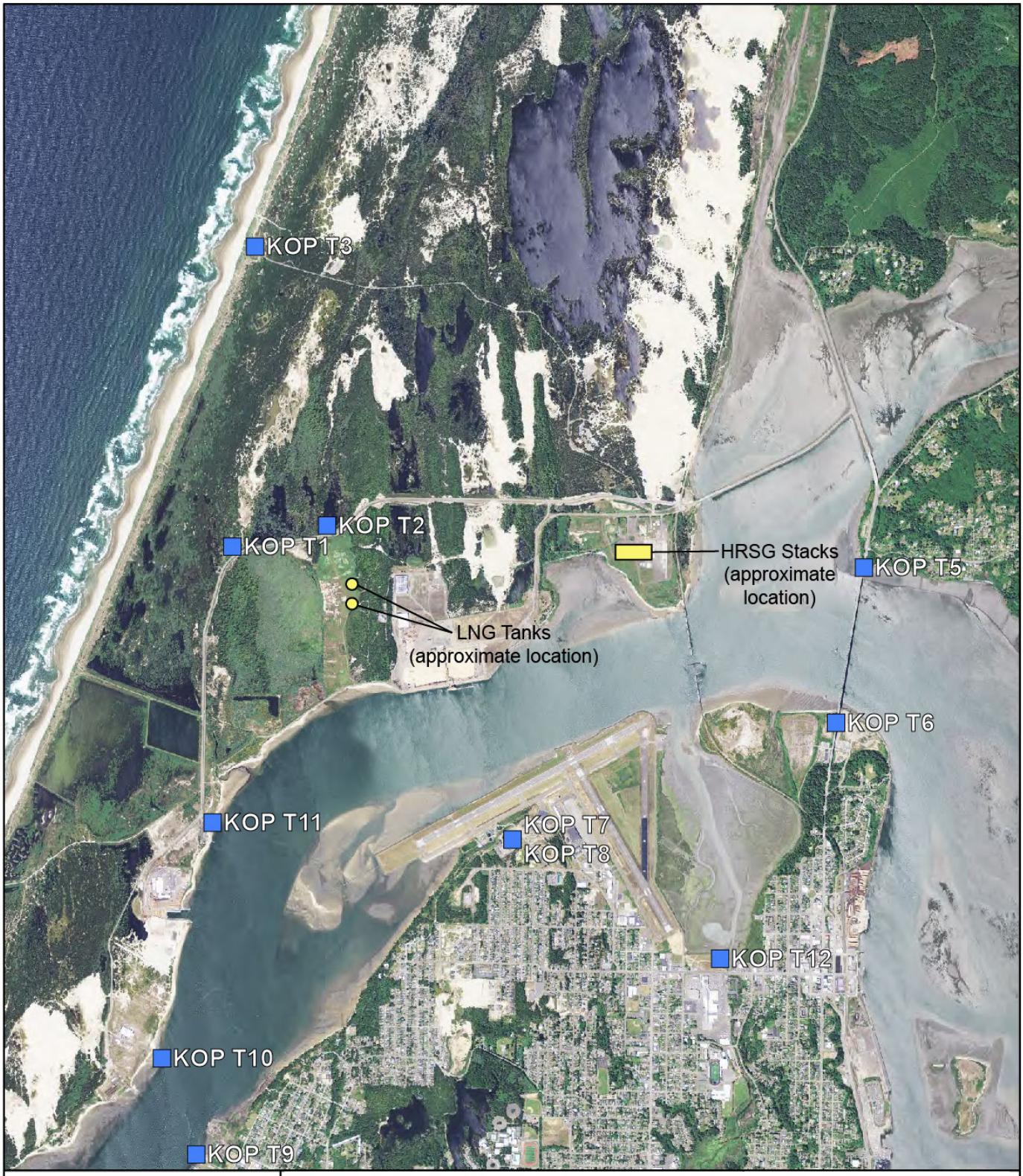
Visual Simulations

To illustrate the anticipated visual changes resulting from the construction of the LNG terminal, simulations were prepared for each of 12 KOPs using computer modeling and rendering. The resulting images are presented in pairs within figures 4.8-4 through 4.8-15, each showing the existing conditions (or "before" view) and a visual simulation (or "after" view), which illustrates built portions of the Project. The visual impact assessment was based on evaluation of the changes to the existing visual resource that would result from completed construction and operation phase of the facilities.

The visual simulations are the result of an objective analytical and computer modeling process, and are accurate within the constraints of the available site data and LNG terminal design. Existing geographic information systems (GIS), a digital elevation model, engineering data, and digital aerial photographs provided the basis for developing three-dimensional digital models of the LNG storage tanks using a real-world coordinate system.

KOP Analyses

For the purposes of the visual impact analysis, emphasis has been placed on the visibility of the LNG storage tanks and the HRSG units, which would be the most visible feature of the LNG export terminal and non-jurisdictional South Dunes Power Plant, respectively.



0 0.25 0.5 1
Miles

Figure 4.8-3

Key Observation Point Locations

KOP-T1 Weyerhaeuser North Spit Overlook—Located approximately 0.6 mile west of the LNG storage tanks, this location represents views experienced by visitors of the North Spit Overlook and associated nature trail. There would be an unobstructed view of the LNG terminal from this location. Additionally, once the forested sand dune is removed, as shown in figure 4.8-4, facilities at the adjacent Roseburg wood chip facility would become visible from this location. The facilities of the non-jurisdictional South Dunes Power Plant would be almost completely hidden by vegetation from this viewpoint.

KOP-T2 Trans-Pacific Parkway at Jordan Cove Project Site Entrance—Located approximately 0.3 mile north of the LNG storage tanks, this point represents views from the Trans-Pacific Parkway at the entrance to the LNG terminal project site. This is the closest point at which members of the general public would be able to view the LNG terminal and the LNG tanks in particular. As shown in figure 4.8-5, there would be an unobstructed view of the LNG terminal site from location. Additionally, facilities at the adjacent Roseburg wood chip facility would become visible after the forested sand dune is removed. The South Dunes Power Plant would not be visible from this perspective.

KOP-T3 Horsfall Beach Campground and Day Use Area—Located approximately 1.6 miles northwest of the LNG storage tanks, this point represents views experienced by visitors of the ODNA. The simulation indicates that the domes of the LNG storage tanks would be visible above the existing tree line (figure 4.8-6). Intervening topography and vegetation obstructs views to other LNG terminal from this location. The South Dunes Power Plant would not be visible from this perspective.

KOP-T5 U.S. Highway 101 at the Northern end of McCullough Bridge—Located approximately 2.3 miles east of the LNG storage tanks, this KOP is representative of the views seen by motorists on U.S. Highway 101 and residents in the city of North Bend. The simulation depicts the removal of the forested sand dune, but the LNG storage tanks are located behind other intervening topography and therefore would not be visible from this location (figure 4.8-7). Additionally, buildings and other aboveground facilities/materials located on the Roseburg wood chip facility site would obscure views of most of the LNG terminal facilities. KOP-T5 is approximately 1.0 mile from the South Dunes Power Plant site, the approximately 100-foot-tall HRSG units of which would be clearly visible from this location.

Figure 4.8-4. KOP-T1. Weyerhaeuser North Spit Overlook. Existing and simulated views of the LNG terminal from the Weyerhaeuser North Spit Overlook

Figure 4.8-5. KOP-T2. Trans-Pacific Parkway. Existing and simulated views of the LNG terminal from Trans-Pacific Parkway.

Figure 4.8-6. KOP-T3. Horsfall Beach Campground and Day Use Area. Existing and simulated views of the LNG terminal from the Horsfall Beach Campground and Day Use Area.

Figure 4.8-7. KOP-T5. U.S. Highway 101 at McCullough Bridge, North. Existing and simulated views of the LNG terminal and South Dunes Power Plant HRSG Units, from U.S. Highway 101 at the northern end of McCullough Bridge.

KOP-T6 U.S. Highway 101 at the Southern end of McCullough Bridge—Located approximately 2.3 miles east of the LNG storage tanks and 1.3 miles southeast of the South Dunes Power Plant, this point is representative views seen by motorists along U.S. Highway 101 and residents of the City of North Bend. Viewers at this location would have an unobstructed view of both the LNG storage tanks and the HRSG units (figure 4.8-8).

KOP-T7 Airport Lane in North Bend, facing NW—Located approximately 1.3 miles south of the two LNG storage tanks and 1.5 miles southeast of the South Dunes Power Plant, this point represents views seen by North Bend residents and visitors to the Southwest Oregon Regional Airport. Viewers at this location would have an unobstructed view of the LNG storage tanks, as well as LNG vessels at the slip (figure 4.8-9).

KOP-T8 Airport Lane in North Bend, facing NE—Located approximately 1.3 miles south of the two LNG storage tanks and 1.5 miles southeast of the South Dunes Power Plant, this point represents views seen by North Bend residents and visitors to the Southwest Oregon Regional Airport. Viewers at this location would have an unobstructed view of the South Dunes Power Plant HRSG units (figure 4.8-10).

Taken together, the views at KOPs T7 and T8 represent a panoramic view from the airport and the northern portion of the peninsula, meaning that an observer would have to change their viewing direction in order to see each facility, but that an overall viewing experience from this location would include the visual impact of both facilities.

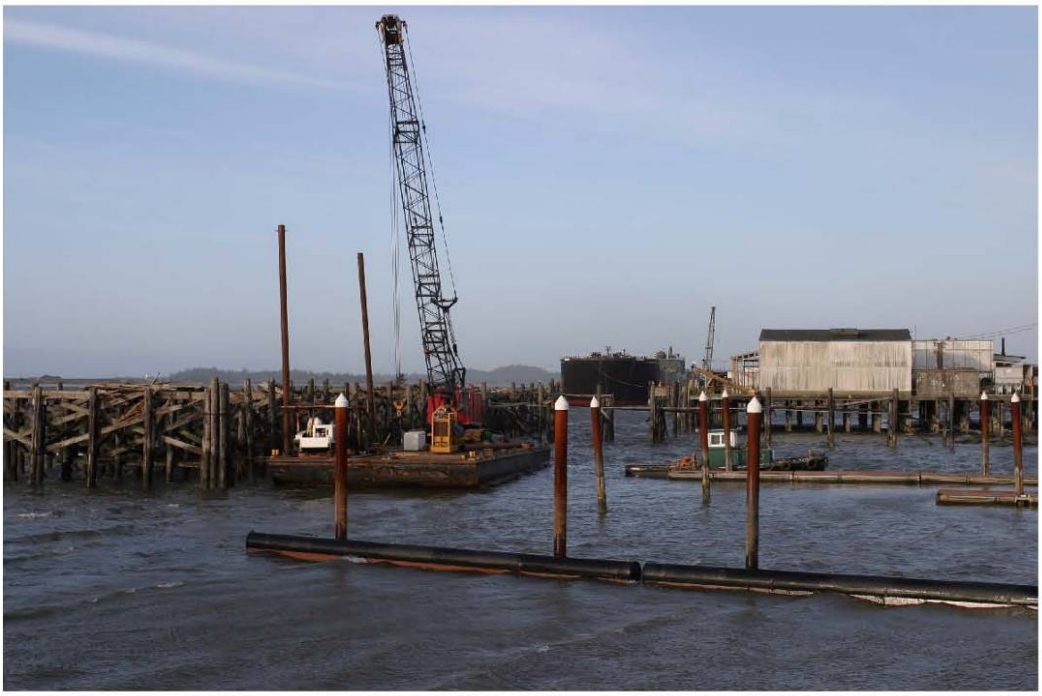
KOP-T9 Empire Shoreline—Located approximately 2.7 miles south of the LNG storage tanks, this point near Michigan Avenue in Empire represents views seen by residents in the Empire neighborhood. The simulation indicates that the LNG storage tanks would be visible from this location, as would LNG vessels at the slip (figure 4.8-11). The South Dunes Power Plant site is approximately 3.5 miles to the northeast, and intervening structures would completely obscure any view of the HRSG units from this location.

KOP-T10 Pier Near Industrial Facilities at South End of Trans-Pacific Parkway—Located approximately 2.3 miles southwest of the LNG storage tanks, this point represents views from the industrial area across the bay from the community of Empire. The LNG storage tanks and vessels docking at the slip would visible from this location (figure 4.8-12). The South Dunes Power Plant site is approximately 3.2 miles to the northeast and a viewer at this location would have the potential to visually detect the plant.

Figure 4.8-8. KOP-T6. U.S. Highway 101 at the southern end of McCullough Bridge. Existing and simulated views of the LNG terminal, from U.S. Highway 101 at the southern end of McCullough Bridge.

Figure 4.8-9. KOP-T7. Airport Lane, facing NW. Existing and simulated views of the LNG Terminal from Airport Lane, facing northwest.

Figure 4.8-10. KOP-T8. Airport Lane, facing NE. Existing and simulated views of the LNG terminal.



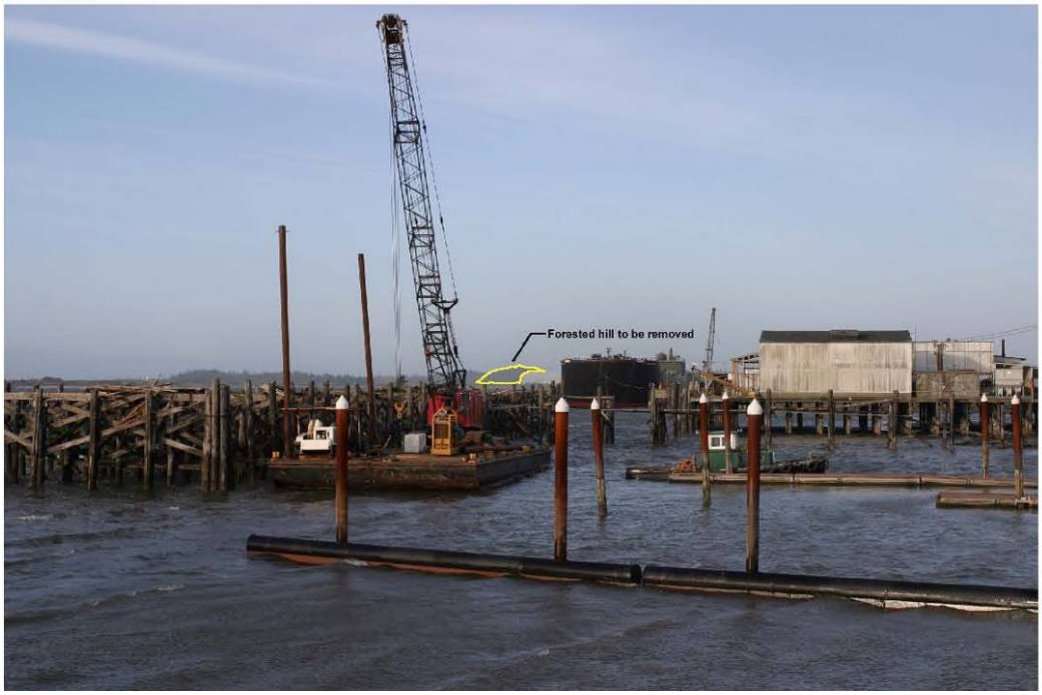


Figure 4.8-11. KOP-T9. Empire Shoreline. Existing and simulated views of the LNG Terminal from the boat launch near Michigan Avenue in Empire, Oregon.

Figure 4.8-12. KOP-T10. Pier Near Industrial Facilities at South End of Trans-Pacific Parkway. Existing and simulated views of the LNG terminal from the pier near the southern end of Trans-Pacific Parkway.

KOP-T11 BLM North Spit Boat Launch Area—Located approximately 1.2 miles southwest of the LNG storage tanks and 2.3 miles southwest of the South Dunes Power Plant, this point represents the view seen by recreationists using the Coos Bay Shorelands SRMA. The simulation indicates that the LNG storage tanks and vessels docking at the slip would be visible from this location (figure 4.8-13). The South Dunes Power Plant would be obscured by the Roseburg wood chip facility and intervening landform from this location.

KOP-T12 Pony Slough—Located approximately 1.9 miles southeast of the non-jurisdictional South Dunes Power Plant, this point represents the view seen by residents of North Bend, and of patrons of the Pony Village Mall, just to the south of this location. A viewer at this location would have an unobstructed view of the South Dunes Power Plant across the water (figure 4.8-14). Not pictured in figure 4.8-14, views of the LNG storage tanks, approximately 2.3 miles to the northeast, would likely be somewhat obscured by structures and topography from this location.

Visual Impacts and Proposed Mitigation Measures

An adverse impact on visual resources was considered significant and would require mitigation if construction or operation of the LNG terminal facilities would:

- cause inconsistency with adopted VRM Plans of the BLM;
- conflict with existing plans, policies, or regulations, and/or ordinances regarding aesthetics and visual resources established by a jurisdiction (state, county, or local governments) directly affected by the LNG terminal;
- displace or destroy a sensitive receptor location (business or permanent residence) from its established location;
- result in reductions in the quality of the recreation experience for more than one visitor use season (such as from a reduction in visual quality from landscape modifications and night illumination or reduced visibility to valued landscape features);
- result in a substantial adverse effect on a scenic area or vista;
- substantially damage scenic resources (including, but not limited to, trees, rock outcroppings, and/or historic buildings) visible from a state or federal scenic area, National Recreation Area, Scenic Byway, or Scenic Highway; or
- substantially degrade the existing visual character or quality of the site and its surroundings.

<u>Short-Term Visual Impacts</u>

Construction of the LNG terminal would be noticeable to recreational users on Coos Bay, in portions of the ODNRA, in portions of the North Spit Overlook, and in the Shorelands SRMA including the boat launch. Some residences in both the cities of North Bend and Coos Bay would also have views across the bay to the terminal. Construction activities would also be noticeable to motorists using the Trans-Pacific Parkway and the Pacific Coast Scenic Byway (U.S. Highway 101). Visual effects from construction activities would include dust as well as the presence of construction equipment on the LNG terminal site. These effects would be temporary and limited to the construction period.

Figure 4.8-13. KOP-T11. BLM North Spit Boat Launch Area. Existing and simulated views of the LNG Terminal from the BLM North Spit Boat Launch Area, on the North Spit.

Figure 4.8-14. KOP-T12. Pony Slough. Existing and simulated views of the South Dunes Power Plant HRSG units from the southern end of Pony Slough, in Coos Bay.

Short-term visual impacts during construction of the North Point Workforce Housing Complex would include the presence of a parking lot and pre-fabricated housing units and basic utility structures, which would visually resemble a small, dense residential community. The North Point Workforce Housing Complex would be dismantled and all structural elements removed from the site following completion of construction activities, and therefore visual impacts resulting from the housing complex would be short term.

Long-Term Visual Impacts

Based on the visual simulations, the Jordan Cove LNG terminal would be visible to the public and would alter the existing visual character and quality of the site. In addition to installation of the LNG tanks, another permanent impact includes the removal of portions of a forested dune located on the eastern portion of the terminal site. This hill is a prominent topographic feature, and its removal was incorporated in the simulations whenever possible.

The Jordan Cove LNG terminal would have a moderate to high visual impact on the nearby residential communities due to vegetation removal, landform modifications, and introduction of the LNG facilities at a previously undeveloped site. Most of the residential areas in the viewshed of the LNG site are located in the cities of Coos Bay and North Bend, to the south and across the bay from the LNG site. At a distance of about one mile, these residences would have middleground views of the Jordan Cove LNG terminal. These residential areas fall into two topographic areas: shoreline and hillside. Residences located along the shoreline of Coos Bay off Maxwell Road, Seagate Avenue, and to a lesser extent Fenwick Street would be subject to greater visual impacts than the hillside residences. This is due to the existing scenic quality along the shoreline and the generally unobstructed views of the Jordan Cove terminal site. The visual impact for these residences is considered high even when coupled with the fact that the shoreline residences currently have views of the industrial and commercial activities to the east of the Jordan Cove and the slip sites. Moderate visual impacts are anticipated for residences that would have views of the Jordan Cove and slip site as seen through partially obstructed views due to existing structures and vegetation.

The Jordan Cove LNG terminal facilities would be visible to recreational users on Coos Bay, in portions of the ODNRA, from the North Spit Overlook, and in portions of the Coos Bay Shorelands SRMA including the BLM boat launch. Visual impacts on recreational users in these areas with views of the Jordan Cove terminal would be moderate. LNG facilities would also be noticeable to motorists using the Trans-Pacific Parkway and the Pacific Coast Scenic Byway (U.S. Highway 101). Visual impacts to travelers on these roadways would be low.

A related element of the LNG terminal would be the introduction of LNG vessels to the viewshed of the Coos Bay area communities. Traveling between 4 and 10 knots, an LNG vessel would cross through the viewshed of the shoreline of the waterway in a few minutes. While LNG vessels are very large vessels, they are relatively close in size to other cargo ships that frequent the bay for the purpose of loading and hauling wood products, which average around 208 yards in length. Because ships of this scale are already a regular occurrence in the waterway, the presence of LNG vessels would not be a new impact on the visual resources of the waterway.

Proposed Mitigation Measures

Jordan Cove has proposed several measures that may mitigate long-term visual impacts. The exterior of the LNG storage tanks would be constructed of untreated concrete of a light grey color for cryogenic purposes, which would somewhat emulate the sand dunes characteristic of the area. While a darker color would help reduce the visual impact of the tanks from a distance, such treatment is not generally considered feasible because dark colors absorb heat, increasing the temperature of the tank exterior, and thus becoming problematic for LNG storage control. Various tank profiles and locations were evaluated in order to minimize visual effects with the conclusion that the proposed size, profile, and location would be the optimum considering other environmental factors, safety, and reliability. The LNG storage tanks would be enveloped with a 60-foot high storm surge barrier. The final landscape design would include provisions to contour and stabilize landforms not affected by construction to provide some level of screening. The use of native plants for restoration and stabilization of the landforms would also be incorporated into the final planting design to the extent practical.

Only lighting required for operation and maintenance, site safety and security, and to meet FAA requirements would be used on the LNG storage tanks and whenever possible, the light would be localized to minimize off-site effects. The lighting levels would be based on API standards. Lighting around equipment and facilities where routine maintenance activities could occur on a 24-hour basis would range from 1 to 20 foot-candles, with 20 foot-candle lighting levels within the compressor enclosures. General process area lighting would be kept to a minimum, on the order of 2 foot-candles. LNG terminal access road lighting would be 0.4 foot-candle. Perimeter security would be on the order of 1.3 foot-candles, using evenly spaced 400-watt floodlights. As a frame of reference, 20 foot-candles is close to the indoor lighting in a typical home, 2 foot-candles is typical of that found in a store parking lot, and 0.4 foot-candle is typical of residential street lighting.

4.8.2.2 Pacific Connector Pipeline

Visual resources along the pipeline alignment vary greatly. The natural landscape features vary from sandy treed dunes, to expansive bay views and temperate rain forest in the Coos Bay area to rolling steep conifer-forested hillsides in the Coast and Cascade ranges and foothills. Open oak savanna, pasturelands, and rolling hills are common in the viewsheds near Roseburg and east of Medford, with views transitioning to dramatic conifer mountain and volcanic landscapes in the Cascade Mountains. Rolling sagebrush rangeland and pine-juniper forests punctuated by westerly views of the Cascades compose a unique scenic landscape in the Klamath Basin.

Culturally-modified landscapes include farm and rangelands, small towns, and forest management activities including clearcut timber harvesting. Several viewsheds along the western portion of Pacific Connector pipeline route are of very low scenic integrity, including hillsides altered by clearcuts and traversed by logging roads. A few forested areas also include existing utility corridors. Where the pipeline crosses NFS lands within the Umpqua, Rogue River, and Winema National Forests, the forested viewsheds are characterized as ranging from low to high scenic integrity, with varying stages of forest maturity.

On BLM and NFS lands, visual resources are managed according to visual resource management guidelines. Most of the pipeline alignment would pass through viewsheds which allow moderate change. These are areas where alterations of the existing landscape would not significantly alter the existing characteristics of the viewshed. In a few locations, the pipeline would cross public

lands managed by the BLM or Forest Service that are designated as having high visual resource sensitivity under the agencies' visual management system. These areas are discussed in detail later in this section.

Key Observation Point Selection

A visual impact assessment was conducted to determine the potential impacts on the visual resources associated with the pipeline. The viewshed for the pipeline, within which representative KOPs were identified, extends to within 5 miles of the pipeline and was defined using aerial and ground photography, local planning documents, computer modeling, and field reconnaissance. Site visits were conducted in the summer of 2007 to document visual conditions along the pipeline route and to identify potentially affected sensitive viewing locations along the proposed route. From much of the pipeline route viewshed, it is anticipated that views of the pipeline facilities would be partially or fully screened by existing trees, landforms, or intervening development. Figures 4.8-15 to 4.8-17 show the proposed route as it moves through the various BLM and Forest Service VRM classifications and objective classes as well as the KOP locations along the route.[120]

A supplemental visual impact assessment was conducted to determine the potential impacts on the visual resources associated with the pipeline as it crosses the PCT. The viewshed for the PCT at this crossing is quite limited because of the old-growth forest, dense brush and understory trees, and the pedestrian scale of the characteristic landscape.

In response to comments in the DEIS, a detailed visual analysis was undertaken for this crossing site. Several site visits were conducted in the spring of 2015 to document existing visual conditions of the PCT at the pipeline crossing. The Forest Service determined that two new KOPs would be required to accurately simulate the expected future visual conditions as seen from the PCT. Forest Service personnel and the visual analysts established two new KOPs in this pedestrian landscape.

For this supplemental analysis, the new KOPs are numbered sequentially as KOP-P8 and KOP-P9, as shown on figure 4.8-17 (MP 155 to 228).

The VQO for the affected landscape along the PCT is Foreground Partial Retention. Human activities should remain visually subordinate to the characteristic landscape. Activities may repeat form, line, color, and texture common to the characteristic landscape, but changes in their qualities of size, amount, intensity, direction, pattern, etc. should remain visually subordinate to the characteristic landscape.

Visual Simulations

The visual simulations are the result of an objective analytical and computer modeling process and are accurate within the constraints of the available site data and pipeline design and route information. Existing GIS, a digital elevation model, engineering data, and site photographs provided the basis for developing digital renderings of the anticipated changes to the landscape that would result from installation of the pipeline using a real world coordinate system.

[120] The VRM class boundaries shown on figure 4.8-16 are incorrect near KOP-P2. They are based on GIS data which is being corrected at the time of publication. The VRM class near the Trail Post Office KOP is VRM-II. See also table 4.8.2.3-3 and section 4.8.2.4.

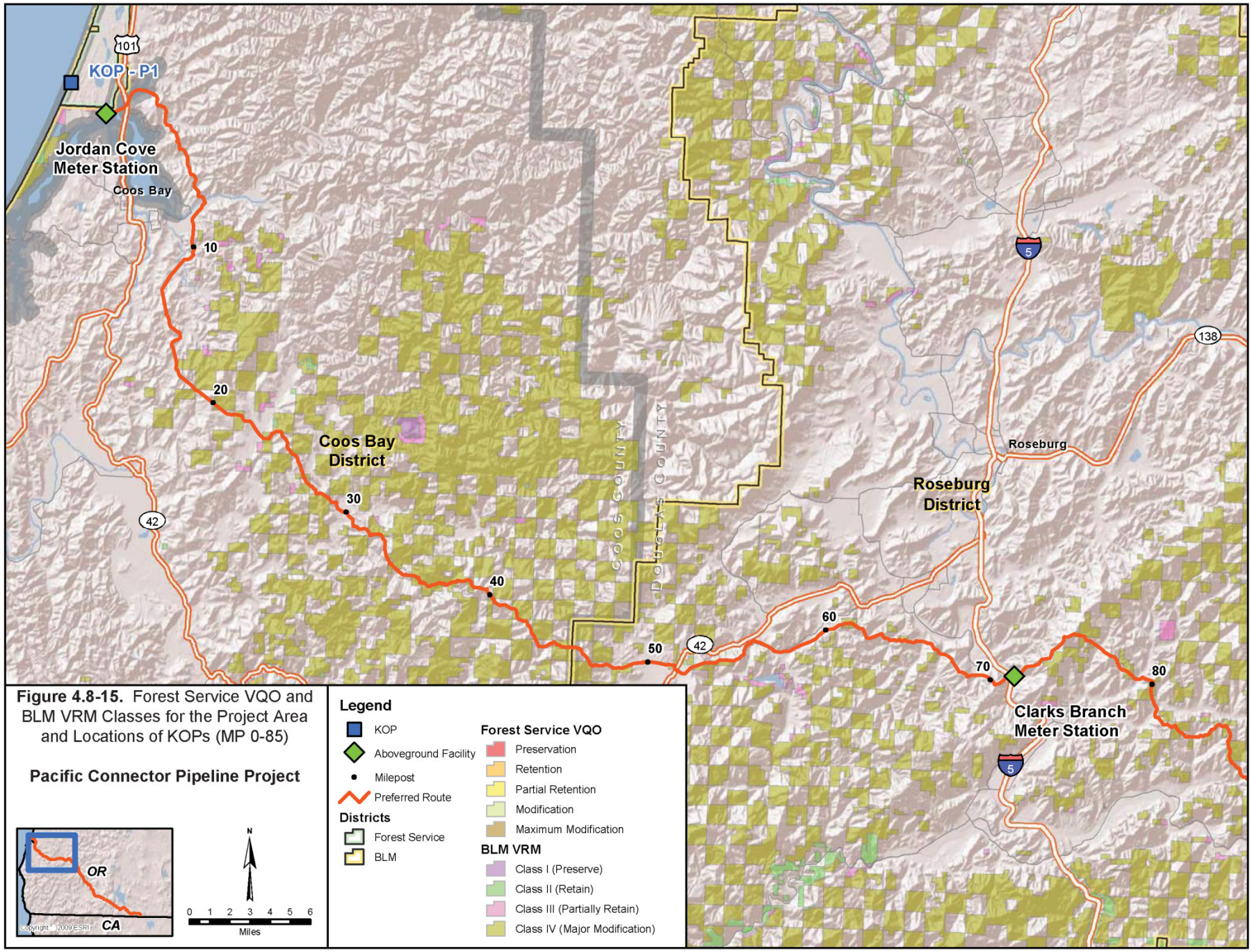


Figure 4.8-15. Forest Service VQO and BLM VRM Classes for the Project Area and Locations of KOPs (MP 0-85)

Pacific Connector Pipeline Project

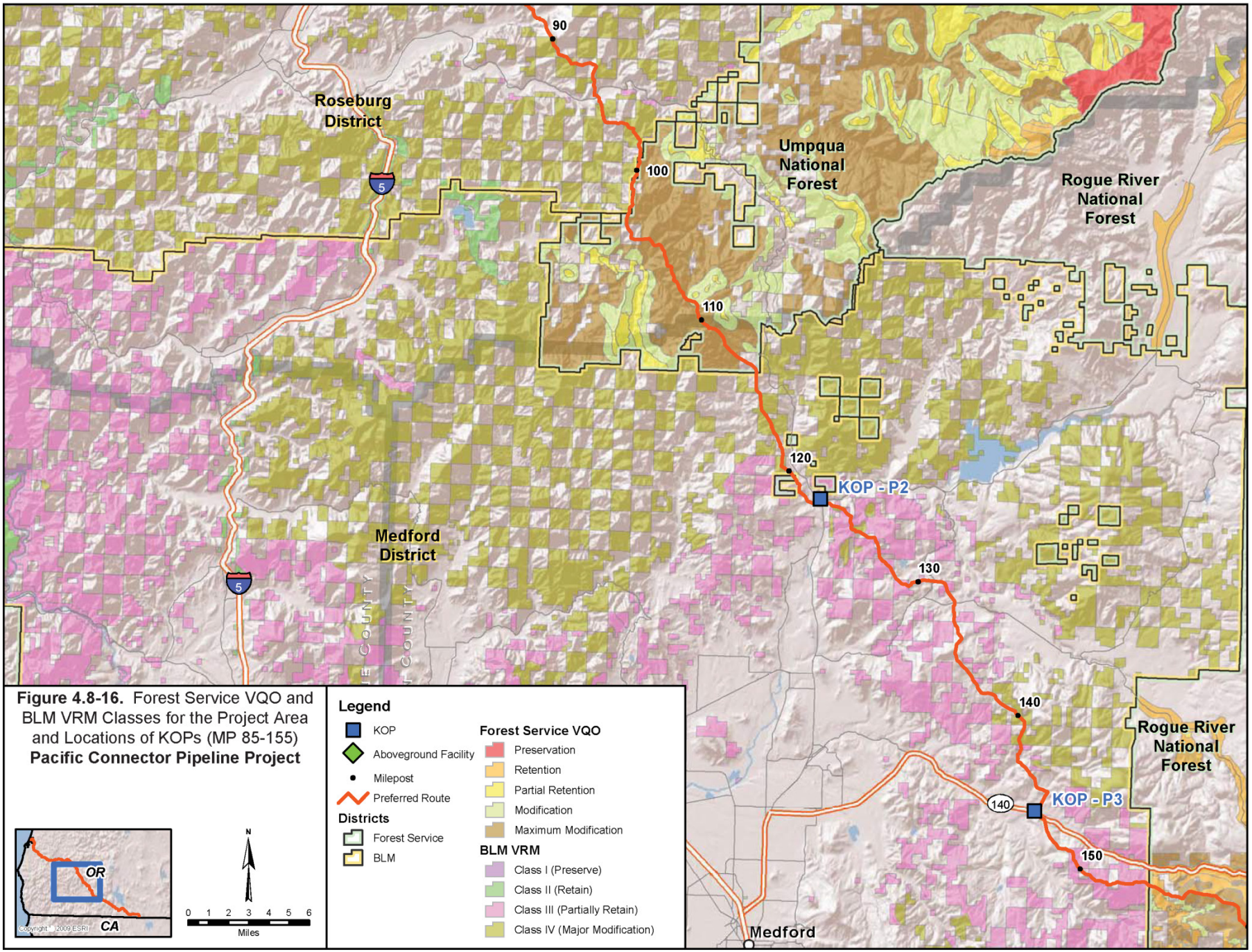


Figure 4.8-16. Forest Service VQO and BLM VRM Classes for the Project Area and Locations of KOPs (MP 85-155) **Pacific Connector Pipeline Project**

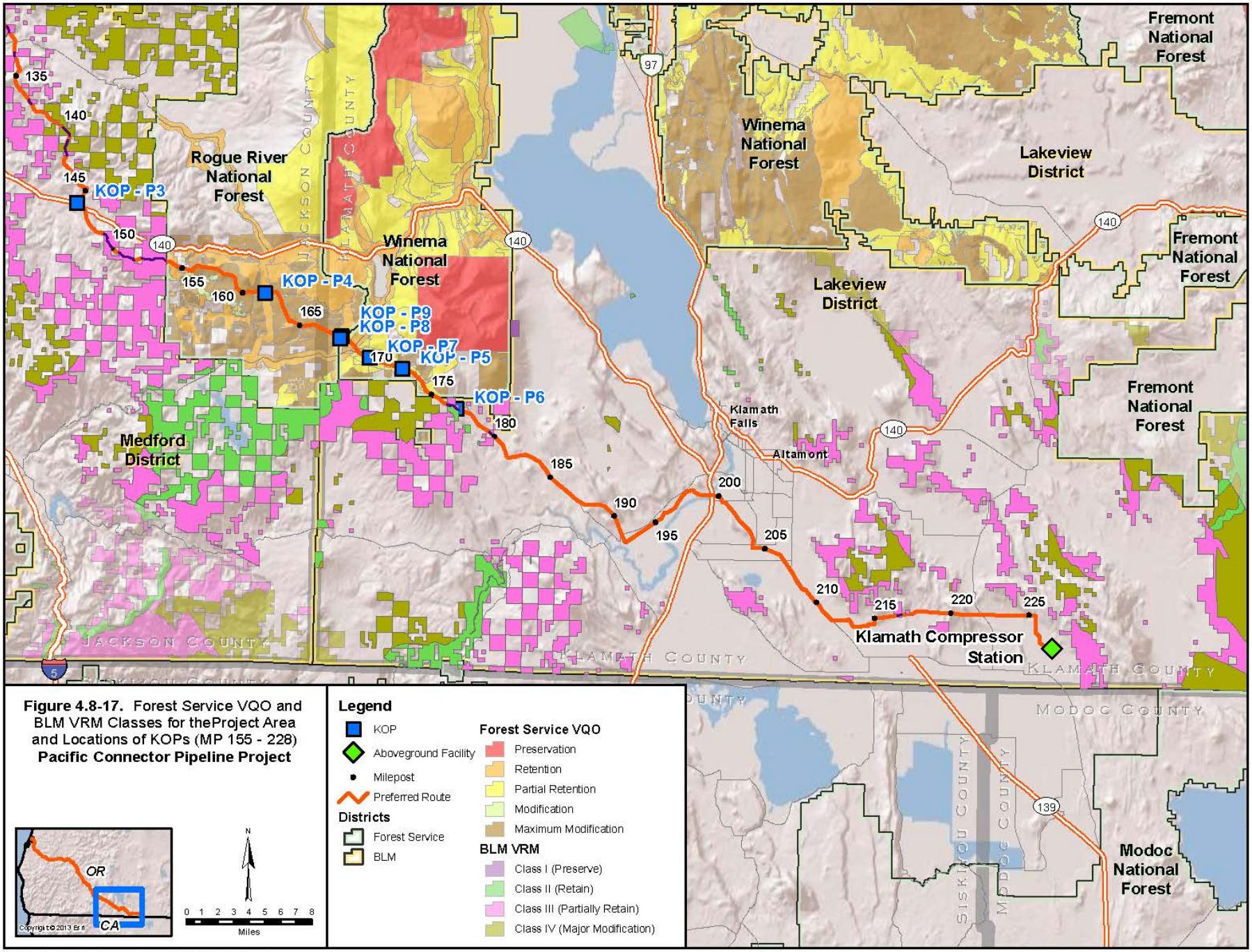


Figure 4.8-17. Forest Service VQO and BLM VRM Classes for theProject Area and Locations of KOPs (MP 155 - 228) **Pacific Connector Pipeline Project**

Photographs of existing visual conditions, plus computerized visual simulations, were prepared for each KOP. The visual simulations presented in figures 4.8-18 through 4.8-23 show the anticipated visible impacts of the pipeline right-of-way and construction work space, immediately following construction. Because the appearance of the pipeline right-of-way would change with time, a series of subsequent simulations were also prepared to illustrate how the pipeline right-of-way would look at 5 and 25 years following construction. The KOP photo sets are presented sequentially as follows:

- Existing Conditions: How the landscape appears at the time of the 2007 site visits.
- Post-Construction (Year 0): The pipeline is in place and backfilled. Soils have been re-contoured, water bars constructed, and cull logs, root wads, and boulders have been scattered across the right-of-way. Seedlings of native trees (Douglas-fir and ponderosa pine) have been planted among the woody debris and boulders, except for a 30-foot-wide corridor directly above the pipeline.
- Year 5: Douglas-fir and ponderosa pine saplings are starting to show among the woody debris, boulders, and water bars. Grasses are growing across the entire right-of-way. There are no trees growing in a 30-foot-wide corridor directly above the pipeline.
- Year 25: Young Douglas-fir and ponderosa pine trees are growing throughout the right-of-way, except for the 30-foot-wide corridor directly above the pipeline, and some of the woody debris (cull logs and root wads) is beginning to deteriorate. The boulders and water bars remain, and maintenance has occurred to keep only low-growing shrubs and grasses in the 30-foot-wide corridor centered directly over the pipeline.

During the site visits for KOP-P8 and KOP-P9, on-the-ground photography was taken, and measurements of the 75-foot-wide right-of-way clearing were plotted and photographed in the field. Exact tree removal was calculated from these photographs, and using computer modeling, the 75-foot-wide right-of-way and 30-foot-wide mowed area were constructed in three-dimensional virtual space and placed into the on-the-ground photographs. The visual simulations presented in figures 4.8-24 and 4.8-25 show the anticipated visible impacts of the pipeline right-of-way and construction work space immediately following construction as well as 5 and 25 years following implementation. The KOP-P8 and KOP-P9 photo sets are presented sequentially as follows (noting further mitigation measures for the PCT as applicable):

- Existing Conditions: This is how the landscape appeared at the time of the spring 2015 site visits. Because the pedestrian landscape has very limited sight distance, only immediate foreground (0 to 300 feet) views are possible.
- Post-Construction (Year 0): Because the pipeline will create a linear opening in this old-growth forest, hikers and equestrians will now have access to immediate foreground (0 to 300 feet) and foreground (0 to ½ mile) views. In the Year 0 simulation, the pipeline is in place and the trench is backfilled. The right-of-way clearing was "necked down" from 95 feet to 75 feet wide for a length of 300 feet each side of the PCT (the immediate foreground zone). Within this 600-foot-long zone at the PCT, all large diameter trees that are right along the edge of the cleared right-of-way have been retained. All stumps have been flush-cut rather than removed in this area of right-of-way so that equipment can drive over them. All shrubs have been mowed to 6 inches in height in this 600-foot-long zone, rather than stripping the right-of-way to bare ground. Timber mats were laid on the working side for equipment to drive on and, on the non-working side, excavated soil was placed on timber mats. The only bare earth was the 10-foot-wide ditch zone. On-site

shrubs and ground cover plants were dug from the 10-foot-wide ditch zone, heeled-in root balls in a safe storage location, and then transplanted back into the trench zone. The Forest Service is requiring Pacific Connector to drip-irrigate these transplanted shrubs for five years. The duff layer (O horizon and A horizon) of the ditch zone was stripped, segregated, and stored, then laid down after backfilling. Duff was placed with rubber-tracked equipment to avoid compaction, and hand crews raked the material out. The entire 75-foot-wide right-of-way was seeded with native grasses and forbs for a length of 300 feet each side of the PCT. In this 600-foot-long zone, trees were planted in masses outside of the 30-foot-wide mowed area and will be irrigated via a holding tank and drip system. Beyond 300 feet from the PCT, the right-of-way expanded back to 95 feet wide, and the entire right-of-way was seeded with native grasses and forbs. Seedlings of Douglas-fir and Shasta red fir were planted in the right-of-way outside the 30-foot-wide mowed zone, and logs were placed in the right-of-way. A small wooden interpretation sign (12 inches x 18 inches) was mounted on a wood post to inform the public about the pipeline construction and restoration efforts at the PCT crossing, although this sign is not visible in any of the simulations.

- Year 5: At Year 5, Douglas-fir and Shasta red fir trees are growing larger, and grasses and forbs are growing across the entire right-of-way. There are no trees growing in the 30-foot-wide corridor directly above the pipeline.
- Year 25: At Year 25, Douglas-fir and Shasta red fir trees are growing larger. Some of the logs are beginning to lose their bark. Maintenance has occurred to keep only low-growing shrubs, forbs, and grasses in the 30-foot-wide corridor centered directly over the pipeline.

KOP Analyses

KOP-P1 ODNRA

Just north of approximate MP 1.0, this KOP is geographically similar to KOP-T3 at Horsfall Beach Campground and Day Use Area (figure 4.8-6). While KOP-T3 focuses on the appearance of the LNG terminal and South Dunes Power Plant facilities, it can be observed at this KOP that the visual impacts from the pipeline would be subordinate to concurrent developments in the area, and negligible overall. No further visual impact assessment is necessary at this location due to complete visual screening of the pipeline alignment by intervening topography. For this reason, there is no photograph/simulation set for KOP-P1 in the figures that follow.

KOP-P2 Trail Post Office

This point is located at the U.S. Post Office in the town of Trail, near MP 123.0 along the proposed route, and is also representative of the view from Crater Lake Highway (Highway 62). Simulations show the view facing southeast where the pipeline would cross under the Rogue River and go uphill across private land. The pipeline route would leave private land about halfway up the hill and enter BLM land managed under the Medford District 1995 RMP (BLM 1995e) as VRM Class II as it climbs to the ridgetop (see the nearer portion of the corridor in the post-construction simulation in figure 4.8-18a). After the pipeline reaches the ridgetop and continues to move away from the viewer, it enters BLM land managed under the Medford District 1995 RMP as VRM Class III (Partial Retention of Character, see the distant portion of the corridor in the post-construction simulation in figure 4.8-18a). Existing vegetation depicted in the view from KOP-P2 at the pipeline right-of-way consists of a dense evergreen forest of

Douglas-fir and ponderosa pine. There are patches of scrub-oak and manzanita at the right-of-way, and a bare patch of soil north (left) of the right-of-way (figures 4.8-18a and 4.8-18b).

KOP-P3 Highway 140 near Little Butte Creek

This KOP is located at MP 145.6, at the point where the pipeline would cross under Highway 140 near Little Butte Creek on private lands (figures 4.8-19a and 4.8-19b). Facing southeast, halfway up the hill in the background (approximately 2.5 miles from KOP-P3) the pipeline crosses into BLM lands classified under the Medford District 1995 RMP as Class III (Partial Retention of Character).

KOP-P4 Big Elk Road (Forest Road 37)

This location represents a view from the Big Elk Road (Forest Road 37), at MP 161.4 along the pipeline route, looking north on the Dead Indian Plateau in a dense stand of mixed conifer forest. The pipeline would cross the road at this location in a west-east alignment, as the road travels south-north, and the clearing would be noticeable to travelers on this forest road. Simulations of the pipeline crossing of Big Elk Road show the long-term visual effects of the permanently cleared 30-foot-wide right-of-way and the creation of a UCSA adjacent to the side of the road, visible to motorists as they pass (figures 4.8-20a and 4.8-20b).

KOP-P5 Clover Creek Road

Simulations from this point represent a long distance view of the right-of-way from along Clover Creek Road, at about MP 172.2 along the pipeline route. This shows the extent of visual impacts of the pipeline in the immediate foreground, foreground, and middleground of Clover Creek Road (figures 4.8-21a and 4.8-21b). The pipeline would be contiguous to Clover Creek Road from approximately MP 169.5 to 187.7, a distance of 18.2 miles.

Figure 4.8-18a. KOP-P2. Trail Post Office (Near MP 123). Existing conditions (above) and post-construction (year 0) simulation (below), of the pipeline right-of-way as viewed from the Trail Post Office.

Figure 4.8-18b. KOP-P2. Trail Post Office (Near MP 123). Simulated views of the pipeline right-of-way as viewed from the Trail Post Office, at 5 and 25 years following construction, respectively.

Figure 4.8-19a. KOP-P3. Highway 140 near Little Butte Creek (MP 145.6). Existing conditions (above) and post-construction simulation (below), of the pipeline right-of-way as viewed at the Highway 140 crossing.

Figure 4.8-19b. KOP-P3. Highway 140 near Little Butte Creek (MP 145.6). Simulated views of the pipeline right-of-way as viewed from the Highway 140 crossing, at 5 and 25 years following construction, respectively.

Figure 4.8-20a. KOP-P4. Big Elk Road (Forest Road 37, MP 161.4). Existing (above) and post-construction simulation (below), of the pipeline right-of-way as viewed at the Big Elk Road (Forest Road 37) crossing.

Figure 4.8-20b. KOP-P4. Big Elk Road (Forest Road 37, MP 161.4). Simulated views of the pipeline right-of-way as viewed from at the Big Elk Road (Forest Road 37) crossing, at 5 and 25 years following construction, respectively.

Figure 4.8-21a. KOP-P5. Clover Creek Road (MP 172.2). A long view of existing (above) and post-construction simulation (below), of the pipeline right-of-way as viewed along Clover Creek Road.

Figure 4.8-21b. KOP-P5. Clover Creek Road (MP 172.2). Simulated long views of the pipeline right-of-way as viewed along Clover Creek Road, at 5 and 25 years following construction, respectively.

KOP-P6 Clover Creek Road Near Spencer Creek

This location represents a view from Clover Creek Road, near Spencer Creek at about MP 176.8 along the pipeline route, on BLM lands, looking uphill. Within one-quarter mile of Spencer Creek, the viewshed is classified as BLM VRM Class II (Retain Character) per the RMP for the Klamath Falls Resource Area, issued under the NWFP. In this location, the pipeline right-of-way would be immediately adjacent to the road, as shown in figures 4.8-21a and 4.8-21b for KOP-P5 and figures 4.8-22a and 4.8-22b for KOP-P6.

KOP-P7 Clover Creek Road (MP 170.1)

KOP-P7 is intended to show the ground surface in relationship to the road and the visual experience of travelers along Clover Creek Road. KOP-P7 is located at MP 170.1, facing due east and downhill from a motorists' perspective on Clover Creek Road. There is an existing partial-cut timber harvest area on the north (left) side of the road. Simulations from KOP-P7 represent an additional long-distance view of the pipeline right-of-way from along Clover Creek Road. As shown on the post-construction simulation, woody debris (cull logs, slash, and root wads) would be left on the right-of-way to discourage OHV use, which creates unacceptable visual contrasts. The Year 25 simulation shows pine reforestation on the right-of-way, and in this view, the permanently cleared and maintained area directly over the pipeline would be partially to completely screened from view of the road. This shows the extent of visual impacts of the pipeline, over time, in the immediate foreground, foreground, and middleground of Clover Creek Road (figures 4.8-23a and 4.8-23b). This series of three simulations show the typical visual effects that would occur in timbered landscapes along Clover Creek Road from approximately MP 169.5 to 187.7, a distance of 18.2 miles.

KOP-P8 Pacific Crest Trail Northbound

The first new KOP is from a hiker's pedestrian perspective walking on the trail, northbound, looking ahead from the old-growth forest into the 75-foot-wide cleared right-of-way at approximately MP 167.8 and beyond. This vantage point is located between two large trees and is the first opportunity to see the right-of-way clearing, which extends from 67 feet to 142 feet ahead of the camera position. For each of the new KOPs, a hiker is shown in the photographs and simulations to represent human scale (figures 4.8-24a and 4.8-24b). For a typical hiker or equestrian, the duration of view would be short, because it does not take long to walk or ride a few hundred feet along the PCT. The right-of-way created an opening that allows more sunlight to penetrate this forest scene, which created more visual interest. The interpretation sign actually would call attention to the pipeline and the changes in the characteristic landscape. Conversely, the sign explains the visual changes to this characteristic landscape. As seen from KOP-P8, the overall visual effect would achieve the Foreground Partial Retention VQO.

KOP-P9 The Cleared Right-of-Way and the Pacific Crest Trail

The second new KOP is from a hiker's perspective standing in the middle of the 30-foot-wide mowed area, looking west up the pipeline right-of-way, from a short distance (48 feet) east of the PCT (figures 4.8-25a and 4.8-25b). The pipeline clearing extends to the west and then makes a dogleg to the northwest, thereby reducing the length of the "tunnel effect" of the right-of-way clearing. If the viewer turned around at this location and looked east, a similar dogleg would be visible. Both of these doglegs reduce the amount of right-of-way clearing that would be visible from the PCT. Duration of view from this vantage point would be longer than for KOP-P8 because the viewer has gotten off the trail and has stopped to survey the landscape and its

changes. The right-of-way created a completely different viewing experience because of its linear form; however, revegetation with trees, grasses, and forbs, plus placement of logs in the right-of-way, have partially retained the surrounding landscape character. Because of the restoration efforts, the pipeline has remained visually subordinate to the characteristic landscape. The interpretation sign has called attention to the pipeline and the changes in the characteristic landscape, causing viewers to stop and look more carefully. Conversely, the sign explains the visual changes to this characteristic landscape. As seen from KOP-P9, the overall visual effect would achieve Foreground Partial Retention VQO.

Visual Impacts and Proposed Mitigation Measures

Short-Term Visual Impacts

Construction impacts to visual resources would result from the presence of equipment, materials, and work force along the pipeline right-of-way, at TEWAs and staging areas, and along access roads. Construction impacts on visual resources would also result from the temporary alteration of landforms and vegetation along the right-of-way. Vehicles, heavy equipment, helicopters, pipeline components, and workers would be visible during site clearing, grading, trenching, pipeline transport, welding, laying in, backfilling, and site/right-of-way cleanup and restoration. Construction equipment and activities would be seen by various viewers in close proximity to the sites and pipeline corridor including adjacent and nearby residents, recreationists on trails and roads, general motorists on public roadways, and in some cases, pedestrians. View durations would vary from brief to extended periods. Construction activities would be most visible for those elements of the pipeline through residential neighborhoods and adjacent to major travel corridors, including highways and the PCT; however, these effects would be temporary and would be limited to the construction period.

Amendments to the Rogue River and Winema National Forest LMPs were developed to address consistency with specific standards and guidelines related to VQOs. These amendments acknowledge the short-term visual impacts that would occur that would be inconsistent with current management direction. They allow for an extended period of time for the areas to recover and meet the VQOs in a reasonable amount of time.

Figure 4.8-22a. KOP-P6. Clover Creek Road (MP 176.8). Existing (above) and post-construction simulation (below), of the pipeline right-of-way as viewed from Clover Creek Road near Spencer Creek.

Figure 4.8-22b. KOP-P6. Clover Creek Road (MP 176.8). Simulated views of the pipeline right-of-way as viewed from Clover Creek Road near Spencer Creek, at 5 and 25 years after construction, respectively.

Figure 4.8-23a. KOP-P7. Clover Creek Road (MP 170.1). Long view of existing (above) and post-construction simulation (below), of the pipeline right-of-way adjacent to Clover Creek Road.

Figure 4.8-23b. KOP-P7. Clover Creek Road (MP 170.1). Long simulated views of the pipeline right-of-way adjacent to Clover Creek Road, 5 and 25 years after construction, respectively.

Figure 4.8-24a. KOP-P8. Pacific Crest Trail Northbound (MP 167.8). Long view of existing (above) and post-construction simulation (below), of the pipeline right-of-way from the view of a northbound hiker along the PCT.

Figure 4.8-24b. KOP-P8. Pacific Crest Trail Northbound (MP 167.8). Long simulated views of the pipeline right-of-way northbound on PCT, 5 and 25 years after construction, respectively.

Figure 4.8-25a. KOP-P9. The Cleared Right-of-Way and the Pacific Crest Trail (167.8). Long view of existing (above) and post-construction simulation (below), of the pipeline right-of-way at the PCT crossing.

Figure 4.8-25b. KOP-P9. The Cleared Right-of-Way and the Pacific Crest Trail (167.8). Long simulated views of the pipeline right-of-way at the PCT crossing, 5 and 25 years after construction, respectively.

Long-Term Visual Impacts

Pipeline

The landscape setting along the pipeline route is varied, ranging from flat valley floors and agricultural fields, to rolling hillsides covered with oak and madrone woodlands, to steep mountainsides and sharp ridgelines covered with mixed conifer timberlands. On flat terrain in agricultural settings, following construction, the right-of-way would be restored and ranchers/farmers would be allowed to grow shallow-rooted crops over the pipeline. Construction work areas would normally be difficult to distinguish from surrounding areas. Therefore, no long-term visual impacts would result from installation of the pipeline in agricultural areas.

In the mountainous terrain, many of the existing landscapes that would be traversed by the pipeline have already been affected by timber harvests, including large clear-cuts. Existing scenic integrity in these areas is low, and the introduction of the pipeline should not create long-term visual contrasts in these settings.

The greatest long-term visual effects would occur where the new right-of-way would create new clearings through forestlands. The type of right-of-way clearing proposed by Pacific Connector, with straight, geometric, parallel edges, draws attention and does not blend in with natural occurring form, line, color, or texture in the landscape. However, many forested areas are away from roads, trails, and populated areas, and therefore are not immediately visible to viewers.

The clearing of the right-of-way would create a sharp-edged linear feature across a contiguously forested landscape. The excavation would expose sub-grade soils that would contrast with the color of the forest canopy. It is expected that the amount of boulders and root wads would be excessive in this landscape, making it difficult to dispose of in a manner that would not affect scenery. Boulders scattered on top of the ground do not appear natural and root wads with cut stumps are visually distracting if found in more than occasional amounts.

Depending on the methods of clearing, the effects could be similar to road brushing, which uses a thrashing technique that leaves a rough brushed appearance immediately after clearing. The 30-foot-wide corridor, kept cleared of trees within the permanent pipeline easement, would appear in many places as a linear feature that is incongruent with natural terrain or even typical corridors such as roads that gradually climb the side hill rather than rising directly up the face of a slope.

Aboveground Facilities

The aboveground facilities proposed by Pacific Connector would be long-term structural features on the landscape. For instance, a typical meter station would occupy an area of a few acres within a fenced and graveled yard. MLVs would occupy a 50-foot by 50-foot area (less than a tenth of an acre) within the permanent pipeline easement.

Klamath Compressor Station

The Klamath Compressor Station (MP 228.1) would have visual impacts on nearby residents and travelers along Malin Loop Road and Morelock Road (figure 4.8-17). The location is on private land in a rural area that is relatively flat. The landowner formerly used the parcel for winter pasture, and it is currently covered by grasses, sage, and juniper.

To reduce visual impacts on nearby residences and other casual observers, the buildings at the compressor station would be painted a color selected to blend as well as possible with the surrounding landscape, and portions of the outward facing sides of the station would be landscaped with screening vegetation. In addition, the station would be surrounded by a 7-foot-tall chain-link fence with screening slats.

The Klamath Compressor Station would include exterior lighting to support night work activities; however, these lights would only be used when operations personnel are actively working at the station. Pacific Connector has stated that during operation of the station nighttime work or maintenance activities would generally not be scheduled; therefore, these lights would only be used periodically and possibly for short periods during the winter when daylight working hours are shorter. Pacific Connector has not identified specific lighting arrangements, but outside lights at compressor station facilities are typically shrouded to direct light to the specific work areas within the station.

Clarks Branch Meter Station

The Clarks Branch Meter Station would be located at MP 71.5, in Douglas County (figure 4.8-15). The meter station would occupy about 1 acre of privately owned land that is currently used as cropland and pasture. A new PAR would be required (PAR 71.46). The Clarks Branch Meter Station would consist of two buildings to house equipment, a MLV, pig receiver and odorizing facilities, and a 26-foot-tall communication tower. The communications tower is discussed in more detail below. The station would be equipped with shrouded outside lighting, but the lights would only be utilized at night when employees are present. During normal operations, nighttime work would not usually be scheduled. The station would be surrounded by a 7-foot-tall slatted chainlink fence.

Jordan Cove Meter Station

The Jordan Cove Meter Station would be located at the western end of the Pacific Connector pipeline at MP 1.5R (figure 4.8-15). The new meter station would occupy about 1 acre of industrial land, entirely within the Jordan Cove LNG terminal site boundary and adjacent to the South Dunes Power Plant. This was once the location of the Weyerhaeuser linerboard mill, now removed. No new road would be required. The Jordan Cove Meter Station would consist of two buildings to house equipment, a MLV, pig receiver and odorizing facilities, and a 140-foot-tall communication tower. The communications tower is discussed in more detail below. The meter station would be equipped with outside lighting, but the lights would only be utilized at night when employees are present. During normal operations, nighttime work would not usually be scheduled. The station would be surrounded by a 7-foot-tall slatted chainlink fence.

Mainline Block Valves

Pacific Connector proposes to install 17 MLVs along its pipeline, spaced according to DOT requirements (CFR 192.179) as discussed in chapter 2 of this EIS. Three of the MLVs would be co-located within the compressor and meter stations described above. Two of the MLVs (#11 and #14) would be associated with pig launcher/receiver sites, and each of these would occupy an area 95 feet by 200 feet, or less than half an acre, and would be enclosed by a 7-foot-tall slatted chainlink fence.

The remaining 12 MLVs would each occupy a site 50 feet by 50 feet (less than a tenth of an acre) and would be enclosed by a 7-foot-tall slatted chainlink fence. The individual MLV

structures would be within the construction and operational right-of-way for the Pacific Connector pipeline. The MLVs at meter stations, the compressor station, and those that include pig launchers and receivers would exceed the construction and operational right-of-way for the pipeline. New access roads would be required for some of the MLVs. The aboveground structures of the MLVs would be painted green, unless otherwise dictated by permit conditions.

Gas Control Communication Towers

Pacific Connector proposes to construct new gas control communication towers along the pipeline route. One would be located at the Jordan Cove Meter Station, adjacent to the South Dunes Power Plant. This tower would be approximately 140 feet tall. While taller than the power plant HRSG units discussed above, it would be smaller by volume (more like an antennae than a smokestack), and there would be one, rather than six structures, so the visual impact would be smaller overall than that of the HRSG units. The existing Roseburg Forest Products facility along with the LNG terminal and power plant facilities would visually absorb the communications tower, further reducing its overall visual impact. The visual impacts of the Jordan Cove LNG terminal are discussed above in section 4.8.2.1.

Other communication towers are proposed at the Clarks Branch Meter Station and the Klamath Compressor Station. Both of these communication towers would be approximately 26 feet tall, about the same height as a typical two-story building. As described above, other industrial facilities would be constructed at the meter stations and compressor station. The relatively low height and thin structural profile of these two communication towers as well as the presence of other structures proposed for those sites would prevent the new communication towers from visually dominating the landscape.

Pacific Connector proposes to install additional communication facilities at eight existing facility sites (see table 2.1.2-2 and figure 2.1-15). Of these eight existing sites, three are on privately owned land and five are on federally managed lands. Pacific Connector would co-locate equipment on existing towers whenever possible and, when not feasible, proposes to construct new towers at the facility sites. Because the towers and equipment would be located on land already in use for utilities, communications, and other structures of industrial appearance, Pacific Connector's additional equipment would have no new visual impact and may not even be visually detectable by a casual observer.

Proposed Mitigation Measures

Pacific Connector produced an *Aesthetics Management Plan* (Appendix A to its POD) that outlined measures to reduce visual impacts along its pipeline route. Generally, these measures include:

- reducing the width of the right-of-way and elimination of TEWAs at sites with high visual sensitivity;
- strategic alignment of the right-of-way where it crosses roads or trails to reduce the visual corridor;
- strategic placement of construction debris (slash, stumps, and boulders) in visually sensitive areas;
- revegetation of the right-of-way after pipeline installation, including planting trees in temporary work areas that were cleared of forest or woods;

- planting of rows or clusters of trees and shrubs across the right-of-way to provide visual screens as specific sensitive trail or road crossings, using native species whenever possible; and
- painting aboveground facilities in color schemes that would blend into the background landscape.

It should be noted that some visual mitigation measures are not shown in the visual simulations. These include opportunities for revegetation with large-sized trees (tree-spade efforts), forest edge scalloping, and/or feathering treatments to decrease stand density contrasts at the right-of-way edges. Therefore, these simulations represent a worst-case scenario at each KOP.

4.8.2.3 Visual Resources on Federal Lands

Regulatory Setting and Visual/Scenic Management Systems

The responsibility of protecting visual resources on lands owned or under the jurisdiction of the federal government is established by FLPMA, which places emphasis on the protection of scenic resources on public land, and the Forestland and Rangeland Renewable Resources Planning Act (1974) which empowers the Forest Service to manage scenery resources. The National Forest Management Act (1976) required the completion of Forest Plans that established VQOs for the National Forests.

NFS Lands

The Forest Service seeks to manage NFS lands to attain the highest possible quality of landscape aesthetics and scenery commensurate with other appropriate public uses, costs, and benefits. Scenic integrity is defined as "*a measure of the degree to which a landscape is visually perceived to be "complete.*" The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the character valued by constituents for its aesthetic appeal. Scenic integrity is used to describe an existing situation, standard for management, or desired future condition" (Forest Service 1995b).

National Forests use a Visual Management System (VMS) to manage visual resources on NFS lands and to analyze visual effects of proposed projects. The VMS has a rating system known as VQO to establish standards for scenery resource management. The VMS was outlined in FSH 462, published in 1974. Since then, scenery management on NFS lands has been updated by Handbook 701, which introduced the Landscape Aesthetics, Scenery Management System (SMS). The SMS utilizes a rating system similar to VMS to evaluate project impacts on visual quality. The SMS is based on the relative scenic quality of each portion of the landscape and its sensitivity based on the visibility from, and uses in, the surrounding areas. The SMS uses Scenic Integrity Objectives to establish the desired conditions for management of an area.

Under the former VMS system, management prescriptions and related VQOs were developed for all NFS lands. VQOs for each national forest crossed by the pipeline are identified in their respective LRMPs. VQOs are management standards that identify five degrees of alteration to the natural landscape based on a landscape's diversity of natural features and the public's concern for scenic quality. Because the aforementioned forest plans have not been amended to use the SMS, both VMS and SMS are used in this EIS section. A crosswalk between the two

systems is described in *Landscape Aesthetics: a Handbook for Scenery Management* (Forest Service 1995b), and summarized in table 4.8.2.3-1.

BLM Lands

The BLM has a VRM system that is comparable to the Forest Service VMS. Based on a matrix of three factors (scenic quality, sensitivity level, and distance), BLM lands are placed into one of four visual resource inventory classes (table 4.8.2.3-2). These classes represent the relative value of the visual resources, Class I (Preserve Character) and Class II (Retain Character) being the most valued, Class III (Partially Retain Character) representing a moderate value, and Class IV (Major Modification of Character) being of least value. The class objectives describe the different degrees of modification, or contrast, allowed to the basic visual elements of the landscape in each class. VRM management classes are then established through the RMP process and adjusted as necessary to reflect the resource allocation decisions made in RMPs.

The vast majority of the Pacific Connector pipeline route that would cross BLM lands is classified as VRM Class IV in the 1995 RMPs (29.5 miles), and the construction, operation, and maintenance of the pipeline would be consistent with the objectives of this class. An approximately 0.7-mile segment of the pipeline would pass through VRM Class II on land administered by the BLM Lakeview District (MP 176.60 to MP 177.04). The pipeline in this area would run immediately adjacent and parallel to the roadway. Approximately 9.5 miles of the Pacific Connector pipeline route that would cross BLM lands is classified as VRM Class III, and 29.5 miles would cross VRM Class IV. The Pacific Connector pipeline route would also cross BLM land in the Medford District classified as VRM Class II at Trail Post Office on Highway 62 (MP 123.33-124.23).

Mitigation measures described in Pacific Connector's *Aesthetics Management Plan* would be applied to the sensitive viewsheds described below in order to reduce the contrast of the cleared right-of-way corridor.

TABLE 4.8.2.3-1

Crosswalk Between Visual Quality Objectives, Scenic Integrity Objectives, and Scenic Integrity Levels a/

Visual Management System (VMS) 1973 Direction	**Scenery Management System (SMS) 1995 Direction**	
Visual Quality Objective (VQO)	**Scenic Integrity Objective (SIO)**	**Definition of Scenic Integrity Levels**
Preservation	Very High	*Unaltered*: Valued landscape character "is" intact with only minute if any visual deviations. The existing landscape character is expressed at the highest possible level.
Retention	High SIO	*Appears unaltered*: Landscapes where the valued landscape character "appears" intact. Visual deviations (human-made structures or activities) may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such a scale that they are not evident.
Partial Retention	Moderate SIO	*Appears slightly altered*: Noticeable deviations must remain visually subordinate to the landscape character being viewed.
Modification	Low SIO	*Appears Moderately Altered*: Visual deviations (human-made structures or activities) begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but compatible or complimentary to the character within.
Maximum Modification	Very Low SIO	*Appears Heavily Altered*: Visual deviations (human-made structures or activities) may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles within or outside the landscape being viewed. However deviations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.
For Inventory and Scenic Effect Prediction Purposes Only		
Unacceptable Modification UM	Unacceptably Low	*Extremely altered*: Landscapes where the valued landscape character being viewed appears extremely altered. Visual deviations (human-made structures or activities) are extremely dominant and borrow little if any form, line, color, texture pattern or scale from the landscape character. Landscapes of this level of integrity need rehabilitation. This level should only be used to inventory existing integrity. It must not be used as a management objective.

a/ Scenic Integrity Objectives establish desired conditions for management (equivalent to purpose of Visual Quality Objectives under former VMS); Scenic Integrity Levels describe the current condition of the scenic resource.

TABLE 4.8.2.3-2

BLM Visual Resource Management Classes

VRM Class	Definition
Class I Preserve Landscape Character	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention. (This classification is usually applied to wilderness areas, wild and scenic rivers, and other similar situations.)
Class II Retain Landscape Character	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
Class III Partially Retain Landscape Character	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
Class IV Major Modification of Landscape Character	The objective of this class is to provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

BLM Specially Designated Lands: Round Top Butte NNL

During scoping for the Project, the NPS questioned how the Pacific Connector pipeline might impact the Round Top Butte NNL, which is managed by the BLM's Medford District. The pipeline near MP 135.6 would be about one-quarter mile from the Round Top Butte NNL boundary. The pipeline route would not cross or directly affect this NNL. Where it would be closest to the NNL boundary, the pipeline route would cross privately owned timber lands that were recently harvested and are regenerating (see section 4.8.2.4). Visual impacts of the pipeline on the NNL would be reduced by Pacific Connector restoring and revegetating the right-of-way in accordance with its ECRP and its *Aesthetic Management Plan*.

Sensitive Viewsheds on Federal Lands

The federal land managing agencies identified areas they consider to possess sensitive viewsheds along the pipeline route and, as appropriate, developed site-specific amendments to LMPs to ensure compliance with the LMPs if the Project were authorized. Pacific Connector outlined measures it would implement to reduce visual impacts at those areas in its *Aesthetic Management Pla*n (Appendix A to the POD). Table 4.8.2.3-3 lists the sensitive viewsheds on federal land, their visual objective classes, and proposed mitigation measures.

TABLE 4.8.2.3-3

Sensitive Viewsheds on Federal Lands and Proposed Mitigation Measures

MPs	Viewshed Area	Agency/Unit	Visual Class or Objective	Sensitivity Level	Mitigation Methods a/
27.06-27.08	Middle Creek – McKinley	BLM – Coos Bay District	VRM III	Low-Moderate	Revegetation; Screening
123.33-124.23	State Highway 62 – Trail & Shady Cove	BLM – Medford District	VRM II b/	Moderate-High	Right-of-Way Placement; Revegetation; Construction Practices; Slash
148.79-149.89	Highway 140 – North Fork Little Butte Valley	BLM – Medford District	VRM III	High	Revegetation; Construction Practices; Screening; Slash
161.07-161.64	Big Elk Road (FS Road 37) – South Fork Little Butte Valley	Forest Service – Rogue River National Forest	VQO – Foreground Retention	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13
167.49-167.93	PCT	Forest Service – Rogue River National Forest	VQO – Foreground Partial Retention	High	1, 2, 3, 4, 5, 6, 10, 13
168.40-169.00	Dead Indian Memorial Highway	Forest Service – Winema National Forest	VQO – Foreground Retention	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
169.00-174.40 176.15-176.45; 176.60-177.04	Clover Creek Road	Forest Service – Winema National Forest; BLM – Lake View District	VQO - Foreground Partial Retention; VRM III	Moderate-High	1, 2, 3, 4, 5, 6, 7, 8, 10

a/ 1 – Mulch right-of-way and use colorant of dark brownish green for hydro-mulch;
2 – Scallop and feather edges of the right-of-way by removing or cutting some tall trees as directed by land manager;
3 – Transplant trees 15-20 feet tall in clusters spaced 660 feet apart;
4 – Transplant trees in clusters in TEWAs and combine with partly buried boulders;
5 – Bury root wads and boulders in foreground along right-of-way;
6 – Reduce soil compaction according to the ECRP;
7 - Plant 1-2 gallon-sized shrubs and protect them with plant guards;
8 – Construct a berm with boulders to discourage OHV access;
9 – Screen corridor from viewer by leaving trees near roadway and transplanting trees 15-20 feet tall in foreground;
10 – Plant deciduous trees and shrubs such as willow, ceanothus, ribes, huckleberry and chinquapin;
11 – Recontour cut bank to discourage OHV access;
12 – Fund Forest Service tree thinning activities
13 – Necking-down, or narrowing, construction corridor.

b/ This VRM class is inconsistent with figure 4.8-16. The VRM Class shown here is correct.

4.8.2.4 Visual Resources Specific to Consistency with Federal LMPs

BLM Lands

Professional assessments of the Pacific Connector Pipeline Project's impacts were done by Recreation Planners in the Coos Bay, Roseburg, Medford, and Klamath Falls offices at several KOPs in sensitive viewsheds. Although the Pacific Connector pipeline would not fully meet the VRM Class II objectives in the short term at the Trail Post Office KOP (Butte Falls Resource Area) or on the BLM portion of Clover Creek Road (Klamath Falls Resource Area), Class II objectives at those locations would be met in the long term by using mitigation efforts described in the January 2013 *Aesthetics Management Plan*.

Using guidance from the *Aesthetics Management Plan* for these and other sensitive viewsheds along the Pacific Connector pipeline would reduce visual impacts to the point that land use plan amendments of the Medford District and Klamath Falls RMPs are not necessary for the pipeline. The pipeline does not meet VRM Class II objectives in the short term (less than five years) at these two locations, but plan amendments are not needed because the areas in question are very short, and mitigation developed in the *Aesthetics Management Plan* would help the areas reach VRM Class II objectives in the long term (5 to l0 years).

NFS Lands

Umpqua National Forest

The VQO for all lands crossed by the Pacific Connector Pipeline Project on the Umpqua National Forest is Maximum Modification. The pipeline would be within the VQO standards of Maximum Modification upon completion of corridor restoration and revegetation.

Rogue River National Forest

The Pacific Connector pipeline would meet the VQOs of the Rogue River National Forest LRMP with the following three exceptions:

(1). At the crossing of the Big Elk Road at Pacific Connector pipeline MP 161.4 in Section 16, T. 37 S., R. 4 E., W. M., Oregon.

This location has a VQO of Foreground Retention (Management Strategy 6, LRMP, page 4-72). Standards and guidelines for Foreground Retention where the Pacific Connector pipeline route crosses the Big Elk Road require that VQOs be met within one year after completion of the Project and that management activities not be visually evident. The pipeline project would not meet that standard at that location. Amendment RRNF-2 of the Rogue River National Forest LRMP is proposed at this location to make provision for the Pacific Connector pipeline. This proposed amendment would change the VQO at this location to Foreground Partial Retention (Management Strategy 7, LRMP page 4-86) and allow 10 to 15 years for the amended VQOs to be attained. The Big Elk Road in the vicinity of the Pacific Connector pipeline crossing would be affected by this proposed amendment.

Temporal and Spatial Boundaries of Impacts

This proposed change would affect about 5 acres in the year of construction and approximately 2 acres after 10 years. The 5 acres represents the 75-foot-wide construction right-of-way as seen from Big Elk Road. The 2 acres represents the area seen from Big Elk Road associated with the 30-foot-wide operational permanent easement for the pipeline that would be kept clear of tall trees (more than 15 feet tall) 10 years after right-of-way restoration and revegetation. This would not achieve the Forest Plan goals and objectives of a natural appearing forest at that location one year after construction. Drivers passing the corridor would be able to see it for approximately 15 to 20 seconds. This change would affect only recreation and VQOs in the vicinity of the Big Elk Road–Pacific Connector pipeline intersection. No other LRMP goals and objectives would be affected by this change. This proposed amendment is for the Pacific Connector pipeline only. It would not change future management direction.

(2). At the crossing of the PCT at Pacific Connector pipeline MP 168 in Section 32, T. 37 S., R. 5 E., W. M., Oregon

This location has a VQO of Foreground Partial Retention (Management Strategy 7, LRMP page 4–86). Standards and guidelines for Foreground Partial Retention require that VQOs be met within three years of completion of the Project, and that activities be visually subordinate to the landscape. The Pacific Connector pipeline would not meet that standard at that location. Amendment RRNF-3 is proposed at this location to change the VQO to Modification (USDA Forest Service Agricultural Handbook 478) and to allow five years for amended VQOs to be attained. The PCT in the vicinity of the Pacific Connector pipeline crossing would be affected by this proposed amendment.

Temporal and Spatial Boundaries of Impacts

This proposed change would affect approximately 5 acres of seen area in the year of construction. The 5 acres would encompass the 75-foot-wide pipeline construction right-of-way seen from the PCT. Vegetation growth and mitigation measures would reduce the seen area to approximately 2 acres after five years. This would not achieve the Forest Plan goals and objectives of a natural appearing forest at that location within 3 years after construction. Hikers and horseback riders passing the corridor would be able to see it for approximately 1 to 3 minutes. This change would affect only recreation and VQOs in the vicinity of the PCT–Pacific Connector pipeline intersection. This proposed amendment is for the Pacific Connector Pipeline Project only. It would not change future management direction.

(3). Along the ridgetop south of State Highway 140 between Pacific Connector pipeline MPs 156.3 to 156.8 and 157.2 to 157.5 in Sections 11 and 12, T. 37 S., R. 3 E., W. M., Oregon

This location has a VQO of Middleground Partial Retention. Standards and guidelines for Middleground Partial Retention (Management Strategy 9, LRMP Page 4– 112) require that VQOs for a given location be achieved within 3 years of completion of the Project. The Pacific Connector pipeline would not meet this standard at that location. Amendment RRNF-4 of the Rogue River National Forest LRMP is proposed at this location to make provision for the pipeline project. This proposed amendment would allow 10 to 15 years to meet the Middleground Partial Retention standard at this location. Approximately 0.8 mile or 9 acres of the Pacific Connector right-of-way in the Middleground Partial Retention VQO visible at distances of 0.8 to 5 miles from State Highway 140 would be affected by this proposed amendment.

Temporal and Spatial Boundaries of Impacts

This proposed change would affect approximately 9 acres or about 0.8 mile of the pipeline corridor as seen from Highway 140 in the year of construction. For the next 10 to 15 years, the pipeline corridor would remain visually dominant to the surrounding landscape but would become less evident each year. Vegetation growth and mitigation measures would allow the area to meet the assigned VQO of Middleground Partial Retention after 10 to 15 years.

This proposed amendment would not change VQOs, but instead allow more time to meet the VQO of Middleground Partial Retention as seen from Highway 140. To the degree that travelers look up as they are headed west on Highway 140, this location would be visible from a distance of 0.8 to 5 miles for a few minutes. Duration would depend on travel speed but would likely be less than 10 minutes, and would likely not be continuous because of the height of roadside trees

and line of sight from the highway. This location would not be visible from other key observation points or travel routes such as the Big Elk Road.

Winema National Forest

The Pacific Connector pipeline would meet the VQO of the Winema National Forest LRMP with the following exceptions:

(1). Where the Pacific Connector right-of-way crosses the Dead Indian Memorial Highway at approximately pipeline MP 168.8 in Section 33, T. 37 S., R. 5 E., W. M., Oregon

This location has visual standard of Foreground Retention. Standards and guidelines for Scenic Management, foreground retention (LRMP 4–103, Management Area 3A, Foreground Retention) requires visual standards for a given location be achieved within one year of completion of the Project. The Pacific Connector pipeline would not meet that standard at that location. Amendment WNF-2 is proposed to allow 10 to 15 years to meet the specified visual standard at this location. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of the Dead Indian Memorial Highway, and would not change future management direction for any other project.

Temporal and Spatial Boundaries of Impacts

This proposed amendment would affect about 3 acres of Management Area 3A initially, but over a period of 10 to 15 years, the affected area would decrease to around one-quarter of an acre because of the growth of vegetation at the highway crossing. Installing the pipeline across Dead Indian Memorial Highway would create a corridor that would be visible for about 10 to 15 seconds for travelers along the highway. The area affected by pipeline construction at the crossing would be much less than one percent of Management Area 3A. This is a project-specific amendment that would affect only and recreational experiences in a limited area. This proposed amendment would not change visual standards, but instead allows more time to meet the visual standards of foreground retention as seen the Dead Indian Memorial Highway. It would not change future management of any other resource, or alter levels of outputs between any other goods and services so long-term relationships between multiple-use goods and services are not affected.

(2). Where the Pacific Connector right-of-way is adjacent to the Clover Creek Road from approximately pipeline MP 170 to 175 in Sections 2, 3, 4, 11, and 12, T. 38 S., R. 5 E., and Sections 7 and 18, T. 38 S., R. 6 E., W. M., Oregon

This location has a visual standard of Foreground, Partial Retention. Standards and guidelines for Foreground Partial Retention (LRMP, page 4–107, Management Area 3B) require that visual standards be met within three years of completion of a project. The Pacific Connector pipeline cannot meet that standard at that location in three years after construction. Amendment WNF-3 is proposed to allow 10 to 15 years to meet the standard of Foreground, Partial Retention at this location. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of the Clover Creek Road and would not change future management direction for any other project.

Temporal and Spatial Boundaries of Impacts

The Winema National Forest LRMP would be amended to allow 10 to 15 years to meet the VQO for Scenic Management, Foreground Partial Retention from MPs 170 to 175. This change would potentially affect approximately 50 acres and 6 miles of corridor as seen from the Clover Creek Road. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of Clover Creek Road and would not change future management direction for any other project. Over a period of 10 to 15 years, the affected area would decrease to about 29 acres because of changes in vegetation. Initially, the affected area would be visually evident for the entire 5 miles on NFS lands adjacent to the Clover Creek road. Over time, this would become less visually evident because of the ingrowth of vegetation and mitigation measures adopted by the Pacific Connector pipeline. At an average speed of 40 mph, the 5-mile-long area affected by this amendment would be visible for approximately 10 to 12 minutes.

4.9 SOCIOECONOMICS

The potential socioeconomic effects associated with the JCE & PCGP Project include impacts on population, housing, local infrastructure and public services, the regional economy, and environmental justice. For the Jordan Cove Project, these impacts would occur primarily within Coos County, Oregon. Impacts associated with the Pacific Connector Pipeline Project would occur primarily in Klamath, Jackson, Douglas, and Coos Counties, Oregon.

4.9.1 Jordan Cove LNG Terminal

The following section discusses potential socioeconomic effects resulting from the construction and operation of Jordan Cove's LNG export terminal and associated facilities, including the South Dunes Power Plant.

4.9.1.1 Population

The state of Oregon had a total estimated population of 3.88 million in 2012 (table 4.9.1.1-1). Total population in Coos County in 2012 was 62,890. Population increased statewide between 2000 and 2012, with a net gain of 462,000 residents (an increase of approximately 14 percent). The population in Coos County, in contrast, remained relatively unchanged over this period, with 111 more residents in 2012 than in 2000 (an increase of about 0.2 percent). The closest cities to the LNG terminal are North Bend and Coos Bay. These two cities had estimated 2012 populations of 9,710 and 16,060, respectively. Population in North Bend and Coos Bay increased by 2 percent and 4 percent, respectively, from 2000 to 2012.

TABLE 4.9.1.1-1

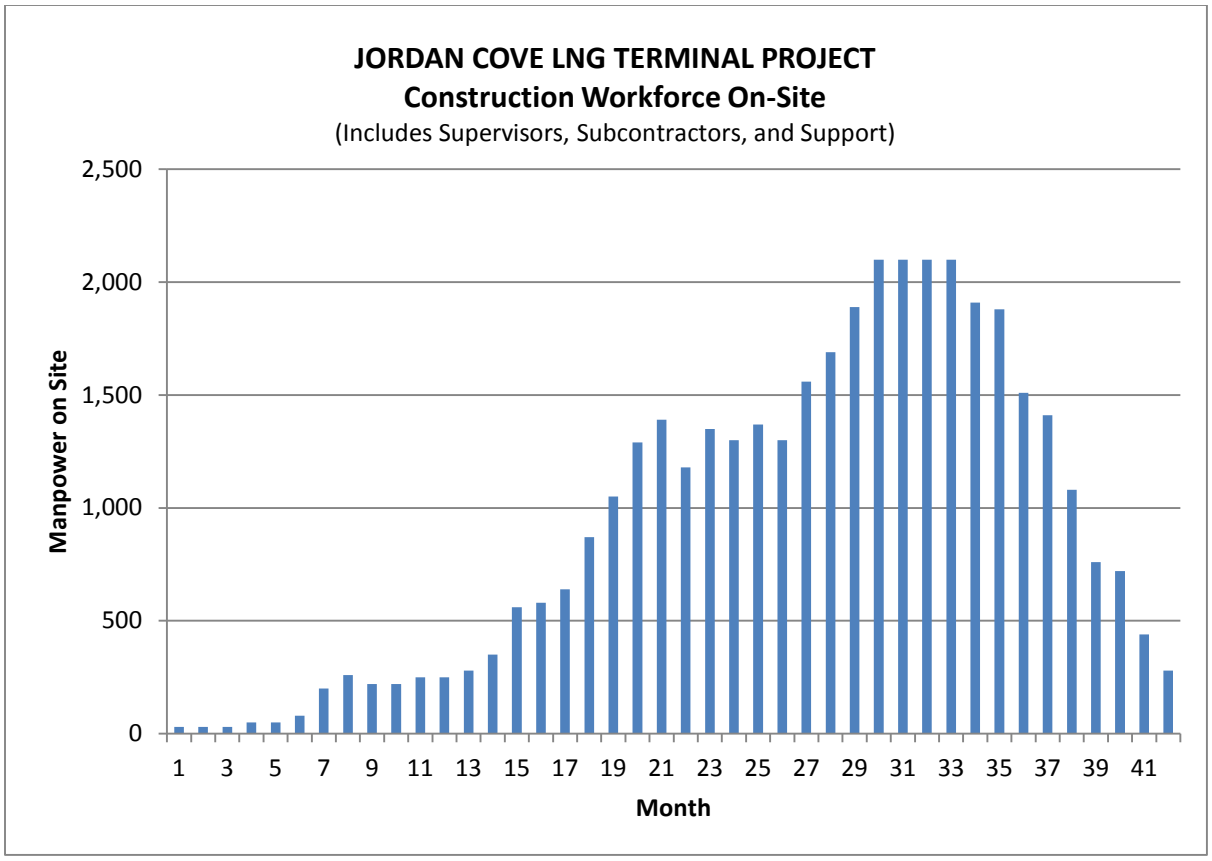
Population by State, County, and Community

State/County/Community	2000	2012	2000 to 2012 Net Change	2000 to 2012 Percent Change
Oregon	3,421,399	3,883,735	462,336	14%
Coos County	62,779	62,890	111	0.2%
City of Coos Bay	15,374	16,060	686	4%
City of North Bend	9,544	9,710	166	2%

Source: U.S. Census Bureau 2000; Portland State University 2012a, 2012b, 2012c

Jordan Cove estimated that it would take about 42 months to construct its LNG terminal and related facilities. During that period, Jordan Cove would employ an average of 922 workers, with a total of 8.3 million worker-hours expended. These estimates include the workforce required to construct the South Dunes Power Plant.

According to a modularization exercise conducted by Jordan Cove's consultant (Black & Veatch), during the first year of construction, the Jordan Cove Project workforce would average between 100 and 300 people and then it would ramp-up during the second year. The construction work force would reach its peak of 2,100 personnel around month 30 and then decline to about 300 workers towards the end of construction. This is illustrated in figure 4.9-1.



Source: Black & Veatch 2012

Figure 4.9-1. Construction Workforce Projections

Jordan Cove has committed to use local and union labor when available for construction of the LNG terminal and related facilities. The latest estimates provided by Jordan Cove[121] assume that 15 to 20 percent of the labor force would consist of local workers, defined as those who live close enough to commute to and from their homes each day. The local workforce is expected to average about 130 workers (about 14 percent of overall average employment) over the life of the construction phase, with an estimated 300 local workers (14 percent of the total peak) employed at the peak of the Jordan Cove Project (months 30 to 33).

Based on these estimates, the non-local workforce would average about 792 employees over the life of the construction phase and peak at about 1,800 non-local workers in months 30 to 33. Jordan Cove anticipates that the majority of non-local workers would normally reside within 250 to 300 miles from the LNG terminal site, and that a large portion would typically return home on weekends. Other non-local workers may come from the adjoining states of Washington and California.

ECONorthwest (2012b) estimated that 244 non-local employees working on the Jordan Cove Project for an average of two years would relocate to Coos County with their families. Assuming an average household size of 2.3 people,[122] the non-local employees moving to the area with their

[121] Presented in its response filed August 29, 2013 to the FERC staff's August 9, 2013, data request question RR5-4.
[122] According to the U.S. Census, the average size of a household in Coos County in 2011 was 2.28 people.

families could add about 317 people to the regional population, including spouses and children (but not counting the employees).

The Jordan Cove Project's total contribution to the regional population could be an average of about 1,109 people during construction, if the average single person non-local workforce of 792 is combined with the additional 317 family members who relocate to the area. An influx of an average of 1,109 people would represent a 4.3 percent increase in the combined population of the cities of Coos Bay and North Bend. At the peak of construction (approximately 4 months), the single non-local workforce (about 1,900 people without families factored in) would represent about 7.4 percent of the combined population of Coos Bay and North Bend. We conclude that population increases directly related to the Jordan Cove Project construction would be temporary and short term. Construction would last less than four years. We believe the cities have the capacity to absorb an average of about a 4 percent increase in population over a four-year period without significant adverse effects on local communities and public services (see section 4.9.1.6 for further discussion of local infrastructure and public services).

Jordan Cove currently anticipates that about 145 permanent staff would be employed to operate and maintain the LNG terminal and related facilities, including the South Dunes Power Plant. Of those, about 55 people would be administrative or engineering support personnel working a regular weekday shift. Because the operation of the power plant would be integrated into the general terminal operations, Jordan Cove indicated that only 3 employees per shift would be solely dedicated to operating and maintaining the South Dunes Power Plant. The combined facilities would be staffed 24 hours per day all year (365 days), using a four-shift system listed on table 4.9.1.1-2.

TABLE 4.9.1.1-2

Shifts Operating the Jordan Cove LNG Terminal and South Dune Power Plant

Shift	Personnel	Days/Times	Number of Employees
Weekdays	Administration and Engineering Support	Monday –Friday, 8:00 a.m.-5:00 p.m.	55
Days	Operation and Maintenance	Seven Days a Week, 7:00 a.m.-3:30 p.m.	30
Swing	Operation and Maintenance	Seven Days a Week, 3:00 p.m.-11:30 p.m.	30
Graveyard	Operations and Maintenance	Seven Days a Week, 11:00 p.m.-7:30 a.m.	30

Jordan Cove anticipates that up to 70 percent of the operations and maintenance workforce could be local hires depending on the availability of personnel with the proper training and education. The potential impacts of relocating about 45 permanent operational employees, and their families to Coos County on housing, local infrastructure and services, and the regional economy are discussed below.

4.9.1.2 Housing

The U.S. Census estimated that there were a total of 27,077 individual households in Coos County in 2011, with the average household containing 2.3 people. Eighty percent of the county population lived in the same house for more than one year. The city of North Bend had 3,955 households in 2011, with an average household size of 2.4 people, and 70 percent of the population

resided in the same house for more than one year. The city of Coos Bay had 6,804 households, with an average size of 2.3 people, and 74 percent staying in the same house for more than a year. Based on statistics from the U.S. Census for 2011, the homeownership rate in Coos County was nearly 67 percent. In the city of North Bend, the homeownership rate was about 57 percent, while in the city of Coos Bay it was 56 percent (U.S. Census Bureau 2013e).

In 2010, Coos County had a total of 30,598 housing units, with 11.3 percent (3,460 units) identified as vacant or vacant part of the year (see table 4.9.1.2-1). Of these vacant units, 677 or 6.7 percent of the housing stock were available for rent. In the cities of North Bend and Coos Bay, an estimated 152 and 167 housing units respectively were available for rent in 2010.

TABLE 4.9.1.2-1

Jordan Cove Project Area Housing Units, 2010

Category	Coos County	City of North Bend	City of Coos Bay
Total Housing Units	30,593	4,450	7,542
Occupied	27,133	4,113	6,950
Vacant or Vacant Part-Year:	3,460	337	592
Seasonal, recreational, or occasional use	1,236	31	105
Rented/sold, unoccupied	192	17	36
For rent	677	152	167
For sale only	1,355	137	284
Total Rental Housing a/	10,062	2,023	3,309
Rental Vacancy Rate b/	6.7%	7.5%	5.0%

a/ This total includes both occupied and vacant rental housing.
b/ This rate is based on the number of vacant units available "For rent" divided by the total number of rental units.
Source: U.S. Census Bureau 2013a

Jordan Cove's economic consultant (ECONorthwest 2012b) estimated that there are about 51 manufactured dwelling (mobile home) parks within 53 miles of the LNG terminal site (roughly about a 75-minute commute one-way), with a total of about 1,753 units. There are no data indicating how many mobile homes would be available for rent, or how many empty spots may be available in manufactured dwelling parks to be acquired by non-local construction workers on a temporary basis.

There are about 70 hotels, motels, and bed and breakfast inns within 53 miles of the Jordan Cove LNG terminal site. These hotels, motels, and inns combined contain about 2,580 rooms. There are 18 hotels, motels, and inns within the cities of North Bend and Coos Bay combined, which contain a total of about 861 rooms (ECONorthwest 2012b).

The number of lodging rooms typically available for rent by construction workers would vary by season. Past studies have identified average occupancy rates for the area that range from under 37 percent in January to almost 80 percent in August (ECONorthwest 2006a). Applying these percentages to the estimated total supply of hotel, motel, and inn rooms within 53 miles of the terminal site (2,580) suggests that 1,729 rooms may be available for rent in January, with 516 rooms available in August. It should also be noted that occupancy rates vary during the week, and tend to be higher during weekends. Many of the non-local Jordan Cove construction workers who reside elsewhere in Oregon, southern Washington, or northern California may drive home on the weekends, and therefore only need lodging in Coos County during weekday nights, when vacancy rates tend to be lower (i.e., when more rooms would be available for rent).

Jordan Cove's economic consultant (ECONorthwest 2012b) identified 69 recreational vehicle (RV) parks and campgrounds within 53 miles of the LNG terminal, with a combined total of approximately 5,107 spaces. As with hotels, demand for RV spaces is highly seasonal (with the highest demand on weekends). The annual average occupancy rate for RV parks in Coos County is about 47 percent, with rates dropping below 20 percent in the winter.

We estimate that an average of 1,109 people, including non-local employees and their families, could move to the area during the 42 months it would take to construct the Jordan Cove LNG terminal and related facilities. At the peak of construction, during months 30 to 33, the single non-local workforce would number almost 1,900 people. Jordan Cove estimated that about six percent of the non-local workforce would share living quarters. If that is factored in, about 1,800 non-local employees would need temporary housing during the peak construction period.

Non-local workers can find lodgings at an array of residential options, including rental houses, mobile homes, hotels, motels, inns, RV parks, and campgrounds. We estimate that combined, these residential options offer a total of 10,117 existing units or rooms within commuting distance from the Jordan Cove facilities. Jordan Cove's economic consultant concluded that the local housing market could comfortably accommodate the anticipated demand resulting from the influx of non-local construction personnel. While we acknowledge that not all of the housing units would be available all the time, because some of the units would be rented by other residents or visitors to the region, we think that the general housing stock is large and diverse enough to meet the residential needs of people moving to Coos County to work on the Jordan Cove Project.

During operation of the LNG terminal and associated power plant, Jordan Cove would employ an estimated 45 non-local workers who would have to relocate to the area. Assuming an average family size of 2.3 people (including the Jordan Cove employees), operation of the Jordan Cove Project could result in an influx of 104 people. At total of 104 people moving into Coos County during LNG Terminal operation would not have any significant adverse impacts on local housing, because of the large stock of residential options available for rent or purchase, as discussed above.

North Point Workforce Housing Complex (NPWHC)

While the local housing stock may have sufficient space for the anticipated influx of personnel, Jordan Cove does not believe that reliance on hotels/motels/inns and RV parks as indicated by ECONorthwest (2012b) would be a viable source of lodging. Specifically, amenities may be lacking for a longer-term stay and Jordan Cove has indicated that workers are likely to seek extended stay rates at commercial locations that may reduce opportunities for tourists during peak tourist seasons.[123]

To address these potential housing issues, Jordan Cove has proposed to construct a temporary housing complex on the south side of the McCullough Bridge within the city of North Bend. This facility, known as the NPWHC, would be designed to accommodate a peak population of 2,100 workers (about 300 more units than may ultimately be needed based on estimates of the peak non-local workforce, as discussed in section 4.9.1.1). All non-local employees would have their choice of living in the NPWHC or finding their own housing; however, the NPWHC would be offered at no cost to employees as a benefit.

[123] See Jordan Cove's April 22, 2015, filing with the FERC.

We received a number of comments concerned about the potential impact of the NPWHC on safety for the local community. Safety considerations related to travel on public roadways and potential congestion in the town centers of Coos Bay and North Bend were a primary factor in selecting the north point site for the facility (see section 3.3.2.5 discussion of alternative sites). Jordan Cove would also implement a number of best practices for the NPWHC to promote a safe environment for workers and the community. A private security force would provide guard services, and not allow anyone onto the premises if they do not provide credentials from Jordan Cove at the entrance gate to prove residency at the NPWHC. The security force would be required to attend the State of Oregon mandated security guard training, which meets the standards codified in ORS 181.883. Security personnel would report any illegal activity to local law enforcement, and local law enforcement would handle it as appropriate. Families or other personal guests would not be permitted to join employees at the NPWHC. Firearms, alcohol, and illegal drugs (including marijuana, which is illegal at the federal level) would not be permitted on-site. Any NPWHC residents who violate the facility rules would no longer be allowed to stay at the facility.

4.9.1.3 Property Values

The closest residences to the LNG terminal site are across Coos Bay in the cities of North Bend and Coos Bay (located more than a mile from the site). According to statistics obtained from the U.S. Census Bureau (2013e), the median value of an owner-occupied house in Coos County in 2011 was $194,500. The average owner-occupied house in the city of North Bend was valued at $207,200, while in the city of Coos Bay the average house was worth $173,400. During Project scoping, some commenters raised concerns about potential impacts on property values.

Jordan Cove had its economic consultant (ECONorthwest 2006b) perform a literature review in 2006 to determine if the siting of an LNG terminal would drastically reduce nearby residential or commercial property values. One cited study (Clark and Nieves 1994), conducted by the Argonne National Laboratory, examined the economic impacts of the presence of so-called “noxious” facilities on local wages and property values. Eight types of “noxious” facilities were studied: nuclear power plants; coal-, gas-, or oil-fired power plants; military chemical weapons sites; hazardous waste sites; refineries; chemical weapon storage facilities; former storage sites that are now contaminated; and LNG facilities. The study examined the effects of 262 facilities (including 11 LNG facilities) on standardized 1,000-square-mile areas across the United States. The results of the study concluded that the presence of five of the eight types of “noxious” facilities has a significantly negative effect on property values and a positive effect on wages. However, the study concluded that the presence of an LNG facility did not have a significant positive or negative effect on either wages or property values.

ECONorthwest also conducted its own study of the affects the siting of peak shaving LNG storage plants at Newport and Portland, Oregon had on local residential and commercial property values. Using data from the Lincoln County Tax Assessors Office, ECONorthwest found that property values around the Newport LNG plant were not depressed, and 25 homes within 0.5 mile and overlooking the facility had above average market values. They also argue that the presence of many other industrial and commercial properties around the Portland LNG facility, including the second-largest industrial employer in the city, suggests that the presence of this facility has not discouraged other businesses from locating in the area (ECONorthwest 2006b).

Based on the studies summarized above, we conclude that there is no evidence to support a finding that the siting of an LNG terminal would have significant adverse effects on nearby residential or commercial property values. In fact, as discussed below, there is evidence that the construction and operation of the Jordan Cove LNG terminal could have beneficial effects on the local economy.

4.9.1.4 Economy and Employment

Coos County had a total estimated civilian labor force of 28,165 in 2012 (see table 4.9.1.4-1). That year, 15,370 people were employed in private non-farm jobs in the county. The highest number (26 percent) of those private sector jobs were in the trade, transportation, and utilities industries. Those industries also contributed the largest amount of gross private sector income to the local economy, with a total payroll in 2012 of $118.8 million (Oregon Employment Department 2013a). In the city of Coos Bay, the retail trade was the largest private employer with 13 percent of jobs. In the city of North Bend, the health care industry was the largest employer with almost 15 percent of the private sector jobs.

TABLE 4.9.1.4-1

Existing Economic Conditions for the Region

Element	Oregon	Coos County	City of Coos Bay	City of North Bend
Population in 2012 a/	3,883,735	62,890	16,060	9,710
Private Non-farm Employment in 2011 b/	1,341,841	16,731		
Unemployment Rate in 2012 c/	8.7%	10.7%		
Average Annual Per Capita Income in 2011 b/	$26,561	$21,171	$20,881	$21,660
Median Annual Household Income 2011 b/	$49,850	$37,789	$36,751	$41,402
Below Poverty Line 2011 b/	14.8 %	16.0%	16.9%	15.5%

a/ Source: Portland State University 2012b, 2012c
b/ Source: U.S. Census Bureau 2013e
c/ Source: Oregon Employment Department 2013b

Of the total non-farm jobs in Coos County in 2012, 28 percent were employed by government agencies. That same year, government jobs in the county contributed a total of $227,225,367 in payroll to the local economy.

Annual per capita income in Coos County in 2011 was $32,443, equivalent to 86 percent of the statewide per average (U.S. Bureau of Economic Analysis 2013a). The median household income in the county in 2011 was $37,789. For the city of Coos Bay in 2011, annual per capita income averaged $20,811, while median annual household income was $36,751. That year in the city of North Bend, the annual per capita income averaged $21,660, while median annual household income was $41,402 (U.S. Bureau of Economic Analysis 2013a).

Transfer payments, including government payments for retirement, disability, unemployment insurance benefits, income maintenance payments, and veteran benefits, accounted for about 32 percent of the Coos County per capita income in 2011, compared to 20 percent statewide. Retirement and disability payments, alone, accounted for about 11.5 percent of per capita income in Coos County, compared to 7.4 percent statewide, indicating the relative importance of this source of income (U.S. Bureau of Economic Analysis 2013a).

The average annual unemployment rate in Coos County in 2012 (at 10.7 percent) was higher than the statewide average of 8.7 percent (Oregon Employment Department 2013b). In 2011, about 16

percent of families in Coos County earned below the poverty threshold.[124] In the city of Coos Bay, about 16.9 percent of families lived below the poverty line, and the poverty figure for the city of North Bend was 15.5 percent (U.S. Census Bureau 2013e).

Jordan Cove's economic consultant (ECONorthwest 2012c, 2012d) prepared two analyses of the economic impacts of the LNG Terminal Project, one for construction and one for operation of the Project.[125] The discussion below is derived in part from these analyses, and Jordan Cove's responses to FERC staff data request questions about socioeconomic issues. Jordan Cove estimated that construction of its LNG terminal and related facilities would cost about $3 billion in 2011 dollars. About $2.6 billion would be for materials, equipment, and other expenditures, with $653 million of that amount spent in the states of Oregon and Washington combined (ECONorthwest 2012c).

As stated in section 4.9.1.1, Jordan Cove estimated that during the 42-month-long construction period, it would employ an average of 922 workers, with a peak of 2,100 employees during months 30 to 33. Total wages and employee compensation during terminal construction would be $412 million; with $364 million of this total expected to be spent in the states of Oregon and Washington (ECONorthwest 2012c).

One potential consequence of constructing the LNG terminal may be that because of its high wages, the Project may attract skilled local laborers who are currently employed in other businesses, including those working in the service industries such as restaurants, hotels, and resorts.[126] However, any such impacts would be temporary, for the four-year terminal construction period. In addition, those impacts may be partly mitigated by indirect and induced job creation in other support industries in the county that could be stimulated by the Project, as discussed below.

ECONorthwest (2012c) estimated total (direct, indirect, and induced) impacts from Project construction to economic output, Gross Domestic Product (GDP), labor income, and full-time equivalent (FTE) jobs for a two state region consisting of Oregon and Washington. Direct impacts are those that happen at the initial source of the economic activity, in this case the project construction sites and offices that oversee construction activity. These direct impacts have downstream impacts that are felt elsewhere in the economy. Indirect impacts occur as a result of business-to-business transactions, such as those with the suppliers who provide goods and services to the construction project (and the suppliers of suppliers, usually a small number). Induced impacts are those caused by household spending by those directly or indirectly employed by the Project. Economic output for construction projects represents the cost of building and completing the Project, including the cost of equipment, engineering, project management, and other related expenses. GDP represents the market value of all the goods and services produced as a result of the Project. FTE jobs represent employment for 2,080 hours per year; FTEs do not necessarily translate into the number of affected workers.

Using IMPLAN (Impact Analysis for Planning) economic modeling software, ECONorthwest (2012c) estimated the combined regional economic impacts of construction of the Jordan Cove

[124] Poverty thresholds are the yearly dollar amounts used by the U.S. Census Bureau to determine poverty status. In 2011, the threshold for a family of four people was a total annual income of $23,021.
[125] These analyses were included as Appendices E.5 and F.5 attached to Resource Report 5 in Jordan Cove's May 21, 2013, application to the FERC.
[126] Personal communication with the Bandon Dunes golf resort, August 4, 2015.

LNG Terminal and the associated Pacific Connector pipeline. Combined, the two Projects would employ a direct labor force of 7,073 FTEs over the four-year construction period, with annual average employment of 1,768 FTEs. Construction of the Projects would also support a combined total of 5,120 indirect and 7,353 induced jobs (table 4.9.1.4-2). The companies would spend a combined total of $4.5 billion to build both the terminal and pipeline; supporting $1,174 million and $974 million in indirect and induced economic output, respectively. The Projects would also support a total of $1,738 million in direct, indirect, and induced GDP in Oregon and Washington over the 4-year construction period (table 4.9.1.4-2).

TABLE 4.9.1.4-2

Regional Economic Impacts of Construction of the Jordan Cove and Pacific Connector Projects in Oregon and Washington

Type of Impact a/	Jobs	Earnings b/	Output b/	GDP b/
Direct	7,073	$731	$4,494	$739
Indirect	6,120	$283	$1,174	$440
Induced	7,353	$307	$974	$559
Total	**20,546**	**$1,321**	**$6,642**	**$1,738**

a/ Impacts are the combined totals for the Jordan Cove and Pacific Connector projects for the entire 4-year construction period.
b/ Impacts are expressed in millions of 2011 $
Source: ECONorthwest 2012c

To operate its LNG terminal and related facilities, Jordan Cove would employ about 145 full-time workers, at an average annual salary of $80,000, generating a total of almost $12 million in direct annual wages. Annual operating expenses, excluding employee compensation, are expected to total $58 million, including $20 million in contributions to local K-12 education and $10 million in contributions to the Bay Area Urban Renewal Association (ECONorthwest 2012d). This total includes operating expenses for the LNG terminal, as well as the portion of the Pacific Connector pipeline that would be located in Coos County. Based on these expected annual expenditures, ECONorthwest (2012d) estimated that Project operations would support an annual total of 455 indirect jobs and 182 induced jobs in Coos County, with associated indirect and induced employee compensation of $19.4 million and $5.4 million, respectively.

No commercial enterprises would be displaced by the Jordan Cove Project, and construction and operation of Jordan Cove's LNG terminal should not result in the loss of local business revenues or taxes. In fact, as can be seen from the discussion above, the Jordan Cove Project would make positive contributions to the regional economy.

4.9.1.5 Tax Revenues

Total revenues for Coos County were approximately $49.5 million in fiscal year 2012. About 93 percent of that total was generated by property taxes (Coos County 2013). Construction and operation of the LNG terminal are expected to have beneficial impacts on government revenue in Coos County and Oregon. Jordan Cove estimated that its employees would pay up to $40 million in income taxes to the state of Oregon during the almost four-year-long construction period. Each year during operation of the terminal, Jordan Cove would make contributions through Coos County's Bay Area Enterprise Zone in lieu of taxes. These contributions would consist of $20 million a year in funding for education and $10 million for urban renewal (ECONorthwest 2012d).

4.9.1.6 Local Infrastructure and Public Services

Law Enforcement and Fire Protection

Coos County has one sheriff's office and seven police departments. The city of Coos Bay has 38 paid and reserve police officers, and the city of North Bend has 28 police officers. Coos County has 17 fire departments. The city of Coos Bay has 64 volunteer and paid firefighters, the city of North Bend has 46 paid and volunteer firefighters, and the town of Charleston has 39 volunteer and paid firefighters.

Jordan Cove anticipates that the temporary increase in the local population related to the influx of out-of-town workers during construction would have a negligible effect on law enforcement and fire protection. Jordan Cove has a reimbursement agreement in place with Coos County to cover any costs associated with public safety during construction and operation.

Jordan Cove has committed to building and funding the SORSC adjacent to the South Dunes Power Plant. The complex would include a full-time professionally staffed fire station and emergency response crews; a Coos County Sheriff's substation; offices for the Port and Coast Guard; and an LNG fire training center that would be developed in conjunction with Southwest Oregon Community College. Although dedicated to the Jordan Cove facility, the fire station and emergency response crews would be available to support the cities of North Bend and Coos Bay if the need arises and availability allows.

Jordan Cove would also be responsible for funding additional security measures outlined in the Coast Guard's WSR and LSR to protect LNG vessel marine traffic to and from the terminal within the waterway. This would include escort boats operated by the County Sherriff's department. On June 14, 2014, ODE entered into an MOU with Jordan Cove regarding LNG emergency preparedness at the export terminal.

In the event of an accident at the LNG terminal, the costs of emergency response, containment, damages, remediation, and repairs would be borne by Jordan Cove or its insurance carrier. Jordan Cove would carry standard liability insurance for facilities of this type. In the event of an accident with an LNG vessel in transit to the terminal, the costs of the accident would be the responsibility of the owners of the ship as mandated by Coast Guard regulations.

Medical Facilities

There are three hospitals located in Coos County. The Southern Coos Hospital in Bandon, approximately 31 miles south of the terminal, is licensed for 21 beds, and is designated a critical access hospital as well as a full-service, general acute care hospital. It is ranked as a Level 4 Trauma Center. The Coquille Valley Hospital in Coquille, approximately 25 miles south of the terminal, is licensed for 25 beds, and is ranked as a Level 4 Trauma Center. The Bay Area Hospital in the city of Coos Bay is the closest to Jordan Cove's LNG terminal, approximately 6 miles from the terminal. This facility has 172 beds licensed for acute care, and is rated a Level 3 Trauma Center. Jordan Cove signed an MOU with the State of Oregon that requires that they equip the Bay Area Hospital according to State policies for all hospitals in treating burns.[127] Other injuries anticipated would be similar to existing treatments already practiced at the hospital and at North

[127] Memorandum of Understanding and Agreement No. 14-008 By and Between Jordan Cove Energy Project and the State of Oregon for LNG Emergency Preparedness. Filed July 1, 2014, in FERC Docket No. CP13-483.

Bend Medical Center. Jordan Cove has also identified a shortage of primary health care professionals as an issue. They expect that, generally, non-local workers would remain under the care of their existing primary care doctors.

To address the potential for non-local workers occasionally requiring medical attention by local doctors, Jordan Cove has communicated with local medical facilities to discuss meeting this new demand for services. Jordan Cove has investigated the possibility of establishing a company-sponsored "walk-in" medical clinic. Alternatively, Jordan Cove has stated it would work in coordination with the local medical community to provide additions to staff that would allow for the provision of high-quality medical services to the temporary workforce during Project construction.

In addition, Jordan Cove would have a licensed nurse practitioner on staff with offices located in the Administration Building on the South Dunes Power Plant site. The primary functions for the nurse would be to assess routine employee needs, manage employee wellness programs to reduce the need for emergency visits, and handle triage of any job-related injuries that might occur within the Project site (for times when the nurse is unavailable, Project personnel would assist each other to quickly determine if medical assistance is necessary). Access to the nurse practitioner would be limited to employees of Jordan Cove while on-site.

With the above noted measures by Jordan Cove, medical facilities in Coos County could be adequate to handle the influx of non-local workers during Jordan Cove Project construction, and the additional families that may move to the area during operation. With mitigation, the Jordan Cove Project should not have any significant adverse effects on local medical facilities.

Schools

Coos County had a total of 30 public schools, organized into six school districts, with a total enrollment of 8,902 students in the 2011-2012 school year. The city of Coos Bay operates 10 schools with a total enrollment of about 3,522 students. There are 9 schools operated by the city of North Bend, with 3,483 students combined.

Since their historic peak in 2002, there has been a trend of declining enrollment in Coos County public schools. As a result, North Bend closed its Bangor Elementary School, while Coos Bay closed its Bunker Hill, Charleston, and Eastside elementary schools.

Jordan Cove's economic consultant (ECONorthwest 2012b) estimated that about 244 non-local workers would relocate to the project area with their families, including children, during construction. It was further calculated that those relocated families would have about 125 children of ages between kindergarten and 12th grade that could attend Coos County public schools. That would represent a potential 1.4 percent increase in school enrollment across the county. If all of these new students attended schools in just Coos Bay and North Bend, their numbers would comprise about a 1.8 percent increase for those two districts combined.

Jordan Cove estimated that up to 45 non-local workers would be relocating to Coos County to assist in the operation of the terminal. Using the figure that working households in Oregon have an average of 0.513 school-age children, there would be 23 new students directly related to the operation of the LNG terminal. This would be an increase in student enrollment of less than two percent county-wide.

Jordan Cove stated that it would be contributing up to $20 million annually to an education fund in lieu of paying county property taxes. Therefore, county school districts should have the resources necessary to provide for additional school children related to the construction and operation of the Jordan Cove Project.

Utilities

Electric power is provided to the cities of North Bend and Coos Bay by PacifiCorp, Coos Curry Electric Cooperative, and the Central Lincoln People's Utility District. Northwest Natural Gas Company provides natural gas to Coos County as part of its local distribution network. Liquefied petroleum gas (propane) is provided by Ferrellgas and AmeriGas. The CBNBWB supplies water to the cities of North Bend and Coos Bay. Solid waste disposal services are provided by the City of Coos Bay Public Works Department and sanitary waste treatment is provided by the Coos Bay Wastewater Department.

Construction and operation of the LNG terminal is not expected to have any significant adverse impacts on public utilities, including electric and natural gas infrastructure. Jordan Cove has indicated that there is sufficient electric power on the North Spit to serve existing customers and meet Project needs during construction. Following construction of the South Dunes Power Plant, the Project would generate its own electricity. Depending on terminal needs, there may be surplus electricity generated from the plant that could be put into the local grid.

During terminal construction, Jordan Cove would relocate portions of the existing CBNBWB raw water and industrial wastewater pipelines adjacent to the Trans-Pacific Parkway, as described in section 2.1.1.10. Jordan Cove would use a total of about 413,100 million gallons of raw water for various construction activities, not including hydrostatic testing. For hydrostatic testing of the terminal facilities, Jordan Cove would need to use about 28.3 million gallons of water, obtained from the CBNBWB raw water line, but limited to 1,000 gpm to reduce stress on the line. During terminal operations, about 350 gpm of water would be consumed. Jordan Cove stated that the CBNBWB has indicated that its system has the capacity to provide the necessary quantities of water. Water usage and impacts are more fully discussed in section 4.4.1 of this EIS.

Solid waste generated during terminal construction would be collected on-site and items that cannot be reused or recycled would be hauled to licensed landfills by authorized waste haulers and disposal companies. Solid waste generated by operation of the workers camp would be handled by a private collection service under contract by the city of North Bend. During operation of the terminal, sanitary waste water would be treated on-site and solid waste would either be recycled or hauled from the site and disposed of by private licensed waste disposal companies without the need for city or county resources.

4.9.1.7 Recreation and Tourism

Recreation

Recreational activities on the North Spit take place along the Pacific Ocean beaches on the west side of the Spit, the BLM's Shorelands SRMA, and the Forest Service's ODNRA. People use portions of those recreational areas for camping, picnicking, walking, wildlife viewing, hunting, swimming, surfing, boat launching, horseback riding, mountain biking, and driving OHVs. Coos

Bay is used by recreational boaters, kayakers, and canoers; and is used for fishing, crabbing, and clamming. Recreational activities are more fully described in section 4.8.1 of this EIS

The OPRD in 2002 reported that the Pacific Ocean beach between the mouth of Tenmile Creek and Coos Bay averaged 38 people on a weekday and 60 people on a weekend, with densities of 3 people-per-mile on a weekday and 4-people-per-mile on a weekend (Shelby and Tokarczyk 2002). There are three Oregon State Parks within 10 miles of Coos Bay (Cape Arago, Shore Acres, and Sunset Bay) that combined had over one million day visits in 2011, supporting 267 jobs, and generating a total of $21.7 million in spending (White et al. 2012).

The Forest Service identified 1.6 million visits to the Siuslaw National Forest, including the ODNRA, in 2011, with 23.6 percent of visitors engaging in OHV use for an average of 6.6 hours a visit (Forest Service 2012c). The BLM counted 27,100 visits to the North Split between October 1, 2003 and September 31, 2004. About 2,500 vehicles travel out to the North Jetty each year; most of these being OHVs using the sand roads or beach routes.

Oregon State University estimated that OHV use in the South Coast area, including Coos County, accounted for about 757,000 trip days in 2008. These OHV trips generated about $81.4 million in expenditures for the regional economy (Lindberg 2009).

In 2008, 66,000 trips for hunting were counted for Coos and Curry Counties combined. Hunting in Coos County generated $3.4 million in expenditures. About 600,000 trips were counted from wildlife viewing in the South Coast of Oregon (Coos and Curry Counties) in 2008, with $15.7 million in expenses generated by that activity in Coos County (Dean Runyan Associates 2009).

There were about 98,000 trips to harvest shellfish along the South Coast in 2008, generating about $5.6 million in expenditures in Coos County (Dean Runyan Associates 2009). Between 2008 and 2011 an average of 14,710 yearly recreational crabbing trips were taken to Coos Bay, harvesting an average of 158,650 pounds per year of Dungeness crabs. About 76 percent of the recreational crabbers resided within 100 miles of Coos Bay (Ainworth et al. 2012). Recreational clammers harvested a total of about 33,700 kilograms of clams in Coos Bay between March and September of 2008, making it the third most productive clamming estuary in the state, after Tillamook Bay and Netarts Bay (Ainworth and Vance 2008) (see section 4.8.1.1).

A study by the COE in 2002 found that recreational marine activities along the Oregon coast and river ports generated $42 million in personal income and supported 1,700 jobs. This included spending on marina rental slips, boat ramp users, and other visitors to ports in Oregon. It was estimated that 735,000 party days a year resulted in $79 million in trip spending in the state (Chang and Jackson 2003). In the South Coast (Coos and Curry Counties), 106,000 saltwater fishing trips were counted in 2008, with $8.4 million in expenditures in Coos County. The OSMB counted 32,774 recreational boat fishing trips in Coos Bay in 2007. Ocean recreational fishing for salmon out of Coos Bay generated $693,000 in 2012 (The Research Group 2013a).

As discussed in section 4.8.1.1, the Jordan Cove Project would not have direct impacts on any federal, state, or local parks or recreation areas or facilities. Indirect effects would include construction related traffic on the Trans-Pacific Parkway and construction and operational noise emanating from the terminal and power plant that may affect users of the BLM's Shorelands SMRA and the Forest Service's ODNRA. Traffic is discussed in section 4.10 of this EIS, and

noise in section 4.12.2. We have previously concluded that construction and operation of Jordan Cove's facilities would have only minor, short-term impacts on recreationalists, and the facilities should not have a significant adverse effect on their activities.

During construction of the access channel to the terminal marine slip, recreational bay users, including boaters, kayakers, and canoers, and people fishing or harvesting shellfish would have to stay outside of the construction zone. Jordan Cove would post signs warning of construction activities at local boat ramps and at the Charleston Marina, on the bay shoreline, and on buoys in the bay demarcating the access channel construction zone. The Coast Guard and OSMB would also provide notice to boaters. Jordan Cove construction workers would warn boats that approach to close. However, if these measures are not sufficient, Jordan Cove may resort to using foam barriers that do not damage boats around the access channel construction zone.

During operation of the terminal, an LNG vessel would be at dock for about 17 hours while actively loading cargo, and boaters and other recreation users of Coos Bay would be restricted from trespassing into the marine slip during that period. Since the marine slip would be mostly excavated from an existing upland on privately owned land outside of the pre-construction natural dimensions of the bay, this restriction should not be considered an inconvenience, nor would it prevent recreational activities from occurring as they currently do elsewhere in Coos Bay. Recreational clamming and crabbing are conducted along the bay shoreline and mud flats outside of the navigation channel and individuals engaged in those activities should not be directly affected by LNG vessel transits in the waterway to and from the Jordan Cove terminal.

LNG vessel marine transit to and from the terminal, and their hoteling at the Jordan Cove berth, may have temporary impacts on recreational users of Coos Bay. Jordan Cove proposes to have 90 LNG vessels visit its terminal each year. A single LNG vessel trip would take about 90 minutes to transit one-way in the waterway from the buoy to the terminal. In accordance with Jordan Cove's WSA, and the Coast Guard's WSR and LOR, an LNG vessel transiting in the waterway would be accompanied by tugs and Sheriff's escort boats, and a moving safety/security zone of about 500 yards would be established around the vessel. Recreational boats would need to stay away from the LNG vessel as it passes, much as they currently avoid deep-draft ships using the Port. Coos Bay pilots have indicated they typically encounter about six recreational boats when they guide deep-draft commercial ships through the navigation channel. It may take up to 30 minutes for an LNG vessel to pass; so recreational boaters should not be unduly delayed.

LNG vessels would only transit in the waterway to the terminal at slack high tide, during daylight hours. According to ECONorthwest (2012a),[128] if 90 LNG vessels visited the Jordan Cove terminal each year, there would be 60 hours total during a year when an LNG vessel would be present in the waterway (0.68 percent of the time). The sum of the time that LNG vessels may be transiting within the Coos Bay navigation channel would be about 1.3 percent of daylight hours. Thus, it appears that LNG vessel marine traffic to and from the Jordan Cove terminal would have negligible potential to affect recreational boaters and other users of the bay. The Coast Guard and OSMB would remind recreational boaters in Coos Bay of their obligation not to impede deep-draft ship traffic in the navigation channel. The Coast Guard and Sheriff's escort may allow individual boats

[128] *Potential Economic Effects of the Jordan Cove Energy Project on Tourism and Recreational Activities in Coos Bay and Coos County*. May 2012. ECONothwest, Eugene. Filed as Appendix D.5 of Resource Report 5 of Jordan Cove's May 21, 2013 application to the FERC.

within the safety/security zone of a passing LNG vessel on a case-by-case basis, according to site-specific circumstances. The escort boats would be able to assist boats to move out of the way of an upcoming LNG vessel in a timely manner.

Tourism

According to ECONorthwest (2012a), tourism accounted for 4.9 percent of the total economic output of Coos County in 2011. That year, the county had about 1.4 million out-of-town visitors; of which, 61 percent came for leisure travel. Visitor volume in Coos County in 2012 was estimated at 952 person trips and 2,959 person nights. Of that, 944 person nights were spent at hotels or motels in the county. About $45 million was spent on accommodations by visitors to Coos County in 2012. This generated about $1.3 in lodging tax receipts. Travel-related spending in Coos County in 2012 totaled about $233.5 million, and supported an estimated 3,050 jobs (about 10 percent of total county employment). That year, visitor travel to Coos County in total generated about $7.7 million in local and state tax revenue (Dean Runyan Associates 2013).

Tourism in Coos County is seasonal. December and January are the slowest months, with hotels only about one-third occupied. Well over half of all yearly visitors come to the county between May and September. Hotel occupancy rates in the summer can average 80 percent on weekends.

Commenters during our pre-filing scoping period stated that the Jordan Cove Project could have negative impacts on the local economy by harming the tourist and recreational industries, and affecting commercial fishing operations. We have found no empirical evidence to support such claims; and stakeholders filed no studies in substantiation. Jordan Cove stated that no jobs would be lost in the local tourist, recreational, or commercial fishing industries as a result of its project. As discussed in this EIS, Jordan Cove has proposed measures that would avoid, reduce, or mitigate potential impacts on recreational or tourist activities; including boating and fishing as well as hotel visits. It appears that the economic benefits of the Jordan Cove Project in terms of employment and dollar expenditures during construction and operation, spurring additional indirect and induced jobs and services in the region as well as making contributions to the GDP (documented in the ECONorthwest analyses) outweigh the minor impacts; and these impacts could be mitigated. The additional expenditures of Jordan Cove, combined with tourist dollars, would likely benefit the local economy.

The greatest potential for the Jordan Cove Project to affect tourism would be during the summer when construction workers would compete with visitors to Coos County for accommodations. As mentioned above in section 4.9.1.1, at the peak of construction there may up to 1,800 non-local laborers employed by Jordan Cove who would need housing. We estimated that there may be as many as 10,117 housing units in the area, including rental houses and apartments, hotels and motels, mobile home parks, as well as RV parks and campgrounds. Within 53 miles of the terminal there are 70 hotels, motels, and small inns, with a total of 2,580 rooms. In August, however, about 80 percent of the hotel and motel rooms would be occupied on weekends by other visitors. As discussed in section 4.9.1.2 above, Jordan Cove would build and operate the NPWHC to accommodate up to 2,100 workers. Because the NPWHC would provide housing for construction workers, the Jordan Cove Project should not have significant adverse impacts on housing for tourists.

4.9.1.8 Other Commercial Activities

Commercial Fishing

Commercial and recreational fisheries are discussed in section 4.6 of this EIS. There are no commercial fisheries for vertebrate fish species in the Coos Bay estuary. Commercial ocean fisheries exist for salmonids and marine species, and commercial boats (trollers and trawlers) targeting tuna, salmon, and groundfish dock and sell their products in Coos Bay. A fisherman's market cooperative and a small commercial fishing fleet are located in Charleston. The Charleston Marina has 448 boat slips and provides infrastructure and services to nearly 200 locally-based commercial fishing vessels, as well as the hundreds of commercial fishing vessels that visit each year (Oregon International Port of Coos Bay 2013).

Coos Bay is the third most important harbor in Oregon in terms of total personal income from commercially harvested and processed fish (exceeded only by Astoria and Newport), generating about $52.5 million, or 9.7 percent of the total economic contribution of commercial fishing in the state in 2012. Commercial fishing in Coos Bay represented about 45.1 percent of earned income in the area, equivalent to 1,370 jobs. Coos Bay is the home port for about 20 percent of the commercial fishing vessels in all of Oregon (about 179 vessels out the state's total fleet of 902). Charleston has a seafood processing plant (Peterson Plant) and a private ice provider. In 2012, Charleston took in 32.5 million pounds in commercial seafood, valued at $26.9 million (The Research Group 2013b). Fish accounted for about $9.4 million or 35 percent of the total landed at Charleston, with albacore tuna and sablefish accounting for about $3.3 million and $2.0 million, respectively (ODFW 2013c).

Shrimp and crab combined accounted for about $17.3 million or 65 percent of the value of commercial seafood landed at Charleston in 2012. In 2013, almost 20 million pounds of pink shrimp were landed at Coos Bay, with a value of $10 million (The Research Group 2014). One commenter claimed that the harvest of Dungeness crabs was the most valuable commercial fishery in Oregon, yielding a total of 14.4 million pounds, worth $50 million to crabbers, and contributing $100 million to the Oregon economy in 2014 (Yamada 2014). In 2013, almost 5 million pounds of Dungeness crab were landed at Coos Bay, with a value of just under $13 million. According to the ODFW, between December 2014 and April 2015 there were an average of 194 monthly landings of commercial Dungeness crab boats at Charleston, offloading an average of 410,114 pounds of crabs per month.[129] Over a two-year period during Project construction, a total of about 82 cargo ships and 18 barges would bring heavy equipment to the Jordan Cove terminal. During operation of the terminal, it is estimated that it would be visited by about 90 LNG vessels per year. Project-related impacts on commercial fishing boats from cargo ships and barges in Coos Bay bringing deliveries during terminal construction and LNG vessel transiting to and from the terminal during its operation would be temporary and short term. Fishing boats would avoid cargo ships and barges making deliveries to the terminal during construction in a manner similar to how they currently deal with commercial deep-draft ship and barge traffic into and out of the Port. Total transit time for an LNG vessel between the K Buoy and the Jordan Cove terminal would be about 90 minutes. During LNG vessel transit in the waterway to the terminal, fishermen would be required to move out of the security zone.

[129] These would be crabs obtained by commercial ocean fishing, and do not include the catch from recreation crabbing within Coos Bay.

ECONorthwest (2012a) estimated that each LNG vessel visiting the terminal would, on average, encounter two commercial fishing boats per transit. The LNG marine traffic would only overlap with the portion of the navigation channel used by the ocean going fishing fleet from Charleston for about 2 miles. There may be slight delays resulting from meeting situations between an LNG vessel and a commercial fishing vessel, because of the security and safety zones or other conditions imposed by the Coast Guard. Jordan Cove indicated that the passing of an LNG vessel may cause fishing boats based out of Charleston to wait about 20 minutes before they could enter the channel. We conclude that the Jordan Cove Project would not have significant adverse effects on commercial fishing out of Coos Bay.

Commercial Ship Traffic

The Port stated that Coos Bay is the largest deep-draft coastal harbor between San Francisco and Puget Sound on the West Coast of the United States. Coos Bay was ranked 120th among national ports, moving more than 1.3 million tons of cargo in 2011. With the decline of the regional lumber industry, there has been a decline in commercial ship traffic into and out of the Port; from a recent high of 310 deep-draft vessel calls at Coos Bay in 1988 to 61 in 2011 (ECONorthwest 2012a). The Port is also visited by about 50 barges per year.

Potential Project-related impacts on commercial ship traffic are expected to be temporary and short-term. During construction, a total of about 82 cargo ships and 18 barges would be making deliveries to the terminal over a two year period. It is expected that other commercial ships would avoid Project construction marine traffic in Coos Bay in a manner similar to how they currently deal with other deep-draft ships and barges using the Port. The existing Coos Bay channel is wide enough to accommodate only one deep-draft ship in one direction. The Coast Guard, as part of its WSR and LOR, is requiring Jordan Cove to develop a Transit Management Plan to outline how conflicts with other commercial vessels would be avoided. Each deep-draft vessel would be under the guidance of a Coos Bay pilot. It is possible that terminal-bound cargo delivery ships during construction and LNG vessels during operation may have to wait in the ocean outside the bay, at the buoy, until another deep-draft commercial vessel exits the navigation channel.

Other Industries

There are several industrial enterprises located in proximity to the Jordan Cove LNG terminal on the North Spit. Adjacent to the terminal on the northeast is the Roseburg Forest Products wood chip facility. Jordan Cove would temporarily lease land from Roseburg Forest Products for a staging area during construction of the LNG terminal. During construction of the marine slip for the LNG terminal, excavated materials would be trucked to the South Dunes Power Plant site through the Roseburg Forest Products property, and the slurry pipeline for materials dredged during creation of the access channel and the return water pipeline would also be located on Roseburg Forest Products land. The slurry and return water pipelines would be placed on the ground surface, on top of the rip-rap along the bayshore, to avoid impacts on Roseburg Forest Products facility operations. In addition, Jordan Cove proposes to remove the two water tanks currently used by Roseburg Forest Products, and the facility would then have to be connected to a new tap to the relocated CBNBWB raw water line along the Trans-Pacific Parkway.

Jordan Cove has stated that it would give Roseburg Forest Products wood chip trucks priority right-of-way when in conflict with trucks using its heavy equipment haul road. Flag men would be used to direct traffic on the haul road through the Roseburg Forest Products property.

Additional measures Jordan Cove would implement to reduce impacts on Roseburg Forest Products operations include safety awareness training for its employees, installation of appropriate signage, and developing a truck traffic management plan in consultation with Roseburg Forest Products.

Southport operates a sawmill about 1.2 miles southwest of the Jordan Cove LNG terminal on the North Spit. The Southport facility includes a barge slip for intermodal cargo movements recently completed by the Port at about NCM 6.3. The Port also constructed a railroad to the Southport sawmill.

At NCM 5.6 on the North Spit is the D.B. Western factory and berth, about 2 miles south of the Jordan Cove LNG terminal. Because of its distance away, the Jordan Cove LNG terminal should have no direct impacts on the operation of either the Southport mill or the D.B. Western factory. However, there may be indirect impacts on Roseburg, Southport, and D.B. Western related to Jordan Cove construction traffic on the Trans-Pacific Parkway, and LNG vessel transit in the waterway during terminal operations. Above, we previously discussed potential conflicts in the navigation channel between other commercial ships visiting the Port and cargo ships and barges making deliveries to the Jordan Cove terminal during construction and LNG vessels transiting to the terminal during its operation. We concluded that marine traffic conflicts in the navigation channel would be short-term and temporary, and would mostly be resolved by Jordan Cove implementing its LNG vessel transit management program and other measures imposed by the Coast Guard. Further, in section 4.10 of this EIS, we discuss Project-related impacts on other users of the Trans-Pacific Parkway.

The Southwest Oregon Regional Airport is located in the city of North Bend, directly across the bay to the east of the Jordan Cove LNG terminal. Some commenters raised concerns that the Project may cause disruptions to air service at the airport resulting in a negative economic impact on businesses in the area, including the Bandon Dunes golf resort (located in the city of Bandon, about 25 minutes from the airport by car).

It is unlikely that the Project would have significant impacts on the airport. Jordan Cove would be required to adhere to all FAA rules and regulations before proceeding. There would not be Project-related major disruptions to air service that could have negative economic impacts on local business and the Bandon Dunes golf resort. First, golfers have multiple options to travel to Bandon Dunes, including several highway routes. Second, if the Project is constructed, the influx of workers and contractors could stimulate additional flights to the Southwest Oregon Regional Airport, resulting in more open seats for golfers. We further discuss impacts the Project may have on the Southwest Oregon Regional Airport in section 4.10.

4.9.1.9 Environmental Justice

EO 12898 requires agencies that are part of the Executive Branch of the federal government to address the adverse health or environmental effects of their programs, policies, and activities on minority or low-income populations. The EO also requires that documents, notices, and hearings related to a project be made readily available to the public. Although the FERC is an independent regulatory agency, not a part of the Executive Branch, we carry out our programs in the spirit of EO 12898. Therefore, below we discuss if the location of the LNG terminal would have any direct impacts on, or adversely effect in a disproportionate manner, any minority groups or low-income

communities. This analysis included determining if any minority or low-income populations are situated in close proximity to the propose facilities.

Guidelines provided by the CEQ (1997a) and EPA (1998) indicate that a minority community may be defined as one where the minority population comprises more than 50 percent of the total population or comprises a meaningfully greater share of total population than the share in the general population. Minority communities may consist of a group of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who experience common conditions of environmental effect. Further, a minority population exists if there is "more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds" (CEQ 1997a, p. 26).

The CEQ and EPA guidelines indicate that low income populations should be identified based on the annual statistical poverty thresholds established by the U.S. Census Bureau. Like minority populations, low income communities may consist of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who would be similarly affected by the proposed action or program. The U.S. Census Bureau defines a poverty area as a census tract or other area where at least 20 percent of residents are below the poverty level (U.S. Census Bureau 2013b).

Two commenters raised concerns about environmental justice. In a letter to the FERC dated October 29, 2012, the EPA requested that we conduct appropriate public outreach to ensure that the public and Native American tribes are informed about the Jordan Cove Project. Further, the EPA stated that it considers children, the disabled, the elderly, and those with limited English proficiency to be communities with unique vulnerabilities that should be addressed in this environmental justice section of our EIS. In a letter to the FERC dated June 20, 2013, the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (Coos Tribe) stated that the Jordan Cove LNG terminal would be within their ancestral lands. The Coos Tribes indicated that this EIS should address adverse environmental and cultural impacts on low-income and minority populations, and consider protection of cultural resources of importance to the tribes.

As discussed in section 1.5 of this EIS, the FERC issued notices and held public meetings to inform local communities about the Jordan Cove Project, and provide information about involving the public in the FERC review process. All documents that form the administrative record for these proceedings are available to the public through the eLibrary link on the FERC's Internet web page (at www.ferc.gov). Our consultations with Indian tribes, including the Coos Tribes, and an assessment of project-related impacts on cultural resources within the area of potential effect are detailed in section 4.11 of this EIS.

Almost 90 percent of the population in Coos County was identified as White in the 2010 Census (see table 4.9.1.9-1). About 87 percent of the population of North Bend, the closet city to the LNG terminal, is White; less than 6 percent is Hispanic; about 2 percent is Native American; 1.7 percent Asian; and 0.3 percent African-American. Therefore, we do not consider this community to have a disproportionately high population of minorities. In 2011, more than 84 percent of the population of the city of North Bend earned household incomes above the poverty threshold (see section 4.9.1.4 above); therefore it cannot be characterized as an impoverished community.

TABLE 4.9.1.9-1

Race and Ethnicity in Coos County, Oregon, 2010

		Percent of Total						
Geographic Area	**Total Population**	**White**	**Hispanic or Latino**	**Black or African American**	**American Indian and Alaska Native**	**Asian**	**Other Race**	**Two or More Races**
Coos Bay city	15,967	83.4	7.6	0.5	2.3	1.3	0.4	4.3
North Bend city	9,695	85.8	5.8	0.3	2.1	1.7	0.3	4.0
Coos County	63,043	87.0	5.4	0.4	2.3	1.0	0.3	3.7
Oregon	3,831,074	78.5	11.7	1.7	1.1	3.6	0.5	2.9

a/ Non-Hispanic only. The federal government considers race and Hispanic/Latino origin to be two separate and distinct concepts. People identifying Hispanic or Latino origin may be of any race. The data summarized in this table present Hispanic/Latino as a separate category.
b/ The "Other Race" category presented here includes census respondents identifying as "Native Hawaiian and Other Pacific Islander" or "Some Other Race."
Source: U.S. Census Bureau 2013c

In 2012, about 22.7 percent of the population of Coos County was over the age of 65 years old; which is greater than the state average of 14.9 percent. In the city of Coos Bay, 19.1 percent of the population is older than 65, while the number for the city of North Bend is 17.6 percent. About 18.6 percent of the population of Coos County is under the age of 18; while children under 18 years old represented 20.3 percent of the population of the city of Coos Bay, and 21.9 percent of the population of the city of North Bend. The median age for the residents of the city of Coos Bay is 41.6 years old, while the citizens of the city of North Bend have a median age of 41.3 years old (U.S. Census 2013e). In Coos County, 4.9 percent of the population speaks a language other than English in the home; far less than the state average of 14.6 percent. Vulnerable populations in Coos County are listed on table 4.9.1.9-2.

TABLE 4.9.1.9-2

Vulnerable Populations in Coos County, Oregon

Geographic Area	**Total Population**	**Percent Under 18**	**Percent Over 65**	**Median Age**	**Percent with Language other than English Spoken at Home**
Oregon	3,899,353	22.1	14.9	38.4 years old	14.6
Coos County	62,534	18.6	22.7	47 years old	4.9
City of North Bend	9,628	21.9	17.6	41.3 years old	3.4
City of Coos Bay	15,857	20.3	19.1	41.6 years old	9.5

Source: U.S. Census Bureau 2013e

Coos County does have a slightly higher percentage of Native Americans (2.3 percent) than the state of Oregon (1.1 percent) as a whole. The Coos Tribe is headquartered in Coos Bay, and owns land at the Hollering Place at the community of Empire. The Coquille Tribe is headquartered in North Bend, and operates the Mill casino-hotel-conference center in North Bend. Project-related impacts on Native American tribes are more fully discussed in section 4.11.

Larger and more populated geographic areas may have the effect of "masking" or "diluting" the presence of concentrations of minority and/or low income populations (CEQ 1997a; EPA 1998). Jordan Cove, therefore, also reviewed data at the census tract level to identify the potential existence of minority and/or low-income communities within a 3-mile radius of the LNG terminal

site. Census tracts were considered a minority population if the combined minority population exceeded 50 percent of the total or was meaningfully greater than the overall population. Jordan Cove identified "meaningfully greater" in this context to be 20 percent higher than the state average. None of the census tracts within 3 miles of the LNG terminal site met these criteria. Applying similar criteria to the share of the population below poverty, Jordan Cove determined that an area with more than 17.8 percent of its population below the poverty level should be considered an environmental justice community. The share of the population below the poverty level exceeded 17.8 percent in four of the nine Census tracts within 3 miles of the LNG terminal site (figure 4.9-2).

Jordan Cove concluded that potential pollution emissions from the LNG terminal would be below the threshold for unhealthy air quality over those three census tracts. Therefore, the Project would not have any significant adverse air quality impacts on census blocks with a higher percentage of low-income or minority populations.[130] Air quality impacts are discussed in more detail within section 4.12.1.

Jordan Cove selected Coos Bay for the location of its LNG terminal because it is the largest deep-draft port on the Pacific Coast between San Francisco and the Puget Sound. It purposefully sought a site for the terminal away from densely populated areas (e.g., there are no residences within one mile of the terminal location). The terminal site is currently vacant land zoned for industrial use. We did not identify any communities with significant percentages of minority or low-income populations in close proximity to the facilities. In addition, the FERC has made documents and notices about the LNG terminal project available to the public, as explained in section 1.5 of this EIS. We conclude that construction and operation of the Jordan Cove Project should not have significant adverse environmental impacts on communities with a disproportionate percentage of minority, low-income, other vulnerable populations, or Native American tribes.

[130] Jordan Cove included an Environmental Justice review as part of its March 2013 PSD Air Permit Application submitted to the ODEQ, filed as Appendix B.9 of Resource Report 9 with its May 21, 2013 application to the FERC.

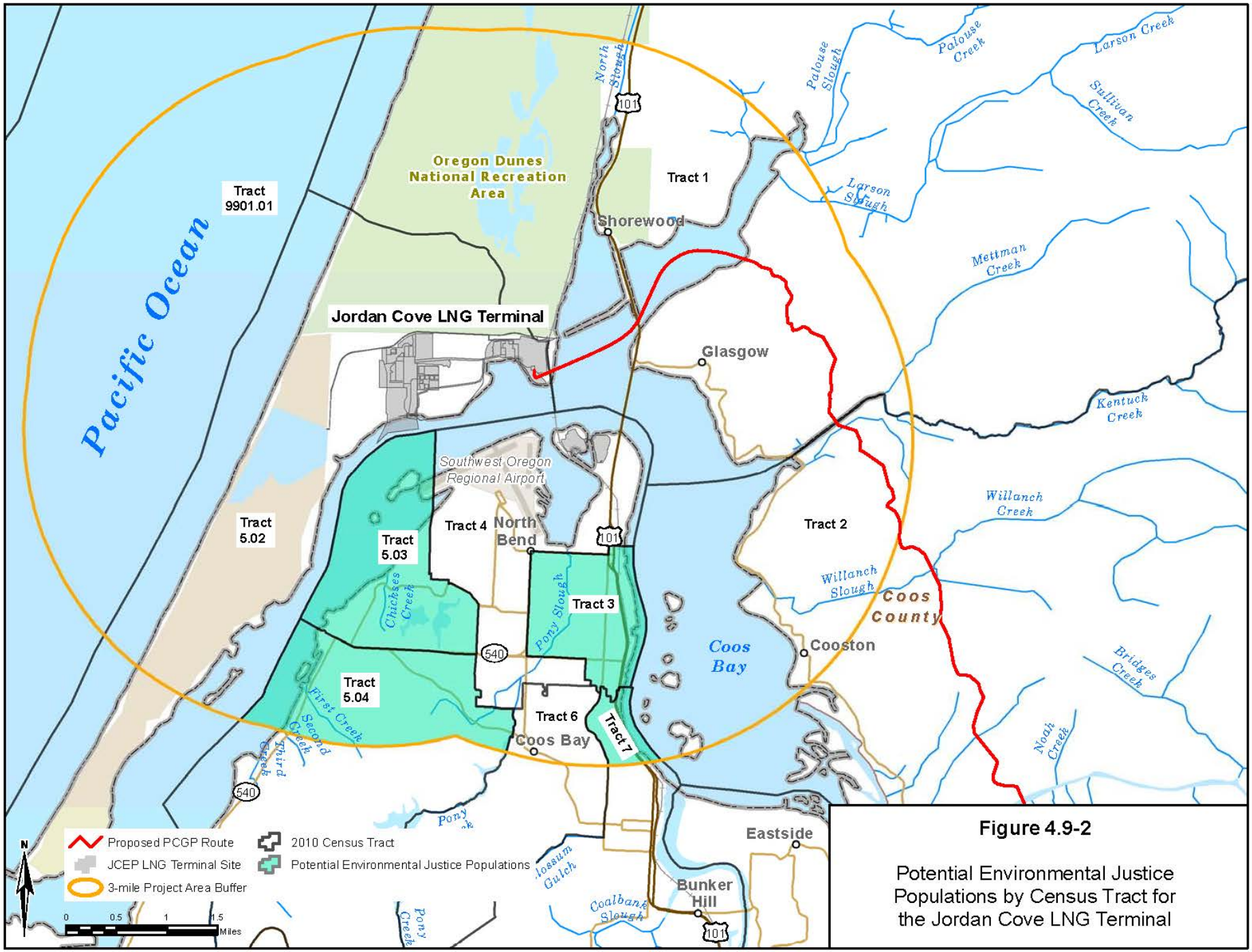


Figure 4.9-2

Potential Environmental Justice Populations by Census Tract for the Jordan Cove LNG Terminal

4.9.2 Pacific Connector Pipeline

4.9.2.1 Population

Population data for the four counties that would be crossed by the pipeline are summarized in table 4.9.2.1-1. The pipeline route mainly passes through sparsely populated rural areas, with population densities in 2010 ranging from 11.2 people per square mile in Klamath County to 73.0 people per square mile in Jackson County. Estimated population in the affected counties in 2012 ranged from 62,890 in Coos County to 204,630 in Jackson County. Statewide, population increased by 13.5 percent between 2000 and 2012. Population increases were below the state average in all four counties crossed by the pipeline, with increases ranging from just 0.2 percent in Coos County to 12.9 percent in Jackson County.

TABLE 4.9.2.1-1

Population by State and County

State/County	Population 2000	Population 2010	Population 2012	Percent Change in Population 2000-2012 a/	Persons per Square Mile 2010
Oregon	**3,421,399**	**3,831,074**	3,883,735	13.5	39.9
Coos County	62,779	63,043	62,890	0.2	39.5
Douglas County	100,399	107,667	108,195	7.8	21.4
Jackson County	181,269	203,206	204,630	12.9	73.0
Klamath County	63,775	66,380	66,740	4.6	11.2
Total b/	**408,222**	**440,296**	442,455	8.4	28.7

a/ These data represent the change from April 1, 2000 to July 1, 2012.
b/ This row is the sum of the four counties that would be crossed by the pipeline.
Sources: Portland State University 2012a, 2012b; U.S. Census Bureau 2013d

In Coos County, the pipeline would pass close to the cities of Coos Bay and North Bend, which had populations of 15,857 and 9,626 people, respectively, in 2012. The two closest communities to the pipeline route through Douglas County would be the cities of Winston and Myrtle Creek, which had populations of 5,385 and 3,445 in 2012, respectively. Roseburg is the county seat and largest city in Douglas County, with a population of 21,920 in 2012 (Portland State University 2012c). In Jackson County, the pipeline route would be near the city of Shady Cove, which had a population of 2,920 in 2012, and would be northeast of the city of Medford, the county seat, with a population of 75,545 in 2012. The pipeline originates near the city of Malin, which had a population of 815 in 2012, and would pass south of Klamath Falls. Klamath Falls is the county seat and the largest city in Klamath County, with a 2012 population of 21,465.

Construction of the pipeline would extend over two years, with an average monthly workforce of 1,400 people over this period. Most of the work would be done between April and November, with the workforce expected to peak during the middle of each season and then gradually taper off toward the end of the season. The pipeline would mostly be installed during the second year, with a peak workforce of 1,844 people spread over five construction spreads. The average workforce for each construction spread would be about 280 workers per month, with a peak of 369 workers mid-season.

Pacific Connector estimates that approximately 50 percent of the construction jobs for the pipeline would be filled by non-local workers (i.e., workers who normally reside too far from the project to commute to the work sites on a daily basis). The number of non-local hires would average 700

workers and peak at approximately 922 workers. The average non-local workforce for each construction spread would be about 140 workers per month, with a peak of 184 workers.

Based on their experience building other large pipeline projects in the western U.S., Pacific Connector does not expect many of the temporarily relocating non-local workers to bring their families with them to the job site. This is primarily because the jobs are short-term in duration, lasting less than 8 months, and spread over two years. If 10 percent of the non-local workers brought their families to the project area, and each family averaged 3 people, an estimated average of 840 people and a peak of 1,106 people would be expected to temporarily relocate to areas along the pipeline. Assuming the 10 percent is evenly distributed by construction spread would result in an average of 168 people and a peak of 221 people per spread. Construction would be spread across four counties with a combined total estimated population of 442,455 in 2012 (table 4.9.2.1-1).

The influx of 1,106 people, including non-local workers and their families at the peak of construction, would represent only a 0.3 percent increase in the regional population; far less than the average population increase of 8 percent in the four counties crossed by the pipeline combined between 2000 and 2012. Such a minor and temporary increase should easily be absorbed by the counties crossed by the pipeline. Long-term operation of the pipeline would require an estimated permanent staff of five employees. These permanent operational employees would be stationed and reside at different locations along the pipeline corridor, but would report to a main office in Eugene, Oregon. We conclude that construction and operation of the Pacific Connector pipeline should not have significant adverse impacts on population in the counties along the pipeline route.

4.9.2.2 Housing

The 2010 Census identified a total of 68,854 rental housing units in the four counties that would be crossed by the Pacific Connector pipeline, with almost half of this total located in Jackson County. An estimated 4,862, or 7.1 percent, of these units were identified as vacant and available for rent (table 4.9.2.2-1). Vacancy rates for rental housing range from 6.7 percent in Coos and Douglas counties to 8.7 percent in Coos County. Available rental units in 2010 ranged from 677 in Coos County to 2,237 in Jackson County.

TABLE 4.9.2.2-1

Housing Units in the Pacific Connector Pipeline Project Area, 2010

Housing/County	Coos County	Douglas County	Jackson County	Klamath County	Project Area Total
Total Housing Units	30,593	48,915	90,937	32,774	203,219
Occupied	27,133	44,581	83,076	27,280	182,070
Vacant or Vacant Part-Year:	3,460	4,334	7,861	5,494	21,149
Seasonal, recreational, or occasional use	1,236	992	1,516	2,528	6,272
Rented/sold, unoccupied	192	205	469	144	1,010
For rent	677	1,060	2,237	888	4,862
For sale only	1,355	2,077	3,639	1,934	9,005
Total Rental Housing a/	10,062	15,186	33,441	10,165	68,854
Rental Vacancy Rate b/	6.7%	7.0%	6.7%	8.7%	7.1%

a/ This total includes both occupied and vacant rental housing.
b/ This rate is based on the number of vacant units available "For rent" divided by the total number of rental units.
Source: U.S. Census Bureau 2013a

Temporary housing options available for rent daily, weekly, and monthly include houses and apartments, hotels and motels, mobile home parks, RV parks, and campgrounds. Pacific Connector developed estimates of the number of motel rooms and RV hookups for communities within the vicinity of the pipeline route, gathered from the Oregon State Tourism Web site, local chamber of commerce organizations, and online directories. About 70 hotels, motels, and bed and breakfast inns are located within 53 miles of the Jordan Cove Meter Station in the Coos County area, which combined contain about 2,580 rooms. The TravelOregon webpage listed 16 lodgings in Roseburg and Canyonville, and Pacific Connector estimated that there were 1,673 hotel or motel rooms in Douglas County. The Medford-Jackson County Chamber of Commerce listed 34 hotel and motels, 4 extended stay lodgings, 4 bed-and-breakfasts, and 8 resorts; while Pacific Connector counted 4,373 rooms in Jackson County. The Klamath County Chamber of Commerce listed 21 hotels and motels, 4 resorts, and 1 bed-and-breakfast, mostly in Klamath Falls; while Pacific Connector estimated that there are 1,089 hotel and motel rooms in Klamath County. Pacific Connector counted 181 RV hook-ups in Klamath County, 1,247 in Jackson County, 1,170 in Douglas County, and 1,862 in Coos County.

Pacific Connector stated it would attempt to maximize the number of local workers hired, given union agreements and contractor hiring practices at the time of construction. Local workers would be able to commute to the job from their homes, and would not need other accommodations. It was estimated that about half the people employed on the pipeline project during construction would be non-residents who would have to move to the area to work on the pipeline. The number of non-local construction laborers would average 700 employees per month, and peak at approximately 922 workers. The construction workforce would be distributed across five construction spreads. Non-local workers would average 140 workers per spread, with a peak of 184 workers. Pacific Connector would not provide temporary construction camps along the pipeline route to house non-local employees. Therefore, non-local construction workers would require short-term housing in the vicinity of the pipeline project. As stated in section 4.9.2.1, at the peak of pipeline construction we estimate there would be an influx of a total of about 1,106 people to the project area, including out-of-town workers and their families. However, as explained below, some of those non-local workers would bring their own housing in the form or an RV, camper, or tent; while others would share living quarters to reduce costs, which would also mitigate the demand for accommodations.

Based on its previous pipeline construction experience, Pacific Connector estimates that about 30 percent of non-local workers would provide their own temporary housing, such as RVs or pop-up trailers. Therefore, we assume that the number of out-of-town workers providing their own housing would average 210 people, with a peak of 277. At the peak of construction, that would equate to demand for six percent of the total RV hook-ups along the entire four-county pipeline route (table 4.9.2.2-2). If the 277 peak workers with RVs were divided equally among the five construction spreads, with an average of 55, they would require about 3 percent of the hook-ups in Coos County: 5 percent of the hook-ups in Douglas County; 4 percent of the hook-ups in Jackson County; and 30 percent of the RV hook-ups in Klamath County. If demand for RV hook-ups exceeds the supply in nearby communities, workers would either locate further away or seek other types of short-term housing in the vicinity of the pipeline project. This may be more likely to occur in Klamath County.

TABLE 4.9.2.2-2

Pacific Connector Pipeline Project Area Rental Housing, Motel Rooms, and RV Hookups

Housing/County a/	Coos County	Douglas County	Jackson County	Klamath County	Project Area Total
Available Rental Housing b/	446	573	693	408	2,120
Total Motel Rooms c/	1,433	1,537	3,830	1,089	7,889
Total RV Hookups c/	1,862	1,170	1,247	181	4,460
Estimated Average Available Motel Rooms d/	659	707	1,762	501	3,629
Estimated Peak Available Motel Rooms e/	287	307	766	218	1,578
Estimated Available RV Hookups f/	1,024	644	686	100	2,453

a/ Data are provided for the communities in each county in the vicinity of the pipeline. These communities are as follows: Coos County—Bandon, Charleston, Coos Bay, Coquille, North Bend; Douglas County—Canyonville, Green, Myrtle Creek, Roseburg/Roseburg North, Winston/Dillard; Jackson County—Ashland, Central Point, Eagle Point, Medford, Phoenix, Shady Cove, Talent, White City; Klamath County—Bonanza, Klamath Falls, Merrill-Malin.
b/ Data are for vacant housing units that were identified as available for rent in the above communities in the 2010 Census (U.S. Census Bureau 2013a).
c/ These data should be considered partial estimates because they were gathered from the Oregon State Tourism Web site, local chamber of commerce organizations, and online directories. These sources vary in level of detail and are in some cases based on subscription.
d/ The average number of available rooms is assumed to be 46 percent of the total based on the average annual occupancy rate of 54 percent estimated for Coos County (ECONorthwest 2012b).
e/ The peak number of available rooms is assumed to be 20 percent of the total based on an assumed peak occupancy rate of 80 percent.
f/ The number of available RV hookups is assumed to be 55 percent of the total based on an average occupancy rate of 45 percent estimated for Coos County (ECONorthwest 2012b).

The remaining non-local workers without RVs would require short-term housing in the project area in the form of rental houses, apartments, mobile homes, hotels, or motels. Subtracting out the people who may have RVs, and assuming that 6 percent of the remaining work force would share a room,[131] we estimate that a monthly average of 461 units would be required to house the remainder of out-of-town workers. We assume that families who relocate to the area would also share a unit. If the monthly average is evenly divided among the five construction spreads, about 92 units would be needed per county. At the peak of construction, a total of 606 rental units may be required. If the non-local workers were evenly divided among the five construction spreads, there would be a peak demand for about 152 units per county crossed by the pipeline. There may be some counties where two spreads are operating at the same time, adding to the local demand for housing.

Pacific Connector identified a total of 7,889 hotel and motel rooms in the four counties crossed by the pipeline, with totals per county ranging from 1,089 in Klamath County to 3,830 in Jackson County (table 4.9.2.2-2). Based on an annual average occupancy rate of 54 percent, an estimated average of 3,629 rooms would be available for rent, ranging from 501 rooms in Klamath County to 1,762 rooms in Jackson County. At the peak of construction, pipeline-related worker housing demands would require about 11 percent of the total rooms in Coos County; 10 percent of the total rooms in Douglas County; 4 percent of the total hotel rooms in Jackson County; and 14 percent of the total number of hotel/motel rooms in Klamath County.

Pacific Connector construction workers would compete with other visitors to the four counties crossed by the pipeline for accommodations. In 2012, there was a total of 11,729 visitor nights for the four counties combined, broken down as follows: 2,359 in Coos County; 2,400 in Douglas

[131] This was the same figure we used above in section 4.9.1.2 our discussion of housing for the non-local workers employed during construction of the Jordan Cove LNG terminal.

County; 4,966 in Jackson County; and 2,004 visitor nights in Klamath County (Dean Runyan Associates 2013). However, we do not have seasonal data for visitor occupancies.

Construction of the pipeline would coincide with the peak summer tourism season in the project area. During periods of peak demand (June through September), some communities would experience lower vacancy rates and upward pressure on rental rates for lodging. Data on peak hotel and motel occupancy rates is not available, but assuming a peak rate of 80 percent, a total of 1,578 rooms would be available for rent in the four counties, ranging from 218 rooms in Klamath County to 766 rooms in Jackson County. Using the peak construction demand of 152 units per county, pipeline-related housing for non-local labor could represent 53 percent of the rooms available during the summer in Coos County; 50 percent of the rooms available during the summer in Douglas County; 20 percent of the hotel rooms available during the summer in Jackson County; and almost 70 percent of the hotel/motel rooms that may be available during the summer in Klamath County. However, besides hotels and motels, which most summer tourists would occupy, there are houses, apartments, and mobile homes that could be rented by non-local pipeline workers. Pacific Connector estimated that there are a total of 21,169 vacant rental houses in the four affected counties (table 4.9.2.2-1).

We acknowledge that construction of the Pacific Connector Pipeline Project would have impacts on regional housing, especially during the summer when non-local workers would compete with other visitors for accommodations. However, those impacts should be temporary, lasting not more than two years. Factors that would ameliorate the demand for construction housing include some employees staying in their own RVs; some employees sharing accommodations; the large housing stock potentially available in the four counties combined crossed by the pipeline route; the fact that the construction crews would be broken into five spreads; and the ability of construction workers to commute greater distances if housing in one county was constrained. Pacific Connector offered no Project-specific mitigation measures to reduce impacts on local housing; stating instead that such impacts would be off-set by economic benefits of jobs and expenses generated by construction of the pipeline project, as further discussed below.

Operation of the pipeline would require five permanent employees who would be stationed and reside at different locations along the pipeline. This small number of operational employees would have no noticeable impact on the local housing markets.

4.9.2.3 Property Values

Approximately 68 percent of the pipeline route would cross private property. The remaining 32 percent of the pipeline route would cross public lands administered by the BLM (16 percent), Forest Service (14 percent), and the State of Oregon (2 percent). Median values for owner-occupied houses in the four counties crossed by the pipeline are lower than the state average ($244,600), at $196,900 in Coos County; $177,200 in Douglas County; $243,600 in Jackson County; and $166,600 in Klamath County (U.S. Census Bureau 2013e).

The FERC received many comments concerned about the potential impact of the pipeline on property values. Pacific Connector asserts that research on this issue does not support a finding that the presence of a pipeline on or near a property would have negative impacts on its value (see further discussion below).

The Interstate Natural Gas Association of America conducted a national case study to determine if the presence of a pipeline on a piece of property affected the property value or sales price of the property

(Allen, Williford & Seale, Inc. 2001). The study employed paired sales, descriptive statistics, and linear regression analysis to assess impacts to four separate, geographically diverse case study areas. One of these case studies was Medford, Oregon. The study assessed the impact of pipelines on four residential subdivisions in Medford and large undeveloped tracts located outside the city limits, but on the edge of existing development. The study found that having a pipeline on the property did not significantly alter sales prices. Neither the size of the pipeline (diameter) nor the product carried by a pipeline had any significant impact on sales prices. The study also concluded that the presence of a pipeline did not impede the development of surrounding properties.

Whatcom County, Washington, analyzed the impact that the June 1999 Olympic gasoline pipeline explosion had on sales of real estate on or near the pipeline route. That study found that neither the market value of properties nor the length of time necessary for a sale were negatively impacted by the presence of a pipeline within 300 feet. One property near the site of the explosion sold for a higher price afterwards (Whatcom County 2001).

Portland State University evaluated the impact of the South Mist Pipeline Extension (SMPE) on residential sales between 2004 and 2008 in Clackamas and Washington counties, Oregon using a hedonic price modeling approach. Based on sales price data for 10,642 single family residential properties located within one mile of the pipeline, the study found that proximity to the pipeline had no statistically or economically significant impact on residential property values (Fruits 2008).

A 2008 market study conducted by PGP Valuation on behalf of Palomar Gas Transmission LLC also assessed the impacts of the SMPE on property values. Using a sales comparison methodology, the study evaluated sales data for a total of 18 properties encumbered by SMPE right-of-way easements and compared these with sales of other comparable unencumbered properties. Based on this analysis, PGP Valuation concluded that natural gas pipelines had no measurable long-term impact on property values. The study also concluded that variations in short-term values were either not substantial or non-existent, and that residential properties were not impacted by the pipeline easement any more or less than other property types (Palmer 2008).

A more recent study analyzed sales data from approximately 1,000 residential properties in Arizona to test whether proximity to a natural gas pipeline had an effect on real estate sales prices. Using sales price information, the study compared sales prices for properties encumbered by or adjacent to a natural gas transmission pipeline with comparable properties not along a pipeline right-of-way. The study was unable to identify a systematic relationship between proximity to a pipeline and sales price or property value (Diskin et al. 2011).

Based on the research cited above, we conclude that having a natural gas pipeline on or near a property does not necessarily negatively impact the value of that property. The impact a pipeline may have on the value of a tract of land depends on many factors, including the size of the tract, the values of adjacent properties, the presence of other utilities, the current value of the land, and the current land use. Subjective valuation is generally not considered in appraisals, but may affect individual decisions when a property is offered for sale, thus impacting the potential resale value. Purchase decisions are often based on the purchaser's plans for the property, such as use for agriculture, future residential development, a second home, or commercial/industrial development. If the presence of a pipeline interferes with those future plans, the potential buyer may decide against acquiring the property with a pipeline easement. However, each potential purchaser has different criteria and differing capabilities to purchase land.

For private lands, Pacific Connector would need to negotiate a mutually agreed upon easement for its pipeline with the affected landowners. The agreement between Pacific Connector and the landowner would specify compensation for the easement, compensation for damage to property and loss of use during construction, and loss of renewable and nonrenewable or other resources. The agreement would also specify uses of the permanent right-of-way after construction. If the company is unable to reach an agreement with a landowner, and if the Project is authorized by the FERC, the Certificate would convey the right of eminent domain under section 7h of the NGA. In these situations, Pacific Connector could initiate condemnation proceedings, and the value of the easement and the amounts for compensatory damages would be determined by a local, state, or district court.

4.9.2.4 Economy and Employment

The four counties that would be crossed by the pipeline had a total estimated labor force of 203,288 in 2012, approximately 10 percent of the Oregon state total. Labor force estimates by county ranged from 28,165 in Coos County to 100,207 in Jackson County (table 4.9.2.4-1). Table 4.9.2.4-1 also presents average per capita income and median household income by county, and identifies the two largest economic sectors in each county based on total employment data compiled by the U.S. Bureau of Economic Analysis (2013b). Average per capita income in 2011 (the most recent year available) was lower than the state average ($37,527) in all of the affected counties, ranging from $34,602 in Jackson County, to $29,961 in Klamath County. Median household income was also below the state level ($46,876) in 2011 in all four counties crossed by the pipeline, with highest amount being $40,013 in Jackson County and the lowest being $36,667 in Coos County.

TABLE 4.9.2.4-1

Employment and Labor Statistics for the Pacific Connector Pipeline Project Area

State/County	Civilian Labor Force 2012 a/	Unemploy-ment Rate (%) 2012 a/	Per Capita Income ($) 2011	Median Household Income ($) 2011	Two Largest Economic Sectors 2011 (By Percent of Employment) b/
Oregon	1,962,908	8.7	$37,527	$46,876	Health Care and Social Assistance (12%); State and Local Government (11%)
Coos	28,165	10.7	$32,443	$36,567	State and Local Government (17%); Retail Trade (12%)
Douglas	44,859	12.2	$31,222	$38,196	State and Local Government (13%); Health Care and Social Assistance (12%)
Jackson	100,207	10.8	$34,602	$40,013	Health Care and Social Assistance (14%); Retail Trade (14%)
Klamath	30,057	11.7	$29,961	$36,765	State and Local Government (13%); Health Care and Social Assistance (12%)

a/ Labor force and unemployment data are annual averages.
b/ Employment by economic sector is summarized in more detail in table 4.9.2.4-2. Note that components of the government and services sectors are combined in that table for ease of presentation.
Sources: Oregon Employment Department 2013b; U.S. Bureau of Economic Analysis 2013b, 2013c; U.S. Census Bureau 2013e

The biggest private industries in Coos County are health care, retail trade, and accommodations and food services. In Douglas County, most people in private industry are employed in manufacturing, health care, and retail trade sectors. In Jackson County the top private industry employers are retail trade and health care. In Klamath County, retail trades, health care, manufacturing, and accommodations and food service were the private sector industries that employ the most number of people. Government employment ranges from 19 percent of all

workers in Coos County, to 11 percent in Jackson County. More detail on employment by economic sector is presented for Oregon and the potentially affected counties in table 4.9.2.4-2.

TABLE 4.9.2.4-2

Pacific Connector Pipeline Project Area Employment by Economic Sector, 2011

Category	Oregon	Coos	Douglas	Jackson	Klamath
Total Employment a/	2,221,802	32,001	53,763	113,069	32,626
By Type:	**Percent of Total Employment**				
Wage and salary employment	77	76	74	72	74
Proprietors employment	23	24	26	28	26
By Industry:					
Farm employment	3	3	5	3	6
Nonfarm employment	97	97	95	97	94
Private Employment	84	78	79	87	77
Forestry, fishing, related activities, and other	1	5	3	2	1
Mining	0	0	0	0	0
Utilities	0	0	0	(D)	0
Construction	5	4	5	5	4
Manufacturing	8	5	9	7	6
Wholesale trade	4	2	2	(D)	3
Retail trade	10	12	11	14	12
Transportation and warehousing	3	4	4	3	3
Finance, insurance, and real estate	9	7	8	9	9
Consumer services b/	15	15	14	16	15
Producer services b/	14	12	10	13	(D)
Social services b/	14	12	13	16	13
Government and Government Enterprises	13	19	16	11	17
Federal, civilian	1	1	3	2	3
Military	1	1	1	1	1
State and local	11	17	13	9	13

(D) Not shown to avoid disclosure of confidential information. Estimates for these items are, however, included in the totals.
a/ Total employment includes self-employed individuals. Employment data are by place of work, not place of residence, and, therefore, include people who work in the area but do not live there. Employment is measured as the average annual number of jobs, both full- and part-time, with each job that a person holds counted at full weight.
b/ Nine 2-digit North American Industry Classification System categories are combined into these three divisions for ease of presentation. Consumer service includes other services; arts, entertainment, and recreation; and accommodation and food services. Producer services includes information; professional and technical services; management of companies and enterprises; and administrative and waste services. Social services include educational services; and health care and social assistance.
Source: U.S. Bureau of Economic Analysis 2013c

Statewide, earnings accounted for 62 percent of per capita income, with transfer payments and dividends, interest and rents accounting for 20 percent and 18 percent, respectively. Transfer payments consist mainly of government payments to individuals, including retirement, disability, and unemployment insurance benefit payments, income maintenance payments, and veterans benefit payments. Earnings accounted for a smaller share of per capita income in all four counties that would be crossed by the pipeline route than they did statewide, ranging from 49 percent (Coos and Douglas Counties), to 50 percent in Klamath County, to 54 percent (Jackson County). Transfer payments not only comprised a larger share than the state average in all four counties crossed by the pipeline route, but were higher in absolute terms ranging from $8,645 (Jackson County) to $10,529 (Coos County) compared to a state average of $7,616 (table 4.9.2.4-3). These figures may reflect a higher number of retired people in the project area as compared to the entire state average.

TABLE 4.9.2.4-3

Components of Per Capita Income for the Pacific Connector Pipeline Project Area, 2011

Income Category	Oregon	Coos	Douglas	Jackson	Klamath
Per Capita Income a/	$37,527	$32,443	$31,222	$34,602	$29,961
Earnings b/	$23,192	$15,871	$15,254	$18,577	$15,088
Transfer Payments c/	$7,616	$10,529	$10,374	$8,645	$9,737
Dividends, interest, and rent	$6,719	$6,043	$5,594	$7,380	$5,136
Percent of Total					
Earnings	62	49	49	54	50
Transfer Payments	20	32	33	25	32
Dividends, interest, and rent	18	19	18	21	17

a/ Total per capita income consists of earnings, transfer payments, and dividends, interest, and rent.
b/ Earnings includes wages and salaries, other labor income, and proprietors' income.
c/ Transfer payments consist mainly of government payments to individuals, including retirement, disability, and unemployment insurance benefit payments, income maintenance payments, and veterans benefit payments.
Source: U.S. Bureau of Economic Analysis 2013c

All four counties were identified as distressed on Business Oregon's Temporary Distressed List for July 2013 (Business Oregon 2013). A county is considered distressed by Business Oregon if the seasonally adjusted unemployment rate for that county exceeds 8 percent. Twenty-six of Oregon's 36 counties were identified as distressed in July 2013. Annual unemployment rates in 2012 ranged from 10.7 percent in Coos County to 12.2 percent in Douglas County, and were higher than the state average (8.7 percent) in all four counties that would be crossed by the pipeline route (table 4.9.2.4-1).

Construction of the pipeline would involve an average monthly workforce of 1,400 workers with a projected peak of 1,844 workers in the middle of the second construction season. Total construction payroll is estimated to be $240 million. Of this, about $151.5 million would consist of compensation to local workers. Pacific Connector estimates that construction of the pipeline and associated compressor and metering stations would cost approximately $1.74 billion, with $1.515 billion identified as direct costs (Lloyd Levy Consulting, LLC [Levy] 2013).[132] Approximately 27 percent ($413 million) of the total estimated direct cost is expected to be spent locally (within the four counties crossed by the pipeline route). Costs for materials and equipment bought in or brought to Oregon are estimated at about $464 million. About $33 million would be spent during construction for local contracted services, such as logging and hauling, road improvements, and professional services.

Total economic impacts are summarized in table 4.9.2.4-4 over a five-year period including pipeline project planning (Year 1 to Year 3) and construction (Years 4 and 5), according to the study by Levy (2013). This includes direct, indirect, and induced impacts on employment, labor income, value added, and output. It is estimated that during the two-year construction period a combined total of 4,658 jobs would be generated, with labor income totaling about $317.3 million.

[132] The remaining estimated cost ($0.225 billion) consists of overhead costs, arrangement fees, and AFUDC (allowance for funds used during construction). Lloyd Levy Consulting LLC. 31 May 2013. *Revised Economic Impact Analysis, Pacific Connector Gas Pipeline Project*. Attached as Appendix 5A of RR5 included with Pacific Connector's June 6, 2013 application to the FERC in Docket No. CP13-492-000.

TABLE 4.9.2.4-4

Economic Impacts of Pacific Connector Pipeline Construction

Impact Component	Year 1	Year 2	Year 3	Year 4	Year 5
Employment (Jobs) a/	19	116	113	1,356	3,284
Labor Income b/ c/	$599	$3,909	$3,817	$87,614	$229,698
Output b/ d/	$6,045	$11,109	$10,852	$167,542	$421,630
Value Added b/ e/	$1,019	$5,877	$5,744	$110,868	$293,721

a/ Employment (jobs) represent the annual average number of employees, both payroll and self-employed, for either full- or part-time work.
b/ Dollar figures are expressed in $000s.
c/ Labor income is the sum of wages, salaries and benefits for payroll employees, and earnings by self-employed workers and owner-operator businesses.
d/ Output represents the value of all spending associated with a project or the total value of all production components.
e/ Value added is the sum of compensation, taxes, and gross operating surplus.
Source: Levy 2013

Combining the construction of the Jordan Cove LNG terminal with the Pacific Connector pipeline, ECONorthwest (2012c) estimated that a total of 20,546 direct, indirect, and induced jobs would be generated over the four-year construction period, supporting total earnings of approximately $1.3 billion. Combined, the JCE & PGGP Project would support total economic output in Oregon and Washington over four years of $6.6 billion. In addition, the Project would add a total of about $1.7 billion to the value of the GDP of Oregon and Washington (table 4.9.1.4-2).

Pacific Connector would hire 5 people to operate the pipeline. The economic analysis conducted by Levy (2013) estimated that operation of the Pacific Connector Pipeline Project would support approximately 9 jobs, and generate $813,000 in annual labor income. As a result of spending about $1.1 billion annually, the pipeline project would add approximately $935 million to the region's GDP during each year of operation. These figures include direct, indirect, and induced contributions to the regional economy.

Based on the research cited above, it appears that the construction and operation of the Pacific Connector Pipeline Project would have positive impacts benefiting the regional economy. The pipeline project would create jobs, and support millions of dollars in employee compensation.

4.9.2.5 Tax Revenues

The pipeline would generate federal, state, and local tax revenues during both the construction and operation phases. Federal tax revenues would be generated from federal income tax on project-related earnings. There is no sales and use tax in Oregon, but state tax revenues would be generated through income and lodging taxes. Local tax revenues would be generated from property taxes. Table 4.9.2.5-1 lists tax revenues in 2011 for the counties crossed by the pipeline.

Payments in Lieu of Taxes (PILT) are federal payments to local governments that help offset losses in property taxes due to non-taxable federal lands within their boundaries. Annual PILT payments to the four affected counties in Fiscal Year 2013 ranged from $378,821 in Coos County to $765,726 in Jackson County (U.S. Department of the Interior 2013).

TABLE 4.9.2.5-1

2011 Tax Revenues for the Counties Crossed by the Pacific Connector Pipeline

Revenue Type	Klamath County	Jackson County	Douglas County	Coos County
Property Taxes	$12,234,000	$34,137,662	$8,394,503	$10,054,765
Lodging Taxes	$1,409,000	$4,488,000	$1,031,000	$1,251,000
Other Taxes	$1,810,951	$4,274,262	Unknown	$277,342
Intergovernmental	$32,409,581	$87,351, 891	$81,119,837	$26,535,352
Licenses and fees	$1,814,000	$3,365,855	$1,485,002	$3,294,075
Charges for Services	$5,489,757	$14,993,317	$9,281,699	$2,310,372
Timber Sales	Unknown	Unknown	Unknown	$2,644,549
Interest on Investments	$1,147,616	$2,660,440	$1,717,109	$193,780
Other Revenues	$670,307	$498,440	$3,126,272	$685,773

Sources: Pacific Connector application to the FERC, Table 5.2-17, Resource Report 5; and Dean Runyan Associates 2013

During construction, Pacific Connector estimates that the pipeline would generate approximately $46 million in federal income tax based on an estimated construction payroll of $240 million and an average federal income tax rate of 19 percent (table 4.9.2.5-2). This estimated construction payroll would also generate approximately $19.2 million in state income tax, assuming an average state income tax rate of 8 percent. Temporary workers associated with pipeline construction would generate approximately $99,000 in state lodging taxes. Pacific Connector also estimates that personal property taxes on approximately $464 million worth of equipment and materials either purchased in or brought into Oregon would generate about $7 million in tax revenues.

TABLE 4.9.2.5-2

Estimated Tax Revenues from Construction of the Pacific Connector Pipeline

Tax	Estimated Tax Revenues
Federal Income Tax on Payroll Earnings a/	$45,596,200
State Income Tax on Payroll Earnings b/	$19,198,400
Lodging Tax c/	$98,637
Personal Property Tax d/	$6,960,150

a/ Based on a state income tax rate of 19 percent applied to a total estimated construction payroll of $240 million.
b/ Based on a state income tax rate of 8 percent applied to a total estimated construction payroll of $240 million.
c/ Based on a 1 percent lodging tax on an estimated $9.8 million spent on lodging (assumes federal per diem rate of $77 per day for 183 days for 700 workers [assuming that half the projected labor force temporarily relocates to the state]).
d/ Personal Property Tax is based on an estimated $464 million of equipment and materials either purchased in Oregon or brought into Oregon. This is an annual tax based on $15 on $1,000 of value. Note: this number is overstated because some of the cost of materials and equipment is for supplies that are expendable.

During operation, Pacific Connector estimates that the pipeline would generate approximately $152,360 in annual federal taxes based on projected income during the first year of operation. This projected income would also generate approximately $65,040 in annual state income taxes (table 4.9.2.5-3).

TABLE 4.9.2.5-3

Estimated Annual Tax Revenues from Operation of the Pacific Connector Pipeline

Tax	Estimated Tax Revenues
Federal Income Tax on Earnings a/	$152,360
State Income Tax on Earnings a/	$65,040
Personal Property Tax b/	$11,126,820

a/ Based on projected income during the first year of operation
b/ Based on ECONorthwest (2012d) adjusted for filed pipeline length

The Pacific Connector pipeline would not involve federal land disposal, acquisition, or exchange and is, therefore, not expected to affect existing PILT or 25 percent fund/Secure Rural Schools payments to the affected counties. Mitigation presently being evaluated could, however, result in Pacific Connector acquiring private lands on behalf of the federal government. This is discussed further in section 4.9.3.

Following construction of the pipeline, Pacific Connector would provide estimates of the value of the installed facilities in each county to the Oregon Department of Revenue. Personal property taxes would be levied by the Oregon Department of Revenue based on these values with a portion of the associated revenues returned to the affected counties. The Pacific Connector pipeline would pay property taxes primarily based on the number of miles in each county and would be expected to generate an estimated total of $11.1 million in property tax revenues in its first year of operation. Estimated revenues range from $2.3 million in Klamath County to $3.2 million in Jackson County (table 4.9.2.5-4). Property tax payments would vary over time due to pipeline depreciation and changing tax rates.

TABLE 4.9.2.5-4

Estimated Annual Property Tax Revenues in the Counties Crossed by the Pacific Connector Pipeline

County	Pipeline Miles	Assessed Value a/	Tax Rate b/	Estimated Property Taxes
Coos	48.84	$198,282,052	$12.89	$2,555,856
Douglas	66.10	$268,354,701	$11.57	$3,104,864
Jackson	55.78	$226,457,265	$14.06	$3,183,989
Klamath	61.10	$248,055,555	$9.20	$2,282,111
Total	231.82	$941,149,573	na	$11,126,820

na – not applicable
a/ Total assessed value is based on miles per county and an estimated assessed value of $4,059,829 per mile. These estimates do not include the assessed value of other related facilities such as meter or compressor stations.
b/ Tax rates are dollars per thousand dollars of assessed value. Estimated rates are county-wide averages developed by ECONorthwest (2012d)

4.9.2.6 Local Infrastructure and Public Services

Law Enforcement and Fire Protection

The pipeline route crosses four counties, each with its own Sheriff's office. The Klamath County Sheriff's office employs 54 officers; the Jackson County Sheriff's office has 70 total paid staff; the Douglas County Sheriff's office consists of 62 officers; and the Coos County Sheriff's office has 57 officers. In addition, many of the local municipalities near the pipeline route have police departments. There are a total of 23 municipalities with police departments in the four potentially affected counties, with a total of about 344 officers combined (table 4.9.2.6-1). The Klamath Falls Police Department

employs 40 officers, and Merrill and Malin each have 1. The Medford Police Department has 103 officers, Butte Falls has 1, and Central Point has 22. The Roseburg Police Department employs 38 officers, Myrtle Creek has 8 employees, and Winston employs 6 officers. The Myrtle Point Police Department has 3 officers, Coquille 6, Coos Bay 12, and North Bend 17.

The State of Oregon is responsible for fire suppression on state lands. Municipal fire departments and Rural Fire Protection Districts (RFPDs) are the primary responders for incidents on private land. There are approximately 29 municipal fire departments and 42 RFPDs in the four counties that would be crossed by the pipeline (table 4.9.2.6-1). RFPDs tend to be mainly staffed by volunteer firefighters. There are a total of 270 fire-fighters in Klamath County, combining all volunteer and full-time staff from all of the 15 fire departments; 375 fire-fighters in the 14 fire departments in Jackson County; 510 fire-fighters in the 26 fire departments in Douglas County; and 357 fire-fighters in the 16 fire departments in Coos County.

TABLE 4.9.2.6-1

Law Enforcement and Fire Protection Resources in the Counties Crossed by the Pacific Connector Pipeline

County	Sheriff and Police Departments a/	Municipal Fire Departments b/	Rural Fire Protection Districts b/
Coos	7	6	10
Douglas	6	10	16
Jackson	10	7	7
Klamath	4	6	9
Total	27	29	42

a/ Totals include each County Sheriff's office. In addition to these resources, federal agencies are responsible for law enforcement on federal lands that would be crossed by the pipeline.
b/ In addition to these resources, fire protection on state and federal lands would be provided by state and federal agencies, respectively.

We have previously estimated that at the peak of pipeline construction there may be as many as 1,106 people moving to the area, including non-local workers and their families. Broken down by spread and county, this influx would represent only about a 0.3 percent increase in the population of Klamath County; about a 0.1 percent increase in the population of Jackson County; 0.2 percent in Douglas County; and 0.4 percent in Coos County. This would be much less than the average population growth over the last 12 years in those counties (see table 4.9.2.1-1). We believe the minor and temporary population influx of non-local workers and their families during the peak pipeline construction period would not stress or adversely impact existing law enforcement or fire-fighting capabilities.

The DOT is mandated to provide pipeline safety, and the DOT pipeline standards are published in 49 CFR Parts 190-199. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues. Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Pacific Connector would provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment is expected be required to handle pipeline emergencies. Pipeline safety is discussed further in section 4.13 of this EIS.

Pacific Connector has developed an *Emergency Response Plan*, *Fire Prevention and Suppression Plan*, and *Safety and Security Plan.*[133] Pacific Connector would be responsible for the cost of implementing these plans. Pacific Connector does not anticipate that implementation of these plans would require additional medical or other public service personnel (including additional police or fire fighting capabilities).

Pacific Connector has indicated that in the event of a pipeline accident, the party deemed responsible for the accident would ultimately be responsible for paying all costs for emergency response, containment, damages, remediation, and repairs for the public and private property affected. In the event of an accident, Pacific Connector would provide emergency support to completely respond to the accident.

Medical Facilities

There are 10 hospitals in the four counties that would be crossed by the Pacific Connector pipeline, with a total of 1,084 beds (table 4.9.2.6-2). There are emergency medical providers with helicopter medical evacuation services available in Medford, Oregon. In addition, there are five Level III Trauma System Hospitals that can receive helicopter transport and two level IV Trauma Hospitals in the counties crossed by the pipeline, as indicated in table 4.9.2.6-2.

TABLE 4.9.2.6-2

Hospitals in the Counties Crossed by the Pacific Connector Pipeline

County	Hospital	Town	Trauma Level a/	Staffed Beds	Occupancy Rate 2012
Coos	Bay Area Hospital	Coos Bay	III	129	45.5
Coos	Coquille Valley Hospital	Coquille	IV	25	21.2
Coos	Southern Coos Hospital and Health Center	Bandon	IV	19	11.9
Douglas	Lower Umpqua Hospital	Reedsport	NA	16	23.6
Douglas	Mercy Medical Center	Roseburg	III	141	50.1
Jackson	Ashland Community Hospital	Ashland	IV	37	33.6
Jackson	Providence Medford Medical Center	Medford	III	133	50.1
Jackson	Asante Rogue Medical Center	Medford	III	307	60.0
Klamath	Sky Lakes Medical Center	Klamath Falls	NA	100	55.5

a/ Trauma hospitals differ from other hospitals in that they guarantee the immediate availability of surgeons, anesthesiologists, physician specialists, nurses, ancillary services, and resuscitation life-support equipment 24 hours a day and are dedicated to the care of trauma patients. Trauma facilities in Oregon are designated as Level I, II, III, or IV, with Level I and II centers offering the highest level of care (Oregon Health Authority 2013).

Source: Apprise Health Insights 2013

Construction and operation of the pipeline project are not expected to have significant adverse impacts on emergency services or regional hospitals. Existing medical facilities should be adequate to handle issues resulting from the temporary influx of non-local employees working on pipeline construction. As stated above, the number of non-local workers and their families moving to the area would not be large (between 0.4 and 0.1 percent of each county's population during peak construction periods), and their presence would not be long (maximum of 2 years). The pipeline would be safely installed and operated according to DOT regulations, and would not be a threat to public safety. As noted above, Pacific Connector has developed a *Safety and Security*

[133] These were attached as Appendices G, K, and V of Pacific Connector's POD, respectively, and filed as stand-alone reports as part of the June 6, 2013, application to the FERC.

Plan. Measures the company would implement to keep its employees safe include training of on-site personnel in first aid and use of CPR.

Schools

There are 32 school districts within the four counties that would be crossed by the Pacific Connector pipeline. There are a total of 9,234 students enrolled in schools in the 6 districts of Coos County, 14,432 students enrolled in the 15 districts in Douglas County, 28,175 students enrolled in the 9 districts in Jackson County, and 9,508 students enrolled in the 2 districts in Klamath County (table 4.9.2.6-3).

TABLE 4.9.2.6-3

Number of School Districts and Student Enrollment in the Counties Crossed by the Pacific Connector Pipeline 2011-2012 School Year

County	Number of School Districts	Enrollment
Coos	6	9,234
Douglas	15	14,423
Jackson	9	28,175
Klamath	2	9,508
Total	**32**	**61,340**

Pacific Connector's past experience suggests that most construction laborers work for 6 weeks to 12 weeks on this type of project and then move on to the next job. As a result of the short duration of employment most non-local pipeline construction workers temporarily relocating to the area would not typically bring their families. We assume that up to 10 percent of the non-local workers may be accompanied by their families during pipeline construction. At peak periods, that may include up to 110 families. Using the figure that working households in Oregon have an average of 0.513 school-age children, this would equate to 56 new students directly related to construction of the Pacific Connector pipeline. However, those students and their families would be spread out over five construction spreads, for an average increase of 11 students per county; for not more than two years. That would represent a 0.1 percent increase in the enrollment of Coos County schools, a 0.08 percent increase in Douglas County, a 0.03 percent increase in enrollment in Jackson County schools, and a 0.1 percent increase in enrollment in Klamath County schools. The school districts in the counties crossed by the pipeline should easily be capable of absorbing the minor and temporary increase in enrollment related to non-local employees and their families relocating to the area to work on the Pacific Connector Pipeline Project, with no significant adverse impacts on regional educational services or facilities.

Pacific Connector estimates that operation of the pipeline project would require five permanent employees who would be stationed and reside at different locations along the pipeline. The permanent relocation of five employees and their families to the area, spread over the four counties crossed by the pipeline, would not measurably affect enrollment of local schools.

Utilities

Every county crossed by the Pacific Connector pipeline route has existing public utilities already in place, including water, sewers and sanitation, electricity, natural gas and propane, as well as telephone and cable. Some of those services are provided by the county government or

municipalities, and some by private companies. The basic utilities for each county crossed by the pipeline are listed in table 4.9.2.6-4.

TABLE 4.9.2.6-4

Utilities Crossed by the Pipeline by County

County	Water & Sanitation	Electric & Heat
Coos	Coos Bay-North Bend Water Board Bandon Utility Department Lakeside Water District SRCA Water District Glide Water Association Coos Bay Sanitary Service North Bend Sanitation	Pacific Power Coos Curry Electric Cooperative, Inc. Bandon Utility Department Ferrellgas Northwest Natural Gas
Douglas	City of Roseburg Roberts Creek Water District Winston-Dillard Water District South Umpqua Water Association Umpqua Basin Water Association Incorporated Roseburg Disposal Roseburg Urban Sanitary Douglas County Landfill Douglas County Public Works	Avista Utilities Douglas Electric Cooperative Pacific Power AmeriGas Suburban Propane
Jackson	Rogue Valley Sewer Services Shady Cove Water Works Southern Oregon Sanitation Inc. Medford Water Commission Big Butte Springs Reservoir Rogue Disposal & Recycling City of Ashland Water	Avista Utilities Pacific Power City of Ashland Electric Department W P Natural Gas
Klamath	Crescent Water Association Bly Water & Sanitary District Garbage & Rubbish Collection	Avista Utilities Pacific Klamath Energy Inc. Pacific Power Klamath Natural Gas Service AmeriGas Cascade Natural Gas Ed Staub & Sons Petroleum Incorporated

Construction of the pipeline would have only minor, temporary impacts on local community facilities, services, and infrastructure. Pacific Connector would need to hook up to local utilities, including electric power and telephone lines, at its compressor station, three meter station locations, and new communications towers and buildings. Pacific Connector would also use electric power and telephone lines at its contractor yards, where existing power and telephone lines are available.

Other than water required for pipeline hydrostatic testing and dust control during construction, Pacific Connector has stated that its Project would not require public water or sewer services. The pipeline would not require wastewater treatment or the construction or expansion of wastewater facilities and existing stormwater drainage systems.

Pacific Connector developed an *Overburden and Excess Material Disposal Plan* and a S*anitation and Waste Management Plan* as part of its POD (Appendices Q and W, respectively, filed as stand-alone reports with its application to the FERC). During construction, trash and food waste would be collected on a daily basis and removed from the pipeline right-of-way. Excess rocks, overburden, large slash, and timber would be removed to disposal areas (identified in the above referenced *Overburden and Excess Material Disposal Plan*). During cleanup, all construction-

related debris, including mats, skids, rope, and excess padding, would be removed by qualified solid waste disposal companies to appropriate licensed landfills or recycling facilities.

4.9.2.7 Recreation and Tourism

Recreation

A recent report by the Outdoor Industry Association estimated that at least 68 percent of all Oregon residents participate in outdoor recreational activities. These activities include hunting, fishing, camping, boating, OHV use, snowmobiling, skiing, cycling, horseback riding, hiking, and sight-seeing. In Oregon, outdoor recreation generated about $12.8 billion in consumer spending, $4 billion in wages and salaries, $955 million in state and local tax revenues, and supported 141,000 jobs. This included money spent on gear, vehicles, trips, and travel-related expenses.

According to a report by Dean Runyan and Associates (2009), in 2008, hunting accounted for 21.5 percent of the total of $147 million of local recreational expenditures in Oregon, with fishing accounting for 52.3 percent, and wildlife viewing 22.8 percent. That year in Oregon 282,000 hunters took 1.7 million trips; 631,000 anglers took 5.2 million trips, and 1.7 million wildlife viewers took 13.7 million trips. In Southern Oregon, including Douglas, Jackson, Josephine, Klamath, and Lake Counties, 137,000 overnight, day, and local hunting trips combined were counted in 2008, generating $41.4 million in expenditures. In the four counties (Klamath, Jackson, Douglas, and Coos) crossed by the Pacific Connector pipeline route, hunting generated a total of $17 million in travel-related expenses, and $5.8 in local expenditures.

In 2012, 794,400 angler days in Oregon were counted at non-Columbia River inland estuaries and freshwater fisheries, generating $33.5 million in economic contributions to the state. Coastal inland salmon represented 55.2 percent of the contributions, coastal inland steelhead 7.6 percent, coastal inland sturgeon 0.3 percent, and other inland marine fish represented 4.7 percent (The Research Group 2013a). The FWS et al. (2013) found that the average expenditure by anglers fishing Oregon rivers in 2011 was $59 per day. The same survey estimated that non-residents accounted for about 23 percent of the 5.7 million days fished in Oregon in 2011. A total of 1 million overnight, day, and local trips combined were taken for freshwater fishing in Southern Oregon in 2008, generating a total of $67.9 million in expenditures. For the four counties crossed by the pipeline combined, freshwater fishing generated $31.2 million in travel-related expenses and $11.8 in local expenditures (Dean Runyan and Associates 2009).

Wildlife viewers took 2.7 million overnight, day, and local trips in Southern Oregon in 2008, generating a total of $52.8 million in travel-generated expenses, and $4.2 million in local recreation expenditures. In the four counties crossed by the pipeline route combined, wildlife viewing generated a total of $56.5 million in travel-generated expenditures (Dean Runyan and Associates 2009).

Another study estimated that there were 7,858 recreational OHV households in Southern Oregon in 2008. That year, there were 320,917 OHV household day trips to the region. Those OHV trips to Southern Oregon generated $30.3 million in expenditures. The total economic impact of OHV trips to Southern Oregon was estimated at $32.2 million in output, $8.5 million in labor income, and supported 312 jobs (Lindberg 2009).

The Pacific Connector pipeline route would not cross any non-federal recreation area or parks, with one exception. At about MP 3.9R, the route would cross the Haynes Inlet Water Trail. Pacific Connector developed a *Recreational Management Plan* that outlined measures to be implemented to reduce impacts on the Haynes Inlet Water Trail and its users (see section 4.8.1.2 for further discussion of non-federal recreation areas crossed or near the Pacific Connector pipeline route).

The Pacific Connector pipeline route would pass within the vicinity of federal, state, and county lands designated for recreation use, as well as lands that offer dispersed recreation opportunities. These areas and the potential impact of the pipeline on these areas are discussed in section 4.8.1 of this EIS. Installation of the pipeline would not prevent or impede any recreational activities on non-federal land; except along the right-of-way for the two-year construction period. The primary impact on recreation would be from construction activities, including construction traffic on public roadways. Pacific Connector developed a TMP to reduce conflicts between construction traffic and recreational users of local roads (transportation is discussed in section 4.10). During operation of the pipeline, the right-of-way through forested areas would be a new visual impact for recreational users of these areas (visual impacts are addressed in section 4.8.2).

Construction of the pipeline would temporarily affect waterbodies that provide habitat for fish, and, therefore, may have short-term impacts on recreational fishing in those waterbodies (impacts to aquatic resources are evaluated in section 4.6). During construction, fishermen could be temporarily prevented from fishing at the specific location of the pipeline crossing for the duration of river crossing construction activities. There may also be temporary impacts on fishing immediately downstream from the pipeline crossing, as a result of turbidity or sedimentation caused by pipeline construction activities. Potential impacts on waterbodies, include turbidity and sedimentation, blasting, contamination, and hydrostatic testing. Pacific Connector developed a *Wetland and Waterbody Crossing Plan*, *Fish Salvage Plan*, *Blasting Plan*, *Integrated Pest Management Plan*, and *Hydrostatic Test Plan* outlining measures that would be implemented to reduce impacts on waterbodies and fisheries. Impacts on waterbodies and mitigation measures are more fully discussed in section 4.4.2.5.

Concern was expressed by commenters that the crossing of the Rogue River near the community of Trail would have detrimental effects on salmon and steelhead and would, in turn, have negative effects on the recreation-related economy in the area. The Rogue River is well known for its salmon and steelhead fishery, and this section of the river is popular for recreationists using rafts and inflatable kayaks, with use occurring primarily between May and September (Crowe 2009; Satherthwait 2009). American Whitewater (2009) describes the stretch of the river that extends 13 miles upstream from Shady Cove, which includes the crossing location, as "popular as a summer float for self-guided trips." Steelhead is fished all year around. Chinook salmon fishing normally peaks during May, June, and July (Crowe 2009; Satherthwait 2009). Anglers fish from the banks or from drift boats.

Visitors to the area support local businesses by spending money on guide services, bait, and equipment rentals, as well as lodging, restaurants, transportation, and other local goods and services. Outfitters and guides from nearby communities serve this section of the river, as well as guides from further afield, including Klamath Falls and coastal Oregon (Crowe 2009).

An analysis of the economic impact of recreation on the wild and scenic portions of the Rogue River in Josephine County, Oregon found that activities such as rafting, fishing, hiking, and jetboat

tours accounted for $30 million in output, including $15.4 million in personal income, and supported 445 full and part-time jobs. In 2007, 5,977 people floated down the wild section of the river on commercially-guided trips, representing 45 percent of total visitors. The study specifically excluded Jackson County, but did mention that five river rafting and fishing guide outfitter companies were located in the county (ECONorthwest 2009). The Pacific Connector pipeline would have no impacts on the wild and scenic portions of the Rogue River because those segments are so far away from the pipeline crossing, and for the other reasons explained below.

Pacific Connector proposes to cross the Rogue River using HDD technology, which would avoid direct impacts on the river and its fisheries (see sections 2.4.2.2 and 4.3.2.5). There would, therefore, be no direct impacts on recreational users of the Rogue River with successful HDD implementation. The potential for a "frac-out" and subsequent consequences and corrective actions are discussed in section 4.4.2. For recreational users, the effect of a frac-out would range from negligible for a minor leak to severe for a major event that required temporary closure of a section of the river and impacted local water quality and fisheries.

Indirect impacts on river-based recreation activities could include construction noise and traffic, as well as visual effects after construction before the right-of-way is fully restored and revegetated. We address noise issues related to pipeline construction activities and HDDs in section 4.12.2. Recreation and visual impacts are discussed in section 4.8.

Concern was expressed during public scoping that the pipeline would have negative effects on the communities of Shady Cove and Trail by disrupting traffic along State Highway 62, which parallels the Rogue River and connects these communities to Crater Lake. Pacific Connector anticipates that construction could result in a peak of 220 to 260 vehicle round trips per day through Shady Cove and Trail, with trucks accounting for about 50 of these trips. Average annual daily traffic (AADT) counts for the stretch of highway that extends from Shady Creek to Trail in 2011, the most recent year available, ranged from 4,700 to 8,000, with larger vehicles accounting for about 16 percent of the traffic (Oregon Department of Transportation 2013a, 2013b). The addition of 220 to 260 round trips to the overall totals would range from 6 percent to 11 percent of the existing AADT. The addition of approximately 50 round trips by larger vehicles, including three to four pipe stringing trucks, three water trucks, and three dump trucks, would range from about 8 percent to 20 percent of the existing larger vehicle traffic. Pacific Connector developed a TMP to reduce conflicts between construction traffic and recreational users of local roads. Transportation issues related to pipeline construction are more fully addressed in section 4.10.2.

Based on the discussion above, we conclude that construction and operation of the Pacific Connector Pipeline Project would not have any significant adverse impacts on regional non-federal recreation areas or parks or recreational activities. All construction related impacts would be minor and temporary. The route of the pipeline does not cross any non-federal parks or recreation areas or developed facilities; with the exception of the Haynes Inlet Water Trail. Installation of the pipeline would not prevent or impede any dispersed recreational activities on non-federal land; except along the right-of-way for the 2-year construction period. Fish-bearing waterbodies crossed by the pipeline would be restored after construction, and temporary construction related sedimentation and turbidity would be reduced by erosion control devices, with only short-term impacts on fisheries (as discussed in detail in section 4.4.2). When the economic output of the Pacific Connector Pipeline Project is added to the economic output of recreational activities and

travel expenditures in Southern Oregon, the region would receive additional positive economic benefits.

Tourism

Travel spending in the four potentially affected counties in 2012 was approximately $1,070 million, ranging from $138 million in Klamath County to $477 million in Jackson County (table 4.9.2.7-1). Travel spending generated earnings of approximately $262 million and supported approximately 12,000 jobs in the four-county area in 2012. Travel-related employment accounted for about 5.4 percent of total employment in the four-county area in 2011 (Dean Runyan Associates 2013).

TABLE 4.9.2.7-1

Travel Spending, Earnings, and Employment, 2012

State/County	Travel Spending ($ million)	Earnings ($ million)	Employment	
			Jobs	Percent of County Total (2011) a/
Oregon	9,117.0	2,215.0	91,100	na
Coos	233.5	61.7	3,050	10.0
Douglas	221.1	53.6	2,720	5.6
Jackson	477.1	108.5	4,570	4.1
Klamath	138.2	37.7	1,660	5.2
Project Area Total	**1,069.9**	**261.5**	**12,000**	**5.4**

a/ This percentage represents travel-related employment for 2011 as a percent of 2011 total employment.
Source: Dean Runyan Associates 2013

The major impact that the Pacific Connector pipeline would have on tourism is competition for lodging when peak construction periods overlap peak visitor seasons. As previously estimated, at the peak of pipeline construction about 1,106 non-local workers and their family members would relocate to the areas and they would need short-term housing. These out-of-town construction workers would compete with tourists for hotel/motel rooms and spaces at RV camps in the region; especially during the summer.

Using the Oregon Coast as an example, the peak visitor season lasts from June to October. The highest demand for hotel/motel rooms by tourists would be in August, where occupancy rates are over 93 percent on a Saturday night and 63 percent on a Sunday night. In January, average occupancy rates along the Oregon Coast fall to less than 37 percent (ECONorthwest 2006a).

As discussed in section 4.9.2.2, peak demand for temporary housing (other than RV spaces) is expected to be approximately 606 units, which when divided among the five construction spreads would be about 152 units per county. During the summer, when hotel occupancy rates could reach 80 percent on weekends, there may be 1,578 hotel rooms available over the four-county project area. Not all non-local workers would live in hotels, as some would occupy rental houses, apartments, and mobile homes. The total universe of rental housing in the project area is estimated to be 21,169 units. Non-local construction worker demand for housing would be reduced by some sharing accommodations. Further, demand is likely to be lower on weekends, when occupancy rates are highest, because a portion of the non-local workforce would likely return home on the weekend. If short-term housing were to become limited in the immediate project vicinity, workers could have to commute longer distances to secure lodging.

4.9.2.8 Commercial Activities

Commercial Fishing

Commercial fishing landing data for Charleston are summarized in section 4.9.1.8. Approximately 2.4 miles of the Pacific Connector pipeline would be installed in the Coos Bay estuary. This could result in short-term impacts to aquatic resources, including on juvenile Dungeness crab rearing habitat and juvenile salmon rearing habitat. This is discussed further in section 4.6 of this EIS. These construction-related effects are expected to have minimal effects on commercial fishing activities.

Fish are not harvested commercially in the inland rivers and streams crossed by the Pacific Connector pipeline. However, fish such as salmon and steelhead that spawn in the affected rivers are commercially harvested in coastal areas off Oregon, Washington, and California, as well as British Columbia and Alaska. One study estimates that fish originating in the Rogue River and commercially harvested off the Northwest coast have an annual economic impact of approximately $1.36 million (ECONorthwest 2009). Construction of the pipeline outside of Coos Bay would affect waterbodies that may provide habitat for aquatic resources that are commercially harvested. However, short-term construction-related effects on streams and rivers are not expected to adversely affect the spawning of fish that are commercially harvested from the ocean; as impacts such as sedimentation and turbidity would be reduced through the use of erosion control devices. Potential impacts resulting from the pipeline crossing waterbodies and mitigation of those impacts are discussed in section 4.4.2.5, and impacts on aquatic resources in stream habitats are evaluated in section 4.6.2 of this EIS.

Commercial Oyster Farms

The pipeline route between about MPs 1.7 and 4.1 would cross the Haynes Inlet portion of Coos Bay. In this area, there are commercial oyster beds. On July 16 and October 15, 2014, Clausen Oysters commented on potential impacts the pipeline crossing of Haynes Inlet may have on their commercial oyster-growing operations. The pipeline route would go between the company's Silverpoint beds 1 and 3. In this area, the channel is narrow. Pacific Connector would be using a 250-foot-wide right-of-way. Where the route crosses under the Highway 101 bridge, Pacific Connector's construction equipment may block access to Clausen's oyster beds 1, 7, and 8. In addition, turbidity and sedimentation caused by trenching may have negative impacts on oysters, which are filter feeders.

Pacific Connector indicated that its route across Haynes Inlet would mostly avoid commercial oyster beds. This EIS discusses potential impacts from turbidity and sedimentation in the bay in section 4.6. Pacific Connector would use a set of BMPs outlined in its *Report on Preliminary Pipeline Study Haynes Inlet Water Route*. However, Pacific Connector has not documented consultations with Clausen Oysters and other commercial oyster growers regarding the development of mitigation measures that would reduce impacts on commercial oyster beds when crossing Haynes Inlet. Therefore, **we recommend that:**

- **<u>Prior to construction,</u> Pacific Connector should file with the Secretary a plan that outlines measures to avoid, minimize, or mitigate impacts on commercial oyster beds in the vicinity of the crossing of Haynes Inlet between about MPs 1.7 and 4.1, for review and approval of the Director of OEP, and documentation that the plan was**

developed in consultations with Clausen Oysters and other commercial oyster growing companies in that portion of Coos Bay.

Commercial Shipping

The only place in the project area where commercial shipping takes place is in Coos Bay. The Coos Bay navigation channel extends for about 15 miles from the North Jetty to the mouth of the Coos River. However, large deep-draft vessels could not pass under the railroad bridge at NCM 9. The Pacific Connector pipeline would cross Coos Bay for about 2.4 miles across Haynes Inlet between MPs 1.7 and 4.1, about 1 mile north of NCM 9.5. The pipeline crossing of Haynes Inlet would be outside of the Coos Bay navigation channel. Therefore, construction and operation of the Pacific Connector Pipeline Project should have no impacts on commercial shipping to and from the Port.

Businesses

The Pacific Connector pipeline route would cross mostly rural areas, and avoid densely populated or urban areas. Construction and operation of the pipeline would not result in the displacement of any businesses.

There are three commercial industries that may be affected by the Pacific Connector Pipeline Project: outdoor recreation companies, forestry companies, and agricultural businesses. As mentioned above, there are professional companies in the counties crossed by the pipeline that offer services to rent or sell fishing boats, rent or sell recreational boats, rent or sell fishing gear, rent or sell horses or lead horseback riding tours, guide anglers, lead boat tours, rent or sell bicycles, OHVs, or snowmobiles, rent or sell skiing equipment, rent or sell camping gear, and lead hikes and camping trips, and other recreational activities such as wildlife viewing. Impacts related to pipeline construction on outdoor recreational activities were previously discussed in sections 4.8.1.2 and 4.9.2.7.

Approximately 980 MMBF of timber was harvested in the four affected counties in 2012, with an annual average harvest from 2008 to 2012 of 871 MMBF (ODF 2013). The Pacific Connector pipeline route would cross about 161 miles of non-federal lands, including approximately 95 miles of private lands that are forested. During project scoping, some private timber companies commented on the effects pipeline construction may have on their lands. For example, Seneca Jones Timber Company, in a letter to the Commission dated October 25, 2012, raised issues such as competition between Pacific Connector and private timber companies for the use of ridge tops for access and equipment; placement of TEWAs, especially on slopes where there could be rock falls; allowing timber yarding or hauling heavy equipment over the installed pipeline; increased construction traffic on roads conflicting with logging equipment; pipeline construction labor demands making it difficult for private companies to hire contractors; and increased risk of forest fires due to slash in the pipeline right-of-way. Timber harvesting and the mitigation of impacts related to the pipeline are discussed in more detail in section 4.5.2.

As discussed in section 4.1, approximately 981 acres of agricultural land would be affected by pipeline construction, the largest proportion of which would be in Klamath County. The vast majority of these lands can be restored and returned to their original condition and use after the pipeline is installed. Therefore, most potential impacts to agricultural operations would be temporary and short-term in nature. Deep-rooted crops, such as orchards and vineyards, could not be planted directly over the pipeline. Therefore, owners of orchards crossed by the pipeline would

lose a percentage of their trees and potential future income. Orchards comprise less than 0.1 mile of the pipeline route. For both temporary and permanent impacts, Pacific Connector would negotiate with landowners and provide compensation for crop losses or land taken out of use as a result of pipeline construction.

In the Klamath Basin, the pipeline route would cross a number of irrigation features. During construction, the Project could have impacts on agricultural lands if their associated irrigation systems were disrupted. Pacific Connector has stated that it intends to install the pipeline in the Klamath Basin in the winter, when most of the irrigation ditches are dry or not in use. Pacific Connector would follow the measures outlined in its *Winter Construction Plan for the Klamath Basin* and its *Klamath Project Facilities Crossing Plan*.

The company would repair any agricultural drain tiles damaged during construction. Other measures that Pacific Connector would implement when crossing agricultural crop lands to mitigate impacts include topsoil segregation, the removal of large rocks from the surface, and ripping to relieve soil compaction caused by construction.

4.9.2.9 Environmental Justice

The Pacific Connector pipeline would cross a mostly rural region. Race and ethnicity data are summarized for the four counties that would be crossed by the pipeline in table 4.9.2.9-1. These data compiled as part of the 2010 Census indicate that the population in all four counties is predominantly White. Persons of Hispanic or Latino origin make up the largest share of the non-White population in all four counties, but the percent of residents in the project area counties that are Hispanic is lower than for Oregon as a whole. The percentage of the population that is American Indian is higher than the state average in Coos, Douglas, and Klamath Counties (table 4.9.2.9-1).

TABLE 4.9.2.9-1

Race and Ethnicity in Counties Crossed by the Pacific Connector Pipeline, 2010

		Percent of Total						
Geographic Area	**Total**	**White a/**	**Hispanic or Latino**	**Black or African American a/**	**American Indian and Alaska Native a/**	**Asian a/**	**Other Race b/**	**Two or more races**
Coos County	63,043	87.0	5.4	0.4	2.3	1.0	0.3	3.7
Douglas County	107,667	89.5	4.7	0.3	1.7	0.9	0.2	2.7
Jackson County	203,206	83.7	10.7	0.6	0.9	1.1	0.4	2.6
Klamath County	66,380	81.1	10.4	0.6	3.6	0.9	0.2	3.2
Oregon	3,831,074	78.5	11.7	1.7	1.1	3.6	0.5	2.9

a/ Non-Hispanic only. The federal government considers race and Hispanic/Latino origin to be two separate and distinct concepts. People identifying Hispanic or Latino origin may be of any race. The data summarized in this table present Hispanic/Latino as a separate category.
b/ The "Other Race" category presented here includes census respondents identifying as "Native Hawaiian and Other Pacific Islander" or "Some Other Race."
Source: U.S. Census Bureau 2013c

Approximately 2.3 percent of the population of Coos County is Native American. The Coquille Tribe and the Coos Tribes are headquartered in the cities of North Bend and Coos Bay, respectively. Native Americans comprise 1.7 percent of the population in Douglas County. The Cow Creek Tribe is headquartered in Roseburg and operates a hotel and casino in nearby Canyonville. Native

Americans account for 3.6 percent of the population in Klamath County. The Klamath tribes are headquartered at Chiloquin. We discuss consultations with Indian tribes and potential project-related impacts on cultural resources that may be important to tribes in section 4.11.

Pacific Connector compiled data for selected indicators that could indicate the presence of a low income or otherwise disadvantaged community (table 4.9.2.9-2). Median household income in the affected counties ranged from 78.0 percent (Coos County) to 85.4 percent (Jackson County) of the state median in 2011. The percent of the population below the poverty level ranged from 18.1 percent (Douglas County) to 23.0 percent (Klamath County) compared to 17.3 percent statewide (table 4.9.2.9-2).

Pacific Connector also reviewed census data for the 19 census tracts crossed by the pipeline. They found that one of these census tracts located in Klamath County (Census Tract 9706) had a combined minority population that exceeded 50 percent of the total population. They also found that 4 of the other 18 census tracts had what they consider to be meaningfully greater (i.e., more than 1.2 times or 120 percent) percentages of vulnerable populations than the corresponding average populations for the state of Oregon as a whole.

TABLE 4.9.2.9-2

Low Income and Vulnerable Populations in the Counties Crossed by the Pacific Connector Pipeline

Variable	Coos County	Douglas County	Jackson County	Klamath County	Oregon
Total Population a/	62,965	107,513	203,526	66,362	3,871,859
Median Household Income b/	$36,567	$38,196	$40,013	$36,765	$46,876
Percent of State Median	78.0	81.5	85.4	78.4	100.0
Percent of Total					
Below the Poverty Level b/	19.8	18.1	19.7	23.0	17.3
Disabled Population c/	21.9	21.5	16.2	17.4	13.6
Children (under 18 years of age) c/	13.8	15.1	16.0	16.5	22.3
Elderly (over 64 years of age) c/	21.5	21.1	17.8	16.9	14.3
Non-English Speakers at Home c/	5.2	4.2	8.9	9.8	14.9

a/ County population estimates are based on 3-year averages compiled by the Census Bureau.
b/ U.S. Census Bureau 2013e
c/ Estimates are based on 3-year averages compiled by the Census Bureau.

Census tracts 9707 and 9705 in Klamath County had a relatively high number of non-English speakers, and relatively high percentages of low-income and elderly people. In Jackson County, one census tract (25) had a relatively large elderly population. Coos County had one census tract (5.02) where the percent of the population below the poverty level was more than 1.2 times the state average. These tracts are shown in figure 4.9-3.

The Project is not expected to result in significant adverse environmental impacts in any community with a disproportionate percentage of low-income or minority populations. The pipeline route mostly crosses rural regions with low population densities, and avoids towns and cities. Pacific Connector sought to find the shortest, buildable route between Malin, Oregon, where the pipeline would begin, and Coos Bay, where the pipeline would terminate at the Jordan Cove LNG export terminal. Along the way, the pipeline route mostly follows ridges through the mountains. It was not the intent to route the pipeline through any areas that contain a high percent of minorities or Native Americans, low-income communities, or other vulnerable populations. In addition, the FERC made documents and notices about the pipeline available to the public, and had a robust program for public participation and comment, as explained in section 1.5 of this EIS.

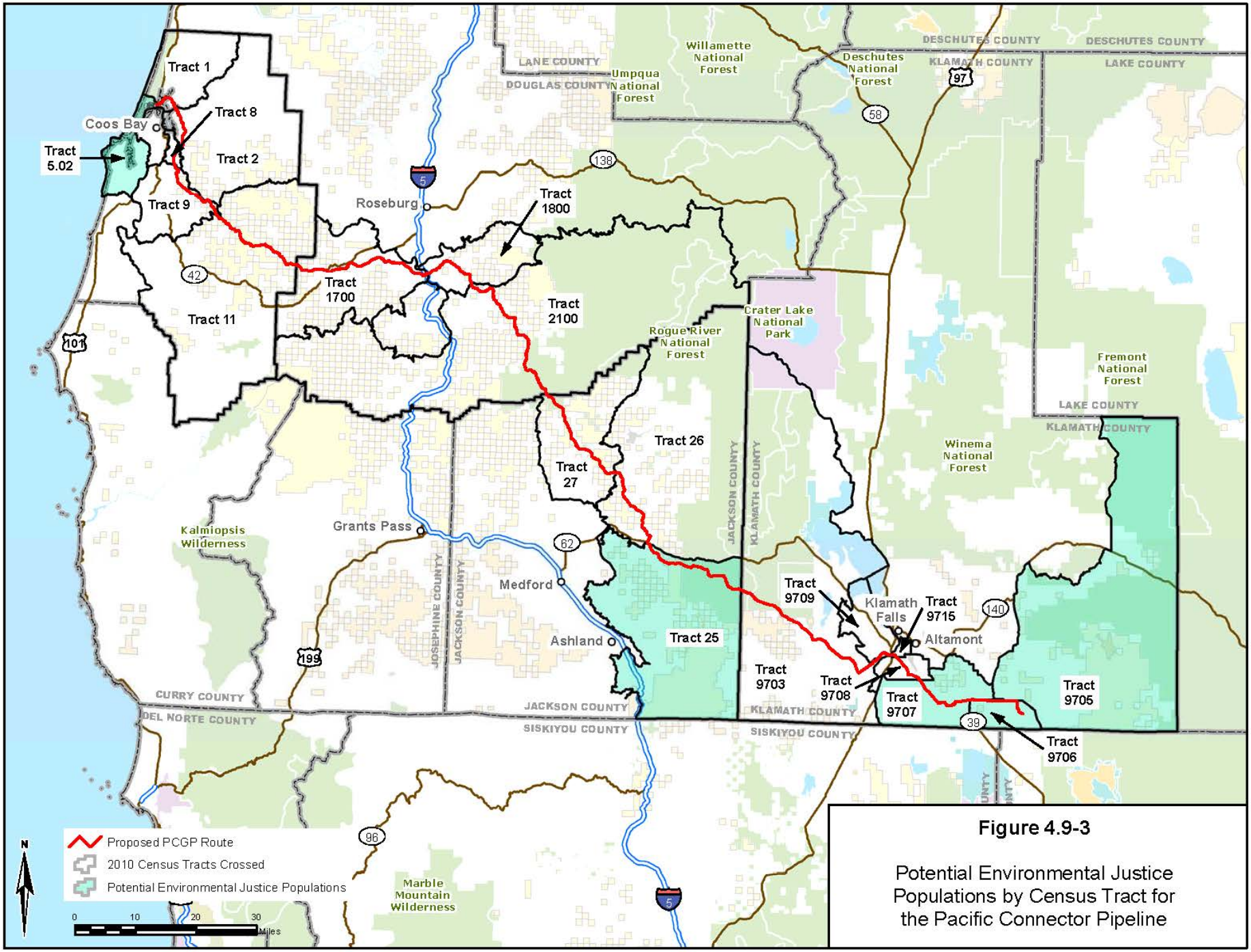


Figure 4.9-3

Potential Environmental Justice Populations by Census Tract for the Pacific Connector Pipeline

4.9.3 Federal Lands

Potential socioeconomic impacts of the pipeline on federal lands would be primarily related to timber harvesting, recreation, and transportation. These are discussed in sections 4.5, 4.8, and 4.10, respectively.

4.9.3.1 Financial Efficiency Analysis

Pacific Connector prepared a Financial Efficiency Analysis that assesses the net present value of costs and benefits that would accrue to the federal government as a result of construction and operation of the pipeline project (Levy 2008). This analysis was prepared in general accordance with direction contained within the Forest Service Handbook. Pacific Connector subsequently updated this analysis by adjusting the dollar amounts to account for inflation. Results are presented in 2010 dollars.

The analysis is limited to those costs and revenues that would result from the direct use of federal assets (land, timber, and roads) and can be directly quantified based on existing fee schedules. The analysis does not include government administrative revenues that would be generated from the fees charged to process the project application and monitor the right-of-way. In addition, the analysis does not include non-market economic costs or benefits that are not part of federal monetary transactions.

Costs and benefits were projected over a 50-year time period, where appropriate, and discounted using a real discount rate of 4 percent. The analysis identifies two sources of direct government revenue: (1) Pacific Connector's payment for timber that would need to be cut, and (2) Pacific Connector's rental payments for construction access and the pipeline right-of-way. The analysis also identifies three sources of government costs: (1) the value of lost timber productivity along the new right-of-way, (2) the value of non-merchantable trees that would need to be cut prematurely (lost timber growth), and (3) the incremental cost of future maintenance for existing roads that Pacific Connector may upgrade above their existing federal maintenance level (Levy 2008). The present values of these projected revenues and costs are summarized in table 4.9.3.1-1. The projected net present value of the Pacific Connector Pipeline Project based on this analysis is $5.24 million in 2010 dollars (table 4.9.3.1-1).

TABLE 4.9.3.1-1

Financial Efficiency Analysis of the Pacific Connector Pipeline Project

Category	Timing	Present Value in 2015 (2010$ millions)
Revenues		
Timber Revenue a/	2015	3.89
Temporary Use Permit and Right-of-Way Revenue b/	2015	2.88
Costs		
Lost Timber Productivity c/	2015	-0.0042
Lost Timber Growth d/	2015	-0.054
Incremental Road Maintenance e/	2017 to 2068	-1.47
Net Present Value		5.24

a/ Timber revenue was calculated based on the pond value of the estimated timber volume, less the costs of logging and hauling the timber to the mill, slash disposal, and road work. Timber volumes and other values used in this estimate are based on preliminary estimates prepared by Pacific Connector.
b/ This analysis assumes that Temporary Use Permits would be required for construction for 2 years and the right-of-way would be required for 50 years. Revenues are estimated based on the federal 2013 Linear Right-of-Way Rental Schedule values per acre for the affected counties. The analysis assumes that Pacific Connector would make a one-time payment, rather than make annual payments over the life of the project.
c/ Lost timber productivity was estimated based on the soil expectation value of the lands that would be permanently lost to timber production and is based on an average soil expectation value of $14.30 per acre.
d/ Lost timber growth accounts for the value of non-merchantable trees that would be cleared in the right-of-way. This value is based on the projected value of these trees at merchantable age. Premature harvest of these trees represents foregone revenue for the federal government and is, therefore, counted as a cost here.
e/ Non-design improvements, such as turn-outs, widening, or blading/grading, to existing roads on NFS and BLM lands would likely be necessary as part of this project and may change the maintenance level of the existing road (by, for example, adding base and gravel to an existing road surface of native materials) and, as a result, impose an incremental maintenance cost on the government. This analysis assumes that all roads on federal lands used by Pacific Connector for construction access would be upgraded from native materials to gravel and, therefore, result in costs at the upper end of the range of possible outcomes. Incremental cost increases are assumed to be $343 per mile per year.
Source: Levy 2008

This analysis does not, however, as noted above, account for other costs and benefits that are not assigned monetary values by the federal government. Other potential impacts (not valued) to federal lands include impacts to recreation, the PCT, grazing, LSRs, and Riparian Reserves (Levy 2008). While no monetary value is assigned to these potential impacts, they are considered in detail elsewhere in this document. Pacific Connector outlined measures it would implement to reduce or mitigate impacts on federal lands in its POD.

4.9.3.2 Secure Rural Schools and Community Self-Determination Act

In Oregon, counties with NFS lands and certain BLM lands have also historically received 25 percent of returns to the U.S. Treasury from revenue-producing federal activities, such as timber sales. Those payments are called 25 percent fund payments and are dedicated by law for schools and roads. Under the 25 percent approach, funding to the state increased or decreased as revenue generated on federal lands increased or decreased. Large reductions in timber harvest on federal lands in the Pacific Northwest resulted in sharp declines in 25 percent fund payments. To protect local communities from the adverse impacts of declining timber revenues, Congress enacted the Secure Rural Schools and Community Self Determination Act of 2000 (Public Law [P.L.] 106-393) as a temporary program of federal payments to counties based on historic, rather than current, timber revenues. Under this act, affected counties could choose to receive a payment amount based on the average of the highest three payments made during the 14-year period between 1986 and 1999. Payments under this program for Fiscal Year 2012 ranged from $1.0 million in Klamath County to $10.2 million in Douglas County (BLM 2013c). Congress extended the Secure Rural

Schools Act for 2013; however, the program expired on September 30, 2014, and was not reauthorized by Congress. Therefore, as of this FEIS, payments to counties are governed by the prior 25 percent approach described above.

4.9.3.3 Recreation and Transportation

As discussed in section 4.8 of this EIS, dispersed recreational activities occur on federal lands, including BLM Districts and National Forests that would crossed by the pipeline route. One recreational trail (the PCT) on NFS land would crossed by the pipeline; and again the mitigation of impacts are detailed in section 4.8. As further discussed in section 4.8, we do not believe that the construction and operation of the Pacific Connector pipeline would have significant adverse effects on recreation on federal lands. It is possible that there could be conflicts between pipeline construction traffic and recreational visitors using roads on federal lands. Pacific Connector developed a TMP for roads on federal lands, and we further discuss transportation issues in section 4.10. In addition, Pacific Connector would implement measures to discourage unauthorized ORV use of the right-of-way on federal lands.

4.9.3.4 Mitigation of Impacts on Federal Lands

Pacific Connector is considering establishing easements or purchasing private lands that could be preserved as late successional forest, to offset impacts on habitat for federally listed threatened and endangered species. If this type of mitigation were to be implemented, it would have the potential to affect the number of acres used to calculate PILT payments. In addition, land purchases may provide some benefit to local economies.

4.10 TRANSPORTATION

4.10.1 Jordan Cove LNG Terminal

4.10.1.1 Marine Traffic

Existing marine traffic in Coos Bay includes deep-draft cargo ships that call at the Port, tugs, and barges, as well as fishing and recreational boats. A total of 63 deep-draft cargo ships called at the Port in 2013, with 47 and 61 deep-draft cargo ships calling in 2012 and 2011, respectively. Fewer than 50 barges are believed to pass through the Coos Bay navigation channel each year (ECONorthwest 2012a). Commercial fishing vessels using the Port include the nearly 200 commercial fishing vessels based at the Charleston Marina, as well as hundreds of other commercial fishing vessels that visit each year (Oregon International Port of Coos Bay 2013). A total of 31,560 recreational boating trips took place in Coos Bay in 2007, with an additional 3,780 recreational trips on the Pacific Ocean originating from Coos Bay ramps (ECONorthwest 2012a). Barges, commercial fishing boats, and recreational boats are all shallow-draft vessels that can move out of the navigation channel to avoid deep-draft cargo ships when necessary.

There are four existing recreational docks, one marina, and five commercial docks adjacent to the waterway for LNG marine traffic, between NCM 2 and NCM 9. These berthing sites include:

- Charleston Marina – at NCM 2, on the south side of the bay at the community of Charleston, is a marina owned by the Oregon International Port of Coos Bay (Port) that is home to approximately 500 vessels including commercial fishing vessels, Coast Guard inspected and uninspected passenger vessels, and recreational vessels;
- Cape Arago Dock – at NCM 5.4, on the east side of the bay at the community of Empire, is a private facility operated by the Sause Brothers, with water depth about 20 feet, and one berth with a 500-foot-long dock;
- D. B. Western, Inc. – at NCM 5.6, on the west side of the bay along the North Spit, is private facility, with water depth about 20 feet, and one berth with a 140-foot-long wharf;
- North Bay Marine Industrial Park – at NCM 5.7, on the west side of the bay along the North Spit, is owned by the Port, but currently not developed;
- Empire Ramp – at NCM 6, on the east side of the bay, owned by the City of North Bend, with a public dock and no slips;
- Southport Lumber Company – at NCM 6.3, on the west side of the bay along the North Spit, is private facility with water depth about 5 feet, and a berth able to take shallow barge traffic only;
- BLM North Spit Dock – at NCM 7, on the west side of the bay along the North Spit is a public dock with no slips;
- Roseburg Forest Products Chip Terminal – at NCM 7.9, on the west side of the bay along the North Spit, with water depth about 38 feet, and one berth with a 260-foot-long wharf; and
- Pony Point Boat Ramp – at NCM 9, on the east side of the bay, at the mouth of Pony Slough, is blocked from public access because of its location within the boundaries for the North Bend Airport.

All deep-draft commercial ships in Coos Bay use the existing navigation channel. They enter and exit the Port under the control of a Coos Bay Pilot. According to ECONorthwest (2006c), the

Coos Bay Pilots Association has stated that they typically encounter an average of six recreational boats and two commercial fishing boats during the transit of each deep-draft vessel through the navigation channel. These numbers tend to be fewer in winter and on weekdays.

During construction of the LNG terminal, Jordan Cove would have large pieces of equipment brought in via water transport, using the existing Coos Bay navigation channel. Two types of vessels would make those deliveries: ocean-going break bulk cargo ships and coastal barges. Both cargo ships and barges would off-load at the terminal barge berth, on the southeast corner of the marine slip. Some cargo ships would come directly overseas to the terminal, but we do not know their points of origin or sea routes. Most likely, the barges would follow the coast either south from Portland or Seattle, or north from ports in California. While Jordan Cove did not provide any details about specific vessels, we assume they would be similar to the cargo ships and barges that currently use the Port. Over a two-year period during construction of the terminal, Jordan Cove expects deliveries by about 82 cargo ships and 18 barges, in total. As explained below, we do not anticipate that the additional cargo ships and barges making deliveries at the terminal during that two-year construction period would have adverse impacts on other bay users, such as other commercial ship traffic, fishing vessels, or recreational boaters.

During operation of the terminal, Jordan Cove expects about 90 LNG vessels to visit each year. Although Jordan Cove has not specified exactly what kind of LNG vessels would call at the Jordan Cove terminal, the Coast Guard, in its LOR, has limited their size to 148,000 m^3 in capacity or smaller. According to Jordan Cove's ship maneuverability study,[134] LNG vessels of that size can use the existing Coos Bay navigation channel without any major channel improvements, except for the creation of the new access channel between the existing navigation channel and the marine slip at the Jordan Cove terminal.

LNG vessels would most likely transit in the waterway at slack high tide during daylight hours, with travel time from the offshore buoy at the beginning of the waterway to the proposed Jordan Cove terminal estimated to be about 90 minutes at typical speeds of 4 to 10 knots. The pilots would not allow an LNG vessel to enter the navigation channel under severe weather conditions, or when the volume of other ship traffic in the channel is so heavy that transit to the LNG terminal could be potentially unsafe. An LNG vessel could also not use the navigation channel when another deep-draft commercial ship is in transit in Coos Bay; the LNG vessel would instead be held either at the buoy outside the bay or in the marine slip at the Jordan Cove terminal until the other deep-draft ship has completed its transit.

Effects on fishing and recreational boats from LNG marine traffic in the waterway would be similar to current deep-draft cargo ship traffic to and from the Port. In general, as deep-draft vessels enter the channel, other boats move out of their way, and boats in the ocean near the mouth of the channel defer entering the channel until the larger ships have passed. The escort boats accompanying each LNG vessel would facilitate moving other boats out of the way in a timely manner. As they currently do for other commercial cargo ship traffic, the Coast Guard and OSMB would remind recreational boaters of their obligation to not impede deep-draft vessels transiting in the navigation channel.

[134] See Moffatt & Nichol, 14 April 2008, *Jordan Cove LNG Terminal Coos Bay, Oregon 148,000 M3 Class LNG Carrier Transit and Maneuvering Simulations, March 17-20, 2008*, included as appendix D.11 of Resource Report 11 filed with Jordan Cove's May 2013 application to the FERC in Docket No. CP13-483-000.

Interactions between deep-draft cargo ships and other boats rarely occur in Coos Bay. The likelihood of a collision between an LNG vessel and another boat would be extremely low because of the mitigation measures imposed by the Coast Guard's WSR, including the implementation of a TMP, and a 500-yard security zone around LNG vessels in the waterway. In addition, the boats escorting each LNG vessel could help keep other boats out of the way. Non-routine events may infrequently occur, such as a recreational boat moving more slowly than expected, or a boat following an LNG vessel too closely. For example, if a recreational boat were to lose power and be unable to move out of the way of an LNG vessel, the escort boats could come to its assistance.

Other boats may be delayed up to 30 minutes waiting for the passage of an LNG vessel. Boats in Charleston Marina ready to head out to sea may need to wait about 20 minutes for an LNG vessel to pass before entering the channel. These delays would be similar to those that occur during the current passage of a deep-draft cargo ship.

While an LNG vessel is moored at berth at the terminal, the Coast Guard's WSR recommends the imposition of a 150-yard security zone around the entire slip. When no LNG vessel is at berth at the terminal, the security zone would be reduced to 25 yards. This security zone would not extend as far as the Coos Bay navigation channel, and would not affect vessels transiting in the channel. However, other boats in Coos Bay on the north side of the navigation channel would need to move around the terminal security zone. This should not be difficult because they would need to move only 25 yards south from the shore.

The addition of 82 break bulk cargo ships during a two-year construction period and 90 LNG vessels per year transiting to and from the Jordan Cove terminal during its operation would increase the total number of deep-draft vessels calling at Coos Bay. This increase in marine traffic in the navigation channel would be less than historic numbers of deep-draft ships that used the Port. In the late 1980s, more than 300 cargo ships per year called at Coos Bay. Today, about 60 deep-draft commercial vessels per year visit the Port. Port authorities expect that deep-draft cargo ship traffic would remain at this level for the near term, in the absence of future marine transits to the proposed Jordan Cove terminal (ECONorthwest 2012a). Past experience, when total annual traffic was 150 deep-draft vessels and higher, suggests that while some other marine traffic might be temporarily inconvenienced, the passage of LNG vessels through the channel would not have significant or long-term impacts on other boats in Coos Bay.

4.10.1.2 Motor Vehicle Traffic

I-5 is an existing interstate federal highway that extends from San Diego, California, to Seattle, Washington, mostly on the east side of the Coast Range. Existing U.S. Highway 101 generally follows the coast from California to Washington State. While I-5 has multiple lanes in each direction and is relatively straight, Highway 101 usually has only one lane in each direction and has frequent curves. Three existing state highways connect between I-5 and Highway 101 near the project area. Oregon Highway 126 extends from I-5 near Eugene to Highway 101 near Florence. Oregon Highway 38 extends from Eugene to Reedsport. Oregon Highway 42 extends from Roseburg to Coos Bay. All three state highways are narrow, winding, two-lane roads; yet they are currently used by many semi-trailer trucks, usually hauling logs.

Jordan Cove has indicated that material deliveries by truck to the terminal would probably come via I-5 and would then use State Highway 42 to interconnect with U.S. Highway 101 near Coos Bay. State Highway 42 would be the preferred route for trucks because it has fewer restrictions,

such as tunnels and bridges with weight limits, than alternative routes such as Highway 126 or Highway 38.

U.S. Highway 101 extends north-south through Coos County, parallel to the Pacific Ocean. The highway crosses Coos Bay approximately 2.3 miles east of the Jordan Cove terminal site. Access to the Jordan Cove terminal would be from U.S. Highway 101 north of the McCullough Bridge to the Trans-Pacific Parkway via a causeway that extends across Hayes Inlet to the North Spit.

The Trans-Pacific Parkway provides the main vehicular access to the North Spit. About 0.5 mile east of the intersection with Jordan Cove Road, there is a turn-off to the northwest to Horsfall Beach Road, which provides access to the ODNRA. The locations of these roads are shown in figure 4.10-1.

There would be two main points of access into the Jordan Cove terminal from the Trans-Pacific Parkway. One would be from Jordan Cove Road towards the existing Roseburg Forest Products facility. It would then connect on the west to the newly proposed Jordan Cove terminal utility corridor and access road heading to the liquefaction trains. Access to the South Dunes Power Plant complex within the former Weyerhaeuser linerboard mill property would be on the east side of the existing Jordan Cove Road. The other main access point would be a new road from the Trans-Pacific Parkway starting at the northwest boundary of the terminal tract into the Ingram Yard property. All points of access into the Jordan Cove terminal would be gated, with a main guard building located on the north side of the South Dunes Power Plant, and the terminal guard building located on the south side of the Trans-Pacific Parkway west of the terminal firewater ponds at the northwest entrance to the Ingram Yard.

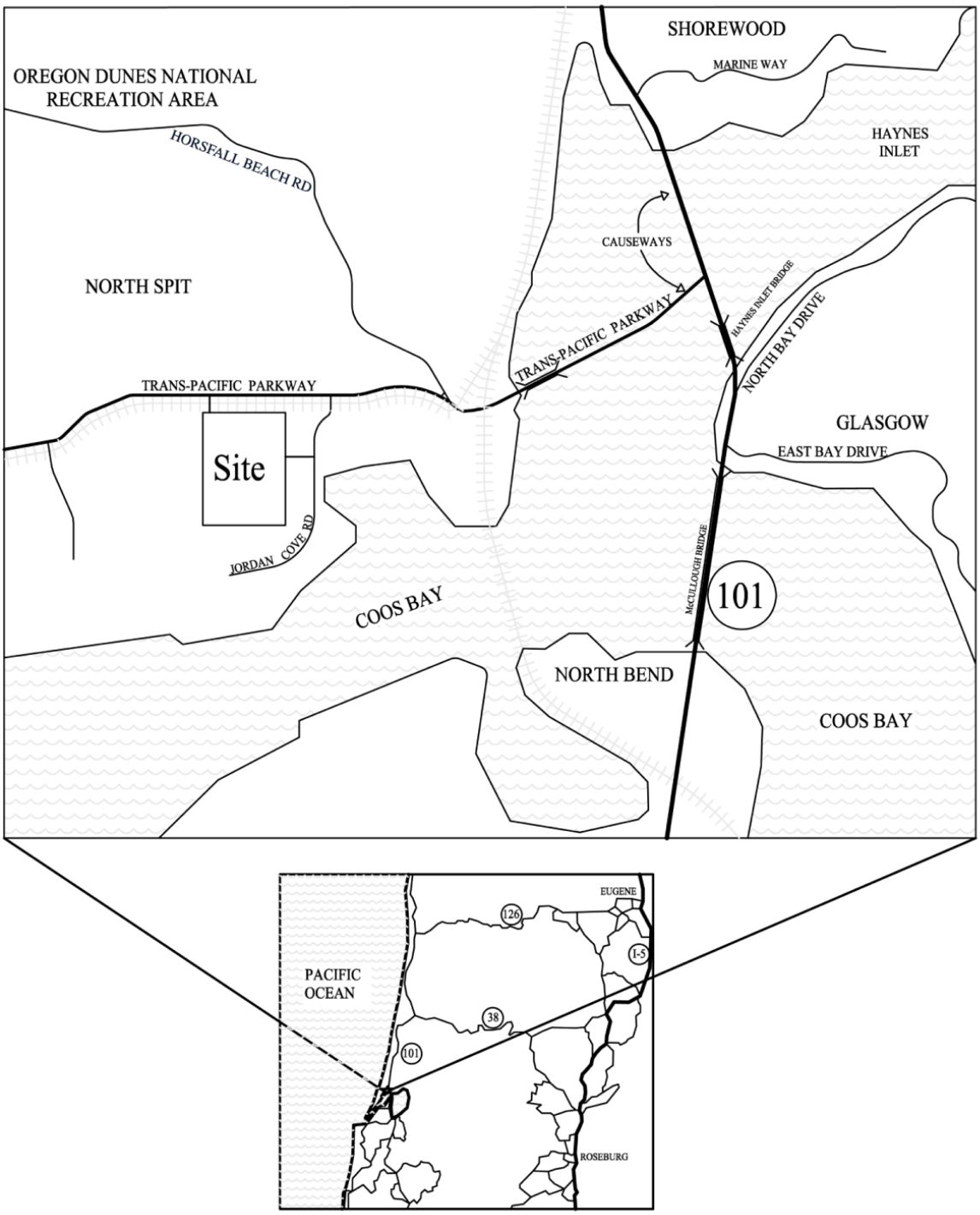


Figure 4.9-1
Figure 4.10-1
Roads in the Vicini[illegible]d LNG Terminal

David Evans & Associates, Inc. (DEA) prepared a *Transportation Impact Analysis* for the proposed LNG terminal project (DEA 2012).[135] As part of this study, traffic count data were collected at four study area intersections in June 2008 (table 4.10.1.2-1). DEA indicated that traffic volumes in the study area between the summers of 2008 and 2011 remained relatively consistent or decreased in some locations. According to DEA, traffic volumes in 2012 indicate that this flat or downward trend is continuing, and as a result, the data from 2008 are assumed to reflect current conditions. Traffic levels along this section of Highway 101 vary throughout the year, with substantially larger traffic flows during the summer months, largely because Highway 101 is a link to popular tourist destinations on the Oregon coastline.

TABLE 4.10.1.2-1

Peak Hour Traffic Volumes at Four Key Intersections Near the Jordan Cove Project Site

Intersection	Peak Hour Traffic Volumes a/	
	A.M. b/	P.M. c/
Highway 101 at Trans-Pacific Parkway	670	1,099
Highway 101 at North Bay Drive	826	1,268
Highway 101 at East Bay Drive	1,017	1,474
Trans-Pacific Parkway at Jordan Cove Road	75	125

a/ Peak hour traffic counts collected by DEA on June 18, 2008.
b/ Starting times for the AM peak volumes reported by DEA (2012) are as follows:
-- Highway 101 at the Trans-Pacific Parkway – 7:30 a.m.
-- Highway 101 at North Bay Drive – 7:00 a.m.
-- Highway 101 at East Bay Drive – 7:30 a.m.
-- Trans-Pacific Parkway at Jordan Cove Road – 7:15 a.m.
c/ Starting times for the PM peak volumes reported by DEA (2012) are as follows:
-- Highway 101 at the Trans-Pacific Parkway – 4:15 p.m.
-- Highway 101 at North Bay Drive – 3:45 p.m.
-- Highway 101 at East Bay Drive – 4:15 p.m.
-- Trans-Pacific Parkway at Jordan Cove Road – 4:30 p.m.
Source: DEA 2012, Appendix A

The DEA traffic operations analysis was performed for two conditions: (1) when construction staffing would be at its maximum level, and (2) when the adjacent roadway traffic peaks during the summer months. This analysis assumed that the maximum construction staffing at the terminal would be approximately 2,500 daily employees. Assuming 10-hour work days and five-day work weeks, the *Transportation Impact Analysis* estimated that peak construction activities would result in 2,009 inbound and outbound vehicle trips each day (based on an average vehicle occupancy rate of 1.3 persons per vehicle).

DEA's analysis examined potential impacts from terminal construction-related traffic at five intersections:

- U.S. Highway 101 at the Trans-Pacific Parkway
- U.S. Highway 101 at North Bay Drive
- U.S. Highway 101 at East Bay Drive
- Trans-Pacific Parkway at Horsfall Beach Road
- Trans-Pacific Parkway at Jordan Cove Road

The results of this analysis indicated that during peak construction with no mitigation, all five intersections would fail to meet ODOT's volume to capacity (v/c) ratio target of 0.70 or less in at least

[135] This report was filed with Jordan Cove's application to the FERC on May 21, 2013, as part of Appendix B.5 in environmental Resource Report 5.

one time period during the day.[136] During peak existing traffic (July) with no mitigation, all intersections except Highway 101 at North Bay Drive would fail to meet ODOT's v/c target in at least one time period during the day. The analysis also found that the addition of the construction trips would result in long delays and vehicle queuing in the peak direction of the construction trips, entering during the morning hours and exiting during the afternoon and evening hours. The DEA study included recommendations for mitigating construction traffic impacts.

The ODOT reviewed the traffic plan and agreed with most of DEA's recommendations in principle, but also indicated that if major schedule changes occur, these measures may not be adequate (Oltman 2012).[137] The ODOT also noted that if different construction techniques or scheduling are imposed, not all the mitigation may be necessary. ODOT recommended that an agreement should be reached between Jordan Cove, the state, and the county, requiring that the following measures be implemented:

- three staggered work shifts with both start and end times that distribute the arriving and departing traffic throughout a 24-hour period;
- manual flagging control at Trans-Pacific Parkway/Horsfall Beach Road during weekday p.m. peak hour whenever construction employees are at or above 1,700 people per day;
- construction of a dedicated eastbound right-turn lane at the intersection of Highway 101 at Trans-Pacific Parkway;
- temporary signalization of Highway 101 at Trans-Pacific Parkway;
- temporary variable speed reduction on Highway 101 in the vicinity of Trans-Pacific Parkway; and
- use of a variable message sign to notify motorists of peak period traffic conditions or traffic control change at Highway 101/Trans-Pacific Parkway.

The Coos County Road Department reviewed DEA's *Transportation Impact Analysis* in a letter dated July 12, 2012. The County required that an updated analysis be submitted at least 90 days prior to the commencement of construction.

In 2013, DEA completed an addendum to the *Transportation Impact Analysis* to analyze the impacts associated with the NPWHC.[138] This addendum indicated that school-type buses would be used to transport workers between the NPWHC and the construction site, and workers would not be allowed to use personal vehicles. Key assumptions in the analysis included that the workforce would be split into two shifts staggered by 45 minutes, the peak month of construction activity would be July, and a standard work week would consist of five days (Monday through Friday) with 10-hour workdays. The beginning of the workday was assumed to occur before the morning peak hour of travel on U.S. Highway 101, and the end of the workday was assumed to coincide with the evening peak hour of travel on U.S. Highway 101. A total of 24 buses would make two round trips during the evening peak travel time as well as 200 vehicles (primarily supervisors and senior staff) returning to the NPWHC. Conservatively, combined there would be

[136] The v/c ratio compares traffic volume demand to intersection capacity. A ratio less than 1.0 indicates that the volume is less than capacity. A v/c ratio close to 0.0 indicates that traffic conditions are generally good with little congestion and low delays for most intersection movements. As the ratio approaches 1.0, traffic becomes more congested and unstable with longer delays.
[137] A copy of this letter was filed with Jordan Cove's application to the FERC on May 21, 2013, as part of Appendix A.5 in environmental Resource Report 5.
[138] Filed with the FERC on April 22, 2015.

a total of 265 commuter trips to and from the terminal during a two-hour peak period in the afternoon. Based on these assumptions, traffic generated by the NPWHC—without mitigation—would exceed the City of North Bend's level of service standard. With mitigation, which would entail installation of a temporary traffic signal at the intersection of U.S. Highway 101 and Ferry Road, traffic would meet level of service criteria.

On November 1, 2013, ODOT provided its review of the traffic addendum. ODOT agreed with the conclusions in the report, and requested that Jordan Cove submit a signal engineering analysis. ODOT stated that U.S. Highway 101 may have to be widened to allow for a left-turn lane at Ferry Street.

In response to an application for an Administrative Conditional Use Permit, on April 18, 2015, the Planning Director for Coos County approved Jordan Cove's Traffic Impact Analysis, subject to conditions. The conditions included that an updated analysis be filed with the County 90 days prior to construction, to be approved by the County Roadmaster.

On April 21, 2014, the City of North Bend Planning Commission issued a conditional use permit and variance permits for the NPWHC.[139] The conditions of the permit related to transportation include that Jordan Cove must:

- adhere to the conditions of a March 14, 2014 letter from ODOT;
- design roads within the NPWHC to be 20 feet wide, with an unimpeded fire lane, and able to support the weight and turn radii of North Bend Fire Department emergency vehicles;
- improve the intersection of U.S. Highway 101 and Ferry Road with a traffic signal and left-turn lane; and
- construct an overlay of Chappell Parkway between the NPWHC and the intersection of U.S. Highway 101 and Ferry Road, and build a hammerhead turnaround at the northwest terminus of Chappell Parkway.

However, in a filing on June 9, 2015, Jordan Cove provided revised estimates of the number of bus trips (one-way) for construction years one through five. In the first year, no bus trips would be required. The number of bus trips would be approximately 5,850 in year two, 42,250 in years three and four, and 13,000 in year five. As these appear to be substantially higher estimates than in the 2013 DEA study, further review and approval by ODOT, Coos County, and the City of North Bend is included as part of our recommendation below.

In response to public comments on the DEIS, additional analysis was completed to assess potential impacts to weekend travel by workers staying at the NPWHC. A supplemental memorandum by DEA dated April 26, 2015[140] assessed weekend travel during the summer tourist season and during peak NPWHC capacity of 2,100 workers. Based on estimated volumes on Friday evening and Saturday midday, the analysis concluded that the capacity improvements already required to accommodate workforce travel during the weekday commute periods would be sufficient to mitigate an increase in workforce travel over the weekend.

None of the DEA studies took into consideration the number of buses that would travel between two off-site parking lots and the terminal during construction. One lot would be located at the Mill

[139] Reviews of Jordan Cove's traffic plan by the ODOT, Coos County, and City of North Bend were filed on April 22, 2015.
[140] Filed with the FERC May 1, 2015, as part of Jordan Cove's response to the April 10, 2015 data request.

Casino in the city of Coos Bay, while the other lot would be located at the abandoned Myrtlewood RV camp off of U.S. Highway 101 near the community of Hauser. Commuting workers not residing at the NPWHC would park at the lots and be bused to the terminal.

In addition, the DEA studies did not address equipment and material deliveries to the terminal by truck. Jordan Cove originally estimated there would be an average of about 21 material delivery truck trips to and from the terminal per day, with a peak of 40 deliveries per day (approximately 10,500 deliveries if extrapolated to a year, minus weekends). In the filing from June 9, 2015, Jordan Cove revised its estimates of deliveries by truck. Jordan Cove estimated that shipments would number 1,996 in construction year one; 17,840 in year two; reach a peak of 48,990 in year three; and reducing to 35,232 and 12,330 in years four and five, respectively. These estimates include both long-haul truck traffic (arriving from more than 75 miles away) and local truck traffic.

Jordan Cove acknowledged that the intersection of U.S. Highway 101 and the Trans-Pacific Parkway would need to be improved to handle additional construction traffic and equipment deliveries by truck. The Trans-Pacific Parkway would be widened for approximately 900 feet to provide a left-turn lane onto northbound U.S. Highway 101. Riprap would be extended approximately 40 feet north into the bay from the existing riprap toe of slope, but would not increase the length of riprap shoreline in Coos Bay. However, these proposed road improvements were not discussed in the DEA studies.

Because there is new information on estimated construction-related traffic that appears to be substantially higher than 2013 estimates, and it is unclear how this new information may affect previous review by regional authorities, including possible need for improvements on roadways, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file with the Secretary a revised *Traffic Impact Analysis*, for review and approval by the Director of OEP, together with documentation that the revised analysis was developed in consultations with the ODOT, Coos County, and the City of North Bend. The revised analysis should estimate project-related traffic, including cars and buses transporting employees to and from the LNG terminal, truck deliveries to the terminal during construction, and non-work-related weekend traffic from the residents of the NPWHC, and assess the impacts that traffic may have on local road users and visitors to the Coos Bay region. In addition, the revised analysis should incorporate mitigation measures, including, but not limited to, potential improvements to the Trans-Pacific Parkway, U.S. Highway 101, Ferry Road, and Chappell Parkway.**

Within the terminal area, Jordan Cove would construct a new heavy haul road, about 60 feet wide and 5,925 feet long, affecting about 8 acres of land that is either owned by Jordan Cove or leased from Roseburg Forest Products (see figure 2.1-12). The haul road would be constructed using a CAT 5130 Excavation and CAT 776 Truck with a 130-ton trailer. Jordan Cove would use the road to bring heavy materials into the terminal and the South Dunes Power Plant. When crossing the Roseburg Forest Products property, wood chip truck traffic would be given the right-of-way over Jordan Cove's haul truck traffic. In addition, to reduce impacts on the Roseburg Forest Products operations, Jordan Cove would:

- coordinate traffic patterns with Roseburg;
- post appropriate signs;

- use flagmen to control truck traffic; and
- conduct safety meetings.

Material deliveries by trucks to the Jordan Cove LNG terminal would occur throughout the construction phase. Deliveries would be limited to off-peak traffic hours to the extent feasible to reduce impacts on other road users. The number of truck deliveries may be reduced if most heavy equipment is brought to the terminal by marine transit, as discussed above. In addition, it is assumed that the use of an on-site concrete batch plant would reduce the potential number of delivery trips to the terminal.

During construction of the terminal slip, about 2.3 mcy of excavated material would be transported by truck to the location of the South Dunes Power Plant and associated facilities. The excavated material truck haul route would go north of the slip through the LNG terminal tract and then follow the route of the access/utility corridor to the South Dunes Power Plant site (see figure 2.1-12). Jordan Cove estimated that with 14 trucks working over a 10-hour shift, there would be about 140 round trips a day carrying excavated materials back and forth from the slip to the power plant site. The excavated material truck haul route would be on Jordan Cove–owned land, and would not cross the Trans-Pacific Parkway. The only potential conflict would be with Roseburg chip truck traffic, when the Jordan Cove excavated material trucks cross Jordan Cove Road.

Jordan Cove expects to employ 145 workers on site to operate the LNG terminal and associated facilities such as the South Dunes Power Plant. DEA concluded that there would be ample capacity on the existing road system to absorb these operational commuter trips with negligible associated impacts to other road users (DEA 2012).

4.10.1.3 Railroad Traffic

The Coos Bay Rail Link (CBR) is a short-line railroad that runs a total of 134 miles from an interconnection with a Class I railroad in Eugene to Coquille. The CBR crosses Coos Bay approximately 1.6 miles east of the terminal site and has spur lines that parallel the Trans-Pacific Parkway and Jordan Cove Road. The CBR primarily transports forest products, chemicals, steel, and liquefied petroleum gas. The prior owners of the CBR closed down the line in 2007 due to safety concerns. On July 11, 2008, the Port filed an application with the Federal Surface Transportation Board to acquire this railroad line under the feeder line provision of 49 U.S.C. 10907. Upon assumption of ownership of the line in 2010, the Port undertook an extensive repair program that placed portions of the line back in service in stages. The entire 134-mile-long line was declared fully operational in April 2013.

Jordan Cove currently anticipates that the larger and heavier pieces of equipment would arrive by marine transport. The only material planned to come to the project site by rail would be sheet pile, which would be delivered by approximately 25 railcars. Rail shipments may be off-loaded at an existing rail spur at the Roseburg Forest Products yard, which runs into the construction laydown area. Minor improvements may occur at this existing facility. No new rail construction is anticipated for the purpose of transporting materials and equipment to the site. Due to the limited use of the CBR by Jordan Cove, construction and operation of the LNG terminal would have limited impacts on the railroad and its other users.

4.10.1.4 Air Traffic

The Southwest Oregon Regional Airport is located in the City of North Bend, directly across Coos Bay and less than 1 mile from the LNG terminal site. The airport is owned and operated by the Coos County Airport District. The airport includes three asphalt runways, two of which are used for air traffic. Runway 4-22 is the primary instrument runway. Runway 13-31 is the primary general aviation runway. The approaches to both of these runways cross the Coos Bay navigation channel, which borders the airport to the north. The third runway (16-34) is no longer used by air traffic and is currently used by the Coast Guard for helicopter hovering practice and maintenance checks.

The Coast Guard has five helicopters based at the airport. The number of fixed wing aircraft based at the Southwest Oregon Regional Airport has ranged from 51 to 68 for the past 20 years, with 51 aircraft based at the airport in 2010. Commercial passenger service to and from the airport is currently provided by Skywest Airlines on behalf of United Airlines, with two flights daily to and from San Francisco. Beginning in August 2015, Skywest, for United, was also offering seasonal twice-a-week roundtrip flights between Denver and the Southwest Oregon Regional Airport. SeaPort Airlines provides scheduled air service to Portland, with three flights per week (two weekday flights and one Sunday flight). Federal Express and Ameriflight operate cargo services out of the airport.

Historically, Horizon Air was the principal commercial airline serving the airport, with flights to and from Portland and Seattle. Horizon Air discontinued service to the airport in October 2008. Following the withdrawal of Horizon Air, the number of enplanements at the Southwest Oregon Regional Airport dropped from 28,568 in 2008 to 22,585 in 2010 (i.e., a 21 percent decline).

There were a total of 20,761 aircraft operations (defined as a take-off or landing) at the Southwest Oregon Regional Airport in 2010. Commercial air traffic (air cargo, air carrier, and air taxi) accounted for approximately 30 percent of this total, with the remainder consisting of general aviation (36 percent) and military aviation (34 percent). The total number of aircraft operations was projected to increase to 25,984 by 2030. About 10 percent, or 2,161 landings at the airport, of the total operations in 2010 (20,761) were classified as annual instrument approaches (RS&H 2013).

During operation of the Jordan Cove terminal, LNG vessels would cross the approach to the instrumented runway (4-22) while in transit to and from the terminal. The portion of the channel that crosses the approach to runway 4-22 is the Lower Jarvis Range, which is approximately 0.8 nmi in length. The approach to runway 4-22 could potentially be affected by an LNG vessel passing through the first 0.3 nmi of the Lower Jarvis Range. At a speed of 5 knots, it would take an LNG vessel approximately 10 minutes to transit the entire Lower Jarvis Range, and approximately 4 minutes to transit the portion of the Lower Jarvis Range that would be crossed by the approach to runway 4-22.

Jordan Cove indicated that there may be four occurrences per week when an LNG vessel could be passing runway 4-22 while transiting through the Lower Jarvis Reach in the Coos Bay navigation channel. Under a worst-case scenario, aircraft may be delayed between 4 to 10 minutes per passing. However, the transit timing of LNG vessels would be known in advance, so that incoming air traffic could account for the time that it takes the LNG vessel to pass. LNG vessel transit times could also be adjusted to avoid conflict with air traffic, if the need arises.

Comments on the Project raised concerns that disruptions to airline service at the Southwest Oregon Regional Airport would have negative economic impacts on businesses in the North Bend-Coos Bay area, including the Bandon Dunes golf resort, which is located about 25 miles south of the airport. Bandon Dunes does not keep records on the locations from which its golfers reach the resort, so it is unknown how many use the Southwest Oregon Regional Airport. It is suspected that many golfers drive to Bandon Dunes, either from Eugene (137 miles) or Portland (243 miles), Oregon. However, Bandon Dunes may benefit during construction of the Project, if an influx of workers and consultants to North Bend/Coos Bay stimulates additional airline flights into the Southwest Oregon Regional Airport, providing more seats for golfers, as well.[141] For the reasons stated above and below, LNG vessel traffic in the Coos Bay navigation channel would not cause significant delays to commercial airline service into and out of the Southwest Oregon Regional Airport. As further discussed in section 4.9 of this EIS, the Jordan Cove LNG terminal would not have significant adverse economic impacts on businesses in the area. Rather, the Project may result in economic benefits to the region.

The airport has been in operation since 1943 and ships have been calling on the Port without conflict with passing aircraft. In a letter to Jordan Cove, dated July 12, 2006, the Coos Bay Pilots Association stated that tankers carrying petroleum products and other commercial ships have transited the channel adjacent to the airport for many years without incidents or delays to air traffic. In a letter to the FERC dated December 22, 2014, the Southwest Oregon Regional Airport stated that it retained the services of experts to independently assess if the Project would have any adverse impacts on the airport.

Commenters also raised concern that the proposed LNG storage tank heights would violate 14 CFR 77, Objects Affecting Navigable Airspace, and that could represent a hazard to aircraft taking off or landing at the Southwest Oregon Regional Airport. Title 49 CFR §193.2155 of the DOT's regulations requires that an LNG storage tank be at least 1 mile from the end of an airport runway, or 0.3 mile from the nearest point on a runway, whichever is longer. Although some terminal facilities are located less than 1 mile from the airport boundary, the nearest LNG storage tank would be about 1.1 miles from the end of the closest runway (runway 4-22) and 1.1 miles from the closest point of the runway. The LNG storage tanks would be greater than 0.3 mile from the nearest point of the runway, as required by DOT regulations. Therefore, the location of Jordan Cove's storage tanks would be in compliance with the federal safety standards.

Jordan Cove submitted a Request for Hazard Determination and a Notice of Proposed Construction or Alteration to the FAA on October 22, 2008. On November 1, 2008, the FAA issued a limited aeronautical review. The FAA review indicated that the LNG terminal would have no impacts on arrivals, departures, or en-route procedures under Instrument Flight Rules. The LNG terminal would have no impacts on planned use of airport facilities, and no cumulative impacts on the airport were identified. However, the LNG storage tank locations would exceed the Category C and D traffic patterns and Visual Flight Rules at the Southwest Oregon Regional Airport by 13 feet, and would exceed the Visual Flight Rules maneuvering areas for Category A and B aircraft (horizontal surface) by 66 feet. Therefore, the LNG storage tanks qualify as obstructions under Part 77 standards. When a structure exceeds the obstruction standards of Part 77, it does not mean

[141] Currently, Bandon Dunes and the Southwest Oregon Regional Airport have a revenue sharing agreement with Skywest-United to support the flights out of Denver. If the Jordan Cove Project is authorized and built, the company may contribute to the support of that airline service into North Bend. Personal communication with the Bandon Dunes golf resort, 4 August 2015.

that the structure is a hazard to air navigation. Rather, it is an indication that further studies should be conducted to determine any adverse effects on operations in navigable airspace. The FAA clarified that the review was not an official determination of findings.

On June 27, 2013, Jordan Cove submitted to the FAA its *Notice of Proposed Construction or Alteration* (form 7460-1) for its LNG export terminal (copies of which Jordan Cove filed in the FERC docket on April 20, 2015). On July 24, 2014, the FAA issued 31 Determinations of No Hazard and five Notices of Presumed Hazard. The five Notices of Presumed Hazard were for two LNG tanks, two amine towers, and one LNG vessel. The Notices of Presumed Hazard are not final determinations; rather, once they have been issued by the FAA, the FAA and applicant continue to investigate potential options for eliminating or mitigating the presumed hazards.

Jordan Cove indicated that it is working with the FAA and the Southwest Oregon Regional Airport to resolve the five Notices of Presumed Hazard. Meetings were held with the FAA on September 24, 2014, and April 24, 2015. The Southwest Oregon Regional Airport provided the FAA with a study produced by Ricondo & Associates, Inc. that outlined obstacles by runway and discussed mitigation alternatives.[142] In a filing with the FERC on August 3, 2015, Jordan Cove stated that after conducting a global search of LNG vessels of the size that could call at its terminal, it found that the maximum height of a vessel riding in water would be 167 feet above MSL. Jordan Cove would file an amended Form 7460 with the FAA to reflect the new calculated vessel height, which should eliminate one of the presumed hazards. Two main options were identified for mitigating the remaining presumed hazards. One option would be to maintain the existing flight pattern and require additional lighting and markings on the LNG storage tanks and amine columns. Raising the altitude of planes would provide another level of safety. The other option would be to "flip" the flight patterns for Runway 04 from its current alignment as a left-handed pattern to the north of the airport that would fly over the Jordan Cove terminal, to a right-handed pattern south of the airport that would avoid the terminal.

On July 24, 2015, the Southwest Oregon Regional Airport provided the FAA with additional data to support its preferred mitigation strategies. The Southwest Oregon Regional Airport does not support the concept of flipping the flight patterns at Runway 04, as that would place aircraft over a populated area. The Southwest Oregon Regional Airport prefers marking the tanks and towers and concluded that the Jordan Cove LNG terminal would not represent a substantial hazard to aircraft because:

- the existing floor of the airport's traffic pattern is 1,000 feet AMSL and no aircraft flying in the pattern would have to change course or altitude to avoid any of the proposed structures;
- the amine towers are lower than surrounding structures, terrain, and surveyed trees, The LNG storage tanks are taller than the trees, but still lower than the McCullough bridge located within the flight pattern area at 268 feet AMSL; and
- marked obstacles (including both structures and trees) are higher than the airport's elevation and require aircraft operating in the pattern airspace to operate at altitudes more than 500 feet above the amine towers and the LNG tanks and no current VFR operation would have to change course or altitude to avoid the proposed structures.

[142] Ricondo & Associates, Inc., 23 September 2014, *Jordan Cove Energy Project LP Liquid Natural Gas Facility Proposal*, prepared for the Coos County Airport Authority, filed with the FERC on August 3, 2015.

However, since the FAA has not issued the final determination, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file with the Secretary the final determinations from the FAA that indicate there will be no hazard to aircraft using the Southwest Oregon Regional Airport, and copies of all studies related to the Project's potential impact on the airport.**

4.10.2 Pacific Connector Pipeline Facilities

During pipeline construction, about 709 existing roads would be used to access the right-of-way and move construction equipment, materials, and personnel. The Pacific Connector pipeline would extend for about 232 miles through four southwest Oregon counties, and would cross about 630 existing roads, including U.S. highways, state routes, county roads, private roads, and BLM and Forest Service roads. In general, gravel roads would be crossed with open cuts, while paved roads would be bored. All roads that would be used for access by Pacific Connector during construction of its pipeline, and crossing methods for all roads crossed by the pipeline route, are listed on table D-2 in appendix D of this EIS.

Construction of the pipeline would mostly result in short-term effects on roads and their users in the project area. Temporary impacts would include traffic delays due to construction-related vehicles using the road system to transport workers and equipment to the right-of-way, or due to pipeline installation across roads. Some existing roads would be improved as Project access, which may also cause delays for other users. Pacific Connector would reduce impacts on other road users by following the mitigation measures outlined in its TMP, discussed below.

Construction and operation of PARs would represent a permanent impact. However, since the PARs mainly lead to Pacific Connector's aboveground facilities, they would not be used by others.

4.10.2.1 Construction Access Roads

Pacific Connector has identified existing egress and ingress points to and from the construction right-of-way to provide for safe, efficient construction and movement of equipment and materials. In some areas, it would be necessary to grade or widen existing roads (to allow large equipment a turning radius) to access the construction right-of-way (see section 2.3.2). The stringing trucks would haul 40- to 80-foot lengths (joints) of pipe, and the total length of these vehicles would be more than 100 feet, which would require travel outside the existing road footprint, especially on corners and with oncoming traffic. Widening access roads in the identified constricted locations would be necessary to accommodate the potential for the stringing trucks to "walk" outside of the existing road footprint. In some circumstances, it may also be necessary for oncoming traffic to pull off of the existing road footprint to pass.

Minor improvements (i.e., filling potholes, grading to remove ruts, and/or limbing to remove overgrowth) would be needed in some areas to accommodate oversized and heavy construction equipment. In other cases, roadway improvements would require extensive reconstruction to make the roads useable for access to the construction right-of-way. Pacific Connector has estimated that modifications of approximately 73 existing access roads may be required outside of the existing road bed, resulting in about 14 acres of disturbance.

New Temporary Access Roads

Pacific Connector would need to construct 13 new TARs with a total length of approximately 11,665 feet (2.2 miles). Twelve of these temporary roads would be located on non-federal land (table 4.10.2.1-1). Construction of the new TARs would impact approximately 5 acres. After the pipeline is installed, the TARs would be removed, and the land restored to its original condition and use, in accordance with Pacific Connector's ECRP.

TABLE 4.10.2.1-1

Proposed New Temporary and Permanent Construction Access Roads

Access Road (TAR/PAR-MP)	Length (feet) a/	Jurisdiction	County
TAR-27.06	1,427	BLM	Coos
TAR-29.88	3,035	Private	Coos
TAR-81.37	388	Private	Douglas
TAR-88.63	985	Private	Douglas
TAR-88.67	275	Private	Douglas
TAR-94.81	114	Private	Douglas
TAR-128.69	650	Private	Jackson
TAR-141.10	471	Private	Jackson
TAR-204.32	922	Private	Klamath
TAR-208.72	287	Private	Klamath
TAR-212.50	2,124	Private	Klamath
TAR-215.72	728	Private	Klamath
TAR-225.46	259	Private	Klamath
Total TAR	**11,665**		
PAR-15.54	150	Private	Coos
PAR-29.48	85	Private	Coos
PAR-48.41	70	BLM	Douglas
PAR-59.58	86	Private	Douglas
PAR-71.46	1,226	Private	Douglas
PAR-80.03	92	BLM	Douglas
PAR-94.66	183	Private	Douglas
PAR-113.66	50	Private	Jackson
PAR-122.18	171	Private	Jackson
PAR-132.46	310	Private	Jackson
PAR-150.70	260	BLM	Jackson
PAR-169.48	342	Private	Klamath
PAR-187.46	107	Private	Klamath
PAR-196.53	107	Private	Klamath
PAR-214.28	106	Private	Klamath
Total PAR	**3,345**		

TAR = Temporary Access Road; PAR = Permanent Access Road; MP = milepost
a/ All or portions of the PARs are located within the permanent pipeline easement. Total disturbance from TAR = 5 acres, total disturbance from PAR = less than 2 acres.

New Permanent Access Roads

Pacific Connector would need to construct 15 new PARs with a total length of approximately 3,345 feet (0.6 mile; see table 4.10.2.1-1). Twelve of these permanent roads would be located on non-federal land. These new roads would provide access during construction as well as for operations and maintenance activities while the Pacific Connector pipeline is in service. Most of the new PARs would be located within Pacific Connector's permanent pipeline easement. Construction of these roads would permanently impact approximately 2 acres.

4.10.2.2 Additional Traffic on Local Roads

Equipment and materials would be transported from various laydown areas and storage yards within the vicinity of the pipeline. Most construction equipment would remain on the right-of-way during construction. Pacific Connector estimates that between three and four pipe stringing

trucks would make approximately two roundtrips per day between the pipe storage yards and pipeline work sites for the duration of project construction. Three water trucks and three dump trucks would make up to six roundtrips per day to deliver materials and equipment to the right-of-way and control fugitive dust. Another five fuel/lube/maintenance trucks and five equipment trucks would make approximately one roundtrip per day between the storage yards and work sites.

Construction personnel would drive to the active construction locations along the pipeline from the various residential centers in the area. The average workforce for each construction spread would be 280 workers per month, with a peak of 369 workers mid-season. Approximately 50 percent of the labor force would be expected to already reside within commuting distance of the project, with the remaining 50 percent expected to temporarily relocate to the area. The majority of the construction workforce would travel each morning from their permanent or temporary home to the construction yard established for the spread they are working on, and then make the return trip in the evening. Because pipeline construction typically is scheduled to take advantage of daylight hours and involves at least 10-hour work days, both journeys would take place during non-peak traffic hours.

Pacific Connector estimates that 80 percent of the workforce for each spread (peak of 295 workers per spread) would be transported from the contractor yard to and from the right-of-way on crew buses. The remaining 20 percent of the workforce (approximately 74 workers per spread) would drive their own vehicles to the work site along the pipeline construction right-of-way using local roads and highways. The 20 percent of the workforce using their own vehicles would make two to three daily trips from the contractor yards to various construction locations. Based on these assumptions, Pacific Connector estimates that between 79 and 86 worker vehicles (including crew buses) would travel on access roads during peak construction periods.

Regional motor vehicle traffic could be affected by the addition of pipeline construction-related traffic on local roads. This additional traffic would mainly consist of equipment and materials being transported to and between construction sites and construction workers commuting to and from work, as well as hauling out timber for right-of-way clearing in forested areas. For example, along Old Ferry Road near the Rogue River HDD crossing, Pacific Connector has estimated that 72 MBF of timber would be hauled out, approximately 11,300 feet of pipe would be delivered, and there would be a peak construction traffic volume of 1,748 one-way vehicle trips over a four- to six-month period.[143] Additional traffic on local roads would vary widely depending on site-specific needs.

Pacific Connector proposes to reduce impacts on local traffic by following the measures outlined in its *Transportation Management Plan for Non-Federal Lands* (non-federal TMP),[144] as discussed below. For over-dimensional loads (e.g., pipe delivery trucks) on state highways, Pacific Connector would be required to follow the ODOT permitting process, which includes routing, time-of-day, and pilot vehicle requirements.

Construction of the Klamath Falls Compressor Station is expected to employ a maximum of 50 people on site, including Pacific Connector's inspectors. Construction traffic to and from the compressor station location would peak in the early morning and in the early evening, and the

[143] Pacific Connector filed additional information about the proposed use of Old Ferry Road on April 27, 2015.
[144] Pacific Connector filed its *Transportation Plan for Non-Federal Lands* with its application to the FERC on June 5, 2013, as Appendix 8H to environmental Resource Report 8.

beginning and conclusion of the 10-hour daily work shift. Welders and operators would drive their personal vehicles to the compressor station site. Other craft workers would ride a bus from a common muster point the site.

4.10.2.3 Roads Crossed by the Pipeline

Major state and federal highways that would be crossed by the pipeline include:

- U.S. Highway 101 (MP 2.6) and State Highway 42 (MP 51.5) in Coos County;
- I-5 (MP 71.2) and State Highway 227 (MP 94.7) in Douglas County;
- State Highway 62 (MP 122.6), Butte Falls Highway (132.5), and State Highway 140 (MP 145.6) in Jackson County; and
- State Highway 66 (MP 191.3), U.S. Highway 97 (MP 199.6), and State Highway 39 (MP 208.8) in Klamath County.

The pipeline would be installed in Coos Bay under Highway 101 between the Glasgow peninsula and Shorewood. State Highway 42, State Highway 140, and State Highway 39 would be crossed with bores. Pacific Connector proposes to use DP technology to cross under I-5. State Highway 62 and Highway 97 would be crossed with HDDs. Highway 227, the Butte Falls Highway, and Highway 66 would be crossed with open cuts. Pacific Connector has developed a non-federal TMP. This plan outlines measures Pacific Connector would implement to maintain public access on non-federal roads used as construction access, or crossed by the construction right-of-way during pipeline construction. Measures to be implemented by Pacific Connector to reduce transportation impacts include the following:

- Pacific Connector would negotiate temporary and permanent road use agreements or easements to use private roads during construction and operation, where necessary.
- Pacific Connector would obtain all necessary permits from ODOT or the counties to cross and/or use non-federal roads, and its contractors would be held responsible for carrying out all stipulations of the permits.
- The appropriate landowner would be notified 7 days in advance of planned road work. In cases where there are unforeseen changes to the schedule, a minimum 48-hour notice would be provided.
- Construction activities would be limited to daylight hours.
- Traffic control measures, such as flaggers, signs, lights, and barriers, would be used during construction to ensure public safety, allow efficient traffic movement through or around work areas, and provide safe working conditions for construction workers.
- In cases where roads would be open cut, Pacific Connector would try to maintain at least one lane of traffic with detours around the construction by plating over the open portion of the trench or by other suitable methods. In some instances, however, it may be necessary to close the road for approximately 24 hours. Where road closures occur, signs would be posted in advance, and access would be provided for local residents and emergency vehicles.
- Roads would be kept free of mud and other debris that may be deposited by construction equipment. Truck-driven equipment would cross roads on tires or construction pads to minimize road damage. Pacific Connector would repair any roadways damaged by construction activities.

- Dust from construction equipment traffic would be reduced by Pacific Connector following its *Air, Noise and Fugitive Dust Control Plan*.[145]
- When traveling to the right-of-way, construction equipment would comply with state and local road and bridge weight limits.
- Construction equipment would mostly stay on the right-of-way and move in a linear fashion.
- The majority of construction workers would park their personal vehicles at contractor yards and be bused to the right-of-way to reduce commuter traffic on local roads.

Pacific Connector has not documented consultations with ODOT and the counties crossed by the pipeline route regarding construction related traffic on non-federal roads. Therefore, **we recommend that:**

- **Prior to construction, Pacific Connector should file with the Secretary a revised *Transportation Management Plan for Non-Federal Lands* for review and approval by the Director of OEP together with documentation that it consulted with ODOT and the counties crossed by the pipeline route regarding project-related impacts on non-federal roads.**

4.10.2.4 Operations

Operation of the Pacific Connector pipeline and Klamath Falls Compressor Station would require an estimated permanent staff of five employees stationed at different locations, but reporting to an operational headquarters in Eugene, Oregon. These employees would commute to various locations along the pipeline and to the Pacific Connector aboveground facilities on varying schedules. The addition of these five new employees commuting to various job sites would not have significant adverse effects on local traffic or roads.

4.10.2.5 Off-Highway Vehicles

Commenters raised concerns that the pipeline right-of-way could be used to increase unauthorized OHV, snowmobile, and dispersed motorized access to adjacent lands. Pacific Connector's *Recreation Management Plan* describes measures to be employed on both public and private lands to control unauthorized OHV use. Pacific Connector would prefer to limit OHV use of its pipeline right-of-way by installing barriers, made of natural or constructed materials, particularly at road crossings. OHV control measures could include:

- dirt or rock berms, sometimes coupled with erosion control devices;
- strategically placed non-merchantable logs, slash, or tree stumps;
- large rocks or boulders partly buried along the right-of-way;
- signs;
- fencing and locked gates; and
- vegetative screening to disguise the existence of the right-of-way.

[145] Pacific Connector filed its *Air, Noise, and Fugitive Dust Control Plan* as a stand-alone report with its June application to the FERC, as Appendix B of its POD. Fugitive dust control is discussed in more detail in the air quality section (4.12) of this EIS.

Pacific Connector would coordinate with landowners during construction and restoration to finalize site-specific OHV control measures. In addition, following construction, the effectiveness of the site-specific measures would be assessed on a periodic basis. Pacific Connector would be responsible for monitoring and managing unauthorized OHV use during the full life of the pipeline project and would implement additional measures as necessary.

4.10.2.6 Roads on Federal Lands

Roads Crossed

The pipeline route would cross approximately 91 roads on BLM lands. Some roads would be crossed at more than one location. The pipeline would be placed within the right-of-way of 45 roads. Open cuts would be used to cross all of the roads on BLM lands, with one exception, which would be crossed by a bore. The road that would be crossed by a bore is an unnamed dirt road on the BLM Medford District at MP 133.4.

The Pacific Connector pipeline would cross approximately 60 roads on NFS lands. Some roads would be crossed at more than one location. Open cuts would be used to cross all of the roads on NFS lands.

Roads Used for Access

Pipeline construction would require the use of many miles of existing roads on federal lands, or existing private roads on which federal land-managing agencies hold an easement. The miles of existing access roads that would be used for pipeline construction on each district on federal lands are listed in table 4.10.2.6-1. These totals include approximately 138 existing roads under BLM jurisdiction, 58 roads under Forest Service jurisdiction, and 11 roads under Reclamation jurisdiction.

TABLE 4.10.2.6-1

Total Miles of Existing Roads Proposed for Use Within Federal Lands (a/)

Agency and District	Access Roads Used for Construction (Miles)
BLM	
Coos Bay District	117.5
Eugene District	0.8
Medford District	53.0
Roseburg District	59.9
Klamath Falls Resource Area	4.6
Forest Service	
Umpqua National Forest	58.9
Rogue River National Forest	46.1
Winema National Forest	1.8
Reclamation	
Klamath Basin Area Office	2.7

a/ Includes private roads for which the federal agency has an easement. Complete lists of roads and length per road are included in Attachments C and D of Pacific Connector's Draft *Transportation Management Plan* included as Appendix Y to Pacific Connector's POD.

The identified BLM, Forest Service, and Reclamation roads are of varying conditions, and some roads would require improvements to surfacing, brushing, drainage maintenance, and other work to accommodate oversized and heavy construction equipment. In most cases, the potentially affected roads are single-lane forest roads designed and built primarily for the removal of timber using conventional log trucks. Pacific Connector's pipe-stringing trucks would be hauling 40- to 80-foot-long sections of pipe to the right-of-way. These vehicles would be approximately 100 feet

long. Because of the size of these and other vehicles that would use these access roads, some minor improvements (straightening, widening, cut and fill, and/or culvert improvements) may be required. In some circumstances, it may also be necessary to construct turnouts for oncoming traffic to "pull out" of the existing road footprint for passing purposes. All road maintenance, reconstruction, and improvements undertaken by Pacific Connector and their contractors would conform to BLM and Forest Service requirements. No maintenance or improvements would be allowed on any road not authorized for use and approved for improvements.

Pacific Connector would need to construct one new TAR on BLM land. This road would be approximately 0.3 mile long and would disturb less than approximately 1 acre of land. This road would provide access during construction and would be restored to preconstruction conditions following completion of construction. This would be a short-term impact.

No new TARs would be built on NFS lands. Two existing T roads (MPs 157.38 and 166.10) on the Rogue River National Forest, however, would be reconstructed as temporary roads.

Pacific Connector would need to construct three new PARs on BLM land, totaling about 422 feet (see table 4.10.2.1-1). Construction of these new roads would permanently impact approximately one-quarter of an acre. These roads would provide access during construction and for operations and maintenance activities while the Project is in service. No new PARs would be built on NFS land.

Construction activities at proposed federal road crossings would also affect public access, as well as use by permittees, contractors, and cost share users. Pacific Connector, in consultation with the BLM, Forest Service, and Reclamation, developed a TMP for federal lands to support the right-of-way grant required to cross federal lands. Pacific Connector's federal TMP provided a list of existing rights-of-way on roads under federal jurisdiction that are expected to be used during clearing and/or construction activities. It also identified all roads on federal lands that would be used during project-related timber extraction activities, and pipeline construction and operations, and specified the standards that would be utilized where improvements on federal roads are necessary. This federal TMP was filed as a stand-alone document with Pacific Connector's June 2013 application to the FERC (Appendix Y to the POD).

To reduce impacts on other road users on federal lands, including commercial trucks related to the timber industry and recreational visitors, Pacific Connector committed to implementing the following measures outlined in its federal TMP:

- Pacific Connector would perform a road-surfacing structural assessment for federal roads a year prior to use, for review by the appropriate land-managing agency.
- Pacific Connector would notify federal land-managing agencies and any third-party road owners of plans to use or improve federal roads 7 days in advance. Any proposed improvements or modifications to roads to accommodate equipment access will be submitted for review, per the federal TMP, to the applicable agency. No improvements will be made until signed approval from the agency is received. In the case of unforeseen changes in the construction schedule, a minimum of 48 hours advance notice would be provided.
- Pacific Connector would provide federal land-managing agencies with projected construction-related trunk counts per each federal road that would be used for access.

- New temporary or permanent access roads and improvements on existing roads on federal lands would be built or improved in accordance with agency specifications.
- All access roads on federal lands used during construction would be maintained in accordance with agency specifications.
- Dust abatement for access roads would be done in accordance with Pacific Connector's *Air, Noise, and Fugitive Dust Control Plan*.
- Paved roads would be kept free of mud. Tracked equipment would cross roads on tires or gravel pads.
- Any damage to roads as a result of construction, including access for construction, would be repaired, and the road would be restored to the pre-construction condition or better.
- Appropriate erosion and sediment control BMPs would be utilized along access roads to minimize resource damage.
- Construction activities would occur during daylight hours.
- The majority of construction workers would park their personal vehicles at a yard, and be transported to the right-of-way on buses.
- Traffic control would include signs, flaggers, barricades, guard rails, safety fence, signals, and other measures deemed appropriated by land managing agencies.
- Posted speed limits and permitted road and bridge weight and size limits for equipment would be observed.
- Once reaching the right-of-way, construction equipment would remain on-site, and move along the right-of-way in a linear fashion.

OHV Use on Federal Lands

Federal land managers have raised concerns that the pipeline right-of-way could be used to increase unauthorized OHV, snowmobile, and dispersed motorized access to federal lands. Locations where unauthorized access could be exacerbated by the pipeline right-of-way include the area around the PCT near MPs 167.0-169.0; the Camel Hump area between MPs 123 and 128; the Obenchain area between MPs 132 and 137.2; along the Clover Creek Road between MPs 168.9 and 175.4 (on NFS land); and MPs 176.2 to 177 and 179.6 to 179.7 (on BLM lands). In the Obenchain area, four-wheel-drive vehicles have caused extensive resource damage. The Camel Hump and Obenchain areas are located within the Jackson Access and Cooperative Travel Management Area, which encompasses both private and BLM lands, and is generally closed to motorized use from mid-October through April. In the area along the Clover Creek Road, the pipeline would closely parallel the road for 18 miles (on public and private lands); thus, the pipeline right-of-way could potentially turn into an OHV thoroughfare without appropriate barriers and mitigation.

OHV controls were addressed in Pacific Connector's *Recreational Management Plan*. The general measures Pacific Connector would use to limit OHV access to its right-of-way on federal lands would be the same as those discussed for non-federal lands above.

4.11 CULTURAL RESOURCES

Section 106 of the NHPA requires the FERC to take into account the effect of its undertakings (including authorizations under Sections 3 and 7 of the NGA) on historic properties and afford the ACHP an opportunity to comment. Jordan Cove and Pacific Connector, as non-federal applicants, are assisting the FERC in meeting its obligations under Section 106, by providing data, analyses, and recommendations in accordance with the ACHP's implementing regulations at 36 CFR 800.2(a)(3) and the FERC's regulations at 18 CFR 380.12(f). The FERC remains responsible for all findings and determinations under the NHPA.

As the lead federal agency for the JCE & PCGP Project, the FERC will address compliance with Section 106 on behalf of all the federal cooperating agencies in this EIS.[146] However, the federal land managing agencies still have obligations regarding cultural resources under other federal laws and regulations, including the FLPMA, Antiquities Act of 1906, Section 110 of the NHPA, Archaeological and Historic Preservation Act of 1974, Archaeological Resources Protection Act of 1979, and the Native American Graves Protection and Repatriation Act.

4.11.1 Consultations

In accordance with the ACHP's implementing regulations for complying with Section 106, the FERC, on behalf of all of the federal cooperating agencies, consulted with the Oregon SHPO,[147] interested Indian tribes, and other consulting parties prior to making determinations of NRHP eligibility and Project effects. We also consulted with the SHPO, interested Indian tribes, and other consulting parties to determine the resolution of adverse effects on historic properties that cannot be avoided. Those consultations are summarized below.

We sent copies of our NOI for this Project to a wide range of stakeholders, including the ACHP; NPS; U.S. Department of the Interior Bureau of Indian Affairs; the SHPO; other federal, state, and local government agencies; affected landowners; environmental organizations; and Indian tribes that may have an interest in the project area. The NOI contained a paragraph about Section 106 of the NHPA, which stated that we use the notice to initiate consultations with SHPO as well as to solicit their views and those of other government agencies, interested Indian tribes, and the public on the Project's potential effects on historic properties.

4.11.1.1 Consultations with the SHPO

Consultations between the FERC staff and the SHPO about the Jordan Cove LNG terminal and Pacific Connector pipeline, including meetings and correspondence, date back to 2006. Consultations between 2006 and 2009 were summarized in section 4.10.1.1 of the EIS we produced in May 2009 for the Jordan Cove LNG import terminal proposal and original Pacific Connector sendout pipeline in Docket Nos. CP07-441-000 and CP444-000. Consultations with the SHPO after May 2009 are discussed below.

[146] Pursuant to 36 CFR 800.2(a)(2), the EPAct, and the May 2002 Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews.

[147] In all cases, the SHPO refers to the staff of the Oregon State Historic Preservation Office within the Oregon State Parks and Recreation Department, including the State Archaeologist.

On September 25, 2009, the SHPO wrote a letter to the FERC commenting on Pacific Connector's final survey report (Bowden et al. 2009), which was submitted by Historical Research Associates, Inc. (HRA) in July 2009 and attached a table providing the SHPO's opinions on eligibility and effect for all the sites recorded in that report. In a letter to the FERC dated December 13, 2010, the SHPO stated that it accepted Pacific Connector's testing report (Bowden et al. 2010), and concurred with the recommendations in the draft *Historic Properties Management Plan* (HPMP). In review of HRA's second addendum survey report (Knutson et al. 2010), the SHPO commented, in an April 18, 2011 letter to the FERC, that additional information would be necessary for sites 35CS264-272, 35JA680, 35JA751, and 35JA790,[148] and these sites should be considered unevaluated.

In an email to FERC staff dated October 1, 2010, the SHPO accepted the Treatment Plans produced in August 2010 (HRA 2010) for 18 historic properties identified at that time as along the Pacific Connector pipeline route that cannot be avoided. On June 3, 2011, the SHPO signed our MOA for resolving adverse effects at the 18 historic properties.

The SHPO sent a letter to the FERC dated August 5, 2013, reviewing the Pacific Connector 2013 Cultural Resources Addendum Report (Bowden et al. 2013), that was included as Appendix 4D in Resource Report 4 with Pacific Connector's June 2013 application to the FERC. In a letter to the FERC dated August 8, 2013, the SHPO commented on the Unanticipated Discovery Plans included with the applications to the FERC for the new LNG export project and associated pipeline.[149]

The SHPO has not filed letters addressed directly to the FERC commenting on any of the recent Jordan Cove cultural resources reports. However, the SHPO has communicated with both applicants regarding reviews of past cultural resources reports, as summarized below. The applicants received state archaeological permits through the SHPO prior to conducting cultural resources field work, and submitted draft and final reports to the SHPO for review and comments regarding their recommendations of NRHP eligibility and Project effects. Communications between the applicants and the SHPO from 2006 to 2009 were summarized in section 4.10.11 of the May 2009 FEIS produced by the FERC in Docket Nos. CP07-441-000 and CP07-444-000. Communications between Jordan Cove and Pacific Connector and the Oregon SHPO after May 2009 are discussed below.

Jordan Cove's Communications with the SHPO

The SHPO has been communicating with Jordan Cove about cultural resources investigations at the LNG terminal location since 2006. Jordan Cove attached copies of some of those communications in Appendix C.4 of Resource Report 4 of its May 2013 application to the FERC

[148] Sites 35JA751 and 35JA790 are outside of the area of potential effect (APE), and therefore no further work is recommended at these resources as they would be avoided by the Project.

[149] Jordan Cove included its Unanticipated Discovery Plan as Appendix B.4 of Resource Report 4 with its application to the FERC filed on May 21, 2013 in Docket No. CP13-483-000; and revised that plan in a filing on August 29, 2013 (Attachment 4.3-2). Pacific Connector's application to the FERC filed June 6, 2013, in Docket No. CP13-492-000 included an Unanticipated Discovery Plan as Appendix 4H in Resource Report 4. Copies of the August 5 and 8, 2013, letters from the SHPO to the FERC were placed into the public record for these proceedings on August 21, 2013.

in Docket No. CP13-483-000. Communications between Jordan Cove, its contractors, and the SHPO since 2009 are listed in table 4.11.1.1-1.

TABLE 4.11.1.1-1

Jordan Cove's Communications to and from the SHPO Since 2009

Date/Author (Representing)	Purpose	SHPO's Response
February 22, 2011 R.S Byram (Jordan Cove)	Conveyed cultural resources report of survey of Kentuck Slough wetland mitigation area to the SHPO	See SHPO letter of April 13, 2011.
April 13, 2013 T, Churchill (SHPO)	Review of Kentuck Slough survey report	Agreed that the Project would have no effect on any known cultural resources. However, site 35CS263 should be monitored.
October 10, 2012 R.S Byram (Jordan Cove)	Conveyed cultural resources report of survey of utility corridor to the SHPO	See SHPO letter of October 30, 2012.
October 30, 2012 D. Griffin (SHPO)	Review of utility corridor survey report	Agreed the Project would have no effect on any known cultural resources. However, subsurface probes should be excavated around site 35CS227, and Area 4 should be monitored during construction.

Pacific Connector's Communications with the SHPO

The SHPO has also been communicating with Pacific Connector about cultural resources investigations along the pipeline route between Malin and Coos Bay since 2006. Pacific Connector attached copies of some of those communications since 2009 in Appendices 4A and 4D of Resource Report 4 of its June 2013 application to the FERC in Docket No. CP13-492-000 (listed in table 4.11.1.1-2).

TABLE 4.11.1.1-2

Pacific Connector's Communications to and from the SHPO Since 2009

Date/Author (Representing)	Purpose	SHPO's Response
June 8, 2009 G. Curtis (SHPO)	Review of cultural resources survey report addendum	Site 35JA758 is not eligible, and site 35DO313 is eligible for the NRHP
No date G. Curtis (SHPO)	Review of four site forms	Sites 35KL3043, 35KL3055, and 35KL3056 are not eligible, and site 35DO1119 requires additional testing
June 22, 2009 G. Curtis (SHPO)	Site review	35DO1136 is not eligible for the NRHP
June 22, 2009 G. Curtis (SHPO)	Review of site forms	Sites 35DO1094 and 35JA759 are not eligible, and sites 35JA760 and 35KL3048 remain unevaluated
September 8, 2009 I, Johnson (SHPO)	Site review	Glendate Rail Yard (AAR-216) is not eligible for the NRHP
October 1, 2010 S. White (SHPO)	Review final treatment plans	Approve final treatment plans

4.11.1.2 Consultations with Indian Tribes

The unique and distinctive political relationship between the United States and Indian tribes is defined by treaties, statutes, executive orders, judicial decisions, and agreements, which differentiates tribes from other entities that deal with, or are affected by, the federal government. This relationship has given rise to a special federal trust responsibility, involving the legal responsibilities and obligations of the United States government toward Indian tribes and the application of fiduciary standards of due care with respect to Indian lands, tribal trust resources, and the exercise of tribal rights. Indian tribes are defined in 36 CFR 800.16(m), as "an Indian tribe, band, nation, or other organized group or community, including a Native village, Regional

Corporation, or Village Corporation, as those terms are defined in Section 3 of the Alaska Native Claims Settlement Act (43 U.S.C. 1602), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their special status as Indians."

The EPA, in response to our NOI, referenced EO 13175, *Consultation and Coordination with Indian Tribal Governments* (November 6, 2000). EO 13175 does not apply to the FERC because it specifically excludes independent regulatory agencies. However, the FERC acknowledges that it has trust responsibilities to Indian tribes, and so, on July 23, 2003, it issued a "Policy Statement on Consultations with Indian Tribes in Commission Proceedings" in Order 635. That policy statement included the following key objectives:

- The Commission will endeavor to work with Indian tribes on a government-to-government basis, and will seek to address the effects of proposed projects on tribal rights and resources though consultations; and
- The Commission will ensure that tribal resources and interests are considered whenever the Commission's actions or decisions have the potential to adversely affect Indian tribes or Indian trust resources.

The FERC contacted Indian tribes that may attach religious or cultural significance to sites in the region, or may be interested in potential Project impacts on cultural resources. We identified Indian tribes that historically used or occupied the project area through basic ethnohistorical sources, such as the *Handbook of North American Indians* (Suttles 1990), communications with the SHPO and the Oregon Legislative Commission on Indian Services, and information provided by the applicants (Byram 2006a; Bowden et al. 2009).

At the time of initial on-the-ground contact with Euro-Americans (c. 1820s), the Coos Bay area was occupied by the Hanis and Miluk bands of the Coos tribes; the lower Coquille River valley was occupied by the Coquille tribe; the lower Umpqua River valley was occupied by Lower Umpqua tribe; the upper Umpqua River valley was occupied by the Upper Umpqua tribe, including the Cow Creek band, Chasta-Costa, and Galice-Applegate tribes; the upper Rogue River valley was occupied by the Takelma and Shasta tribes; and the Klamath Basin was occupied by the Klamath, Modoc, and Northern Paiute tribes. The United States Congress failed to ratify treaties with the Coos, Coquille, and Lower Umpqua tribes.[150] Nevertheless, as a consequence of the Rogue River War of 1855-56, elements of the Lower Umpqua, Coos, and Coquille tribes were forced by the American military to relocate onto what is now the Siletz Reservation, while elements of the Upper Umpqua, Takelma, and Shasta tribes were removed to what is now the Grand Ronde Reservation.[151] Some members of the Coos, Coquille, and

[150] In 1851, Indian Agent Anson Dart negotiated 19 treaties with tribes in Oregon Territory that were never ratified by Congress. Dart's successor, Joel Palmer, negotiated a treaty in 1855 with Oregon Coast tribes, including the Lower Umpqua, Coos, Lower Coquelle, and Lower Rogue River valley bands, that again was not ratified. The U.S. Congress did ratify separate treaties with bands of the Takelma, Applegate, and Shasta Indian tribes who occupied the Upper Rogue River valley (signed on September 10, 1853); the Cow Creek band of Upper Umpqua Indians (signed September 19, 1853); bands of the Shasta, Scotons, and Grave Creek Umpqua Indians (signed November 18, 1854); bands of the Upper Umpqua Indians and Kalapuyans residing within the Upper Umpqua River valley (signed November 29, 1854); and with the Klamath, Modoc, and Yhooskin band of Northern Paiute Indians (signed October 14, 1864).

[151] The so-called "Coast Reservation" was created by Executive Order in 1855, from Cape Lookout to the mouth of the Siltcoos River. It was reduced in 1865, and the area on the coast removed in 1875, with tribes residing within the

Umpqua tribes escaped removal, or left the reservations, and hid in the backcountry or areas of refugia, with many Indian women marrying male Euro-American settlers of southern Oregon. In the late twentieth century, these Indian bands became federally recognized as the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians, Coquille Tribe of Indians, and the Cow Creek Band of Umpqua Tribe of Indians; separate from other members of the same tribes who became integrated into the federally recognized Confederated Tribes of Siletz Indians and the Confederated Tribes of the Grand Ronde Community. Most of the Klamath and Modoc tribes, and the Yahuskin band of the Northern Paiute tribe, were settled on what is now the Klamath Reservation. However, followers of Captain Jack who participated in the Modoc War of 1872-73 were sent to a reservation in Oklahoma. Other Northern Paiute bands were settled at the Warm Springs, Burns Paiute, and Fort Bidwell Reservations.[152]

Consultations between FERC staff and Indian tribes from 2006 to 2009 were summarized in section 4.10.1.2 of our May 2009 FEIS for the Jordan Cove LNG import proposal and original Pacific Connector pipeline in Docket Nos. CP07-441-000 and CP07-444-000. Below we discuss government-to-government consultations since 2009.

On August 24, 2011, Robert Garcia, Chair of Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians (Coos Tribes) signed our MOA for the LNG import project as a concurring party. Edward Metcalf, Chair of the Coquille Tribe of Indians also signed the MOA as a concurring party on June 15, 2011.

Copies of our August 2, 2012 NOI for the current Project were mailed to leaders and resource officials for the Indian tribes and Native American organizations listed in table 4.11.1.2-1. We received letters filed by two Indian tribes in response to our NOI. In a letter to the FERC dated October 12, 2012, Dan Courtney, Chairman of the Cow Creek Band of Umpqua Tribe of Indians (Cow Creek Tribe), stated that the Pacific Connector pipeline route would cross traditional and sacred hunting areas, gathering areas, and vision quest sites. In a letter to the FERC dated October 30, 2012, Perry Chocktoot of the Klamath Tribes stated that the Pacific Connector pipeline route had the potential to impact sacred cultural sites or burials. Mr. Chocktoot requested that Pacific Connector work with the Klamath Tribes to avoid impacts on cultural sites, and ensure that discoveries would be handled in a respectful manner.

During our environmental Pre-filing process, representatives of several Indian tribes spoke at public meetings. At the meeting in Klamath Falls on August 29, 2012, Perry Chocktoot, representing the Klamath Tribes, expressed concerns for the protection of cultural remains. The Klamath Tribes requested an opportunity to comment on the Inadvertent Discovery Plan, and to work on a monitoring contract with Pacific Connector. At the North Bend meeting on October 9, 2012, David Petrie identified himself as a member of the Coos Tribes, and indicated concerns

Alesa subagency ordered to remove to what is now the smaller Siletz Reservation. The Grand Ronde Reservation was officially established by Executive Order in 1857, and that year the majority of the Upper Rogue River valley (Takelma) bands and the Shasta people voluntarily relocated to Siletz. In 1884, the ethnographer J. Owen Dorsey noted more than 20 tribes on the Siletz Reservation, including the Athapascan-speaking Applegate Creek, Galice Creek, Chasta Costa, Upper Coquille, and Upper Umpqua bands, and the Takelma-speaking Upper Rogue River Indians. The ethnographer John Swanton stated that in 1902 there were 84 Upper Umpqua Indians on the Grand Ronde Reservation (Swanton 1953).

[152] See Stewart, O. 1939. The Northern Paiute Bands. *University of California Press Anthropological Records* 2:3.

TABLE 4.11.1.2-1

Indian Tribes and Native American Organizations Contacted by the FERC for Dockets No. CP13-483-000 and CP13-492-000

Indian Tribes or Native American Organizations	Sent 8/2/12 NOI	Sent 12/19/12 Letter	Sent 11/7/14 DEIS	Tribal Responses
Affiliated Tribes of Northwest Indians, c/o Terri Parr, Executive Director	X		X	None filed to date
Burns Paiute Tribe, c/o Charisse Soucie, Chair and Theresa Peck, Cultural Resources	X		X	None filed to date
Chinook Nation, c/o Ray Gardner, Chair	X		X	None filed to date
Clatsop-Nehalem Confederated Tribes, c/o Diane Collier, Chair	X		X	None filed to date
Columbia River Inter-Tribal Fish Commission c/o Paul Lumley, Executive Director	X		X	None filed to date
Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians, c/o Bob Garcia, Chair; Alex Barry, Administrator; Jesse Beers, Culture; Howard Crombie, Natural Resources; Agnes Castronevo, Archaeologist; and Jeffery Stump, Planner	X	X	X	Signed MOA as concurring party on August 24, 2011. Letters to FERC dated June 20, 2013, February 13, 2015, and July 9, 2015.
Confederated Tribes of the Grand Ronde Community, c/o Cheryle Kennedy, Chair; Reynold Leno, Chair; Eirik Thorsgard, Cultural Resources; and Khani Schultz, Cultural Resources;	X	X	X	None filed to date
Confederated Tribes of Siletz Indians, c/o Delores Pigsley, Chair; Mike Kennedy, Natural Resources; Robert Kentta, Cultural Resources	X	X	X	None filed to date
Coquille Tribe of Indians, c/o Ed Metcalf, Chair; George Smith, Executive Director; Melissa Cribbins, Attornery, and Nicole Norris Archaeologist	X	X	X	Signed MOA as concurring party on June 15, 2011.
Cow Creek Band of Umpqua Tribe, c/o Dan Courtney, Chair; Wayne Shammel, Attorney; Amy Amoroso, Natural Resources, and Jessie Plueard, Archaeologist	X	X	X	Letters to FERC dated October 12, 2012, August 9, 2013, and January 28, 2015.
Klamath Tribes, c/o Gary Frost, Chair; Don Genry, Vice-Chair; Todd Volkenand; and Perry Chocktoot, Cultural Resources	X	X	X	Letter to FERC dated October 30, 2012.
Modoc Tribe of Oklahoma, c/o Bill Follis, Chief	X		X	None filed to date
Pit River Tribe, c/o Chair; Tribal Council; and Environmental Coordinator	X		X	None filed to date
Shasta Indian Nation, c/o Janice Crowe, Chair	X		X	None filed to date
Smith River Rancheria, c/o Kara Miller, Chair			X	None filed to date

over potential Project impacts on water resources and fisheries, especially at the Jordan Cove terminal. He mentioned that the Coos Tribes were provided with a "boiler-plate" MOU by Jordan Cove that did not specifically address tribal cultural resources. Dan Courtney, Chairman of the Cow Creek Tribe, at the Canyonville meeting on October 10, 2012, stated that spiritual and religious sites may be impacted by the route of the Pacific Connector pipeline. At the October 11, 2012, meeting in Malin, Lillian Watah of the Klamath Tribes requested cooperation in protecting cultural sites, including mitigation and an agreement for monitoring.

On December 19, 2012, we wrote individual letters to the leaders of six Indian tribes that may have an interest in the Project (see table 4.11.1.2-1). In response to those letters, the Cow Creek Tribe requested a meeting with FERC staff. That meeting was held at the tribal headquarters in Roseburg on March 12, 2013.[153] In a letter to the FERC dated August 9, 2013, Dan Courtney, Chairman of the Cow Creek Tribe, further articulated concerns about potential impacts from the Pacific Connector pipeline on tribal resources, including fisheries, wildlife, vegetation, and cultural resources. The tribe requested that the FERC require Pacific Connector to fund a limited duration Tribal Wildlife Biologist and Botanist positions, fund a GPS collaring study to track the movement of big game through the tribe's ancestral territory, and fund tribal cultural resources monitors. Impacts and mitigation measures for vegetation are discussed in section 4.5 of this EIS; and wildlife and fisheries in section 4.6. We address cultural resources issues in this section of the EIS. In an August 16, 2013, data request, we asked Pacific Connector to document communications with the Cow Creek Tribe, address the tribal comments outlined in the August 9 letter, and file any agreements made with the tribe. Pacific Connector's response, filed on September 6, 2013, was that a meeting would be arranged between the company and the tribe, and the issues of tribal concern were addressed in a letter from Pacific Connector to the tribe dated August 23, 2013.

In a letter dated January 28, 2015, Daniel Courtney, Chairman of the Cow Creek Tribe, commented on our November 2014 DEIS. He requested that an MOA be drafted in consultation with the tribe, and that another agreement be executed so that the tribe can monitor construction activities. The original MOA drafted in June 2011 was sent to the Cow Creek Tribe, which declined to concur. If this Project is authorized by the Commission, a draft amended MOA would be sent to the Cow Creek Tribe with another request for their concurrence. An agreement for tribal monitoring should be worked out with the company, as recommended below.

On June 20, 2013, the Coos Tribes wrote two letters to the FERC, in response to our *Notice of Application* issued May 30, 2013, for the Jordan Cove LNG Terminal Project in Docket No. CP13-483-000, and June 19, 2013 for the Pacific Connector Pipeline Project in Docket No. CP13-492-000. In both cases, the Coos Tribes filed motions to intervene. The tribes pointed out that the JCE & PCGP Project could affect ancestral territory, and requested that the FERC NEPA document address cultural resources and environmental justice. This section of the EIS addresses cultural resources, while environmental justice is discussed in section 4.9.

The Coos Tribes also commented on our November 2014 DEIS in a February 13, 2015, letter to the FERC from Tribal Administrator Alexis Barry. The Tribes requested government-to-government consultations with the FERC. The Tribes expressed concerns about the status of the process of complying with Section 106 of the NHPA, including the identification of historic

[153] Notes from the meeting were placed into the FERC public record for this proceeding on March 21, 2013.

properties, consultations with the SHPO, and affording the ACHP an opportunity to comment on the undertaking. Concerns about potential Project impacts on natural resources, including soils, water, vegetation, wildlife, and air quality, have been addressed elsewhere in this EIS (see section 4.2 for soils, 4.4 for water, 4.5 for vegetation, 4.6 for wildlife, and 4.12 for air quality). Lastly, the Tribes requested that an MOU with the applicants be completed prior to Project implementation, and the Tribes want an opportunity to revise the Unanticipated Discovery Plan. This current section of the EIS summarizes the status of the Section 106 process, including our consultations with the SHPO (discussed in section 4.11.1 above) and the SHPO's opinions on NRHP eligibility and effects (discussed below in section 4.11.3). On October 26, 2010, we notified the ACHP that the Project would result in adverse effects on historic properties, and in a letter to the FERC dated November 19, 2010, the ACHP declined to participate in the resolution of adverse effects. Therefore, we have afforded the ACHP an opportunity to comment in accordance with 36 CFR 800, the regulations for implementing Section 106 of the NHPA. We produced an MOA that was signed by Bob Garcia, Chairman of the Coos Tribes, on August 24, 2011, as a concurring party. This EIS also documents government-to-government consultations between the FERC and Indian tribes. As listed in table 4.11.12-1 above, the FERC sent the Coos Tribes our NOI issued on August 2, 2012; an individual letter about the Project from the FERC dated December 19, 2012, was addressed to the Tribal Chairman; and a copy of our November 2014, DEIS was sent to the Tribes. Below, we recommend that Jordan Cove execute an MOU with the Coos Tribes before we would allow construction of the Project to begin.

On July 9, 2015, in a letter to the FERC staff, the Coos Tribes requested a meeting to further continue government-to-government consultations about the Jordan Cove Project. The FERC staff is having ongoing discussions with representatives of the Coos Tribe regarding a meeting.

Jordan Cove and Pacific Connector have also conducted their own, separate Native American contact programs, as part of their data gathering and inventory efforts. While table 4.10.2-1 in our May 2009 FEIS for Jordan Cove's proposed LNG import terminal and the original Pacific Connector Project in Docket Nos. CP07-441-000 and CP07-444-000 listed communications with Indian tribes between 2005 and 2009, the section below, as well as table 4.11.1.2-2, list contacts between the applicants and tribes since 2009.

Jordan Cove's Communications with Indian Tribes

Jordan Cove provided copies of communications with Indian tribes regarding its LNG terminal in Appendices A.4 and C.4 of Resource Report 4 attached to its May 21, 2013 application to the FERC. Some tribal representatives participated in previous archaeological investigations related to Jordan Cove's proposal. For example, Donald Ivy, former Cultural Resources Program Coordinator for the Coquille Tribe, participated in the 2005-2006 survey covering the proposed Jordan Cove LNG terminal conducted by Jordan Cove's archaeological contractor, R.S. Byram (Byram). Agnes Castronuevo, former Archaeologist for the Coos Tribes, participated in the survey of the Jordan Cove utility corridor in 2012 conducted by Byram. Representatives of the Coos Tribes and Coquille Tribe also participated in the 2012 archaeological excavations at Camp

Castaway (35CS277) on the North Spit conducted by Southern Oregon University Laboratory of Anthropology, funded in part by Jordan Cove.[154]

In a filing on August 29, 2013, Jordan Cove indicated that it had received comments from the Coos Tribes on Byram's survey report covering the Kentuck Slough Wetland Mitigation Area. Field meetings were held in August 2011 and July 2013 between Byram and representatives of the Coos, Coquille, and Siletz tribes regarding the fishing weir site (35CS263) recorded at Kentuck Slough, and it was agreed that an archaeologist should monitor work on the wetland mitigation area.

TABLE 4.11.1.2-2

Communications Between the Applicants and Indian Tribes Since 2009 Regarding Docket Nos. CP13-483-000 and CP-492-000

Indian Tribe Contacted	Date/Author (Representing)	Issue	Tribal Responses
Jordan Cove Export Terminal Project			
Coos Tribes, c/o Agnes Castronuevo, Archaeologist	1/20/11 letter from Byram (Jordan Cove)	Conveyed Kentuck Slough Mitigation Site survey report for review	1/27/11 email from Agnes Castronuevo accepting report
Coos Tribes, c/o Agnes Castronuevo	8/31/11 meeting with Byram (Jordan Cove)	Site 35CS263 at Kentuck Slough	Agreed to monitoring during construction
Coos Tribes, c/o Agnes Castronuevo	8/1/12 letter from Byram (Jordan Cove)	Notification of utility corridor survey	None filed to date
Coos Tribes, c/o Agnes Castronuevo	10/10/12 letter from Byram (Jordan Cove)	Conveyed utility corridor survey report for review	1/27/13 email acknowledged receipt of report
Coos Tribes, c/o Howard Crombie	4/29/13 letter from Byram (Jordan Cove)	Conveyed updated Unanticipated Discovery Plan for review	8/22/13 email from Stacy Scott stating she is now Coos Tribes Archaeologist
Coos Tribes c/o Stacy Scott	7/25/13 meeting with Byram (Jordan Cove)	Site 35CS263 at Kentuck Slough	Agreed to monitoring during construction
Coos Tribes c/o Stacy Scott	8/23/13 email from Stacy Scott (Coos Tribes)	Jordan Cove's Discovery Plan	Comments on Discovery Plan
Coquille Tribe, c/o Nicole Norris, Archaeologist	1/25/11 letter from Byram (Jordan Cove)	Conveyed Kentuck Slough Mitigation Site survey report for review	None filed to date
Coquille Tribe, c/o Nicole Norris	8/1/12 letter from Byram	Notification of utility corridor survey	None filed to date
Coquille Tribe, c/o Nicole Norris	10/10/12 letter from Byram (Jordan Cove)	Conveyed utility corridor survey report for review	None filed to date
Coquille Tribe, c/o Nicole Norris	4/29/13 letter from Byram (Jordan Cove)	Conveyed updated Unanticipated Discovery Plan for review	8/2/13 letter from Nicole Norris with comments
Coquille Tribe, c/o Nicole Norris	7/25/13 meeting with Byram (Jordan Cove)	Site 35CS263 at Kentuck Slough	Agreed to monitoring during construction
Coquille Tribe, c/o Nicole Norris	8/21/13 letter from Nicole Norris (Coquille Tribe)	Jordan Cove's Discovery Plan	Letter conveyed comments on Discovery Plan
Siletz Tribes, c/o Robert Kentta, THPO a/	1/25/11 letter from Byram (Jordan Cove)	Conveyed Kentuck Slough Mitigation Site survey report for review	None filed to date
Siletz Tribes, c/o Robert Kentta	8/1/12 letter from Byram (Jordan Cove)	Notification of utility corridor survey	None filed to date
Siletz Tribes, c/o Robert Kentta	10/10/12 letter from Byram (Jordan Cove)	Conveyed utility corridor survey report for review	None filed to date
Siletz Tribes, c/o Robert Kentta	4/29/13 letter from Byram (Jordan Cove)	Conveyed updated Unanticipated Discovery Plan for review	8/21/13 email from Robert Kentta with comments

[154] Site 35CS277 is on BLM land outside of Jordan Cove's APE. A summary of the investigations was published by Byram (2013).

TABLE 4.11.1.2-2

Communications Between the Applicants and Indian Tribes Since 2009 Regarding Docket Nos. CP13-483-000 and CP-492-000

Indian Tribe Contacted	Date/Author (Representing)	Issue	Tribal Responses
Siletz Tribes, c/o Robert Kentta	7/24/13 meeting with Byram (Jordan Cove)	Site 35CS263 at Kentuck Slough	Agreed to monitoring during construction
Siletz Tribes, c/o Robert Kentta	8/21/13 email from Robert Kentta (Siletz Tribes)	Jordan Cove's Discovery Plan	Commented on Discovery Plan
Pacific Connector Pipeline Project			
Coos Tribes, c/o Arrow Coyote, Cultural Resources Coordinator	8/18/09 email from Arrow Coyote (Coos)	HPMP and Unanticipated Discovery Plan	Comments on plans
Coquille Tribe, c/o Nicole Norris	3/19/13 email from E. Ragsdale (HRA)	Conveyed maps	None filed to date
Coquille Tribe, c/o Nicole Norris	11/13/12 letter from W.R. Miller (Pacific Connector)	Described pipeline project and requested comments	None filed to date
Cow Creek Tribe, c/o Dan Courtney, Chair	8/23/13 letter from W.R. Miller (Pacific Connector)	Request for a meeting to discuss cultural resources issues	None filed to date
Cow Creek Tribe, c/o Jessie Plueard. Tribal Archaeologist	4/10/13 email from E. Ragsdale (HRA)	Conveyed GIS files	None filed to date
Cow Creek Tribe, c/o Jessie Puieard	3/27/13 email from E. Ragsdale (HRA)	Schedule for field work	None filed to date
Cow Creek Tribe, c/o Jessie Puieard	3/19/13 email from E. Ragsdale (HRA)	Conveyed maps	3/22/13 email from Jesse Plueard accepting maps and requesting GIS files
Cow Creek Tribe, c/o Dan Courtney	11/13/12 letter from W.R. Miller (Pacific Connector)	Described pipeline project and requested comments	None filed to date
Cow Creek Tribe, c/o Jessie Puieard	10/14/10 email from HRA	Conveyed final treatment plans	10/21/10 email from Jessie Puieard with comments
Cow Creek Tribe	6/17/10 email from Jesse Plueard (Cow Creek)	Private lands treatment plan	Comments on plans
Cow Creek Tribe	6/7/10 email from Jesse Plueard (Cow Creek)	BLM treatment plans	Comments on plans
Grand Ronde Tribes, c/o Eirik Thosgard, Cultural Resources Director & THPO	3/19/13 email from E. Ragsdale (HRA)	Conveyed maps	3/19/13 email from Eirik Thorsgard requesting GIS files
Grand Ronde Tribes, c/o Eirik Thosgard,	11/13/12 letter from W.R. Miller (Pacific Connector)	Described pipeline project and requested comments	None filed to date
Grand Ronde Tribes, c/o Eirik Thosgard,	8/2/10 email from Eirik Thorsgard	Treatment plans	Comments on plants
Klamath Tribes, c/o Perry Chocktoot, Cultural Resources Director & THPO	8/29/13 letter from W.R. Miller (Pacific Connector)	Request for a meeting to discuss cultural resources issues	None filed to date
Klamath Tribes, c/o Perry Chocktoot	11/13/12 letter from W.R. Miller (Pacific Connector)	Described pipeline project and requested comments	None filed to date
Siletz Tribes, c/o Robert Kentta, Cultural Resources Director & THPO	11/13/12 letter from W.R. Miller (Pacific Connector)	Described pipeline project and requested comments	None filed to date

a/ THPO = Tribal Historic Preservation Officer

In May 2010, Jordan Cove developed a draft MOU with the Coos Tribes, Coquille Tribe, and Siletz Tribes. Jordan Cove indicated that it requested that the Coos Tribes review drafts of the MOU and the Unanticipated Discovery Plan during the Tribal Council meeting of May 2015. If the Tribal Council approves the draft documents, Jordan Cove would execute an agreement with

the Tribes in the near future.[155] Because a final MOU between Jordan Cove and interested tribes has not yet been executed, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file with the Secretary a copy of its final MOU with interested Indian tribes. The MOU should outline procedures for future archaeological test excavations and monitoring at the LNG terminal facilities, and include the participation of representatives from interested Indian tribes.**

Pacific Connector's Communications with Indian Tribes

Pacific Connector has also been communicating with Indian tribes about its pipeline project since 2005, including telephone calls, emails, letters, and meetings. Members of the Klamath Tribes participated in cultural resources surveys in the Klamath Basin managed by HRA on behalf of Pacific Connector. Members of the Cow Creek Tribe volunteered as monitors during archaeological surveys and test excavations conducted by HRA in Douglas and Jackson Counties. Communications between Pacific Connector and interested Indians tribes from 2005 to 2009 were summarized in section 4.10.1.2 of our May 2009 FEIS for Docket Nos. CP07-441-000 and CP07-444-000. Communications after 2009 are discussed below.

Pacific Connector provided copies of communications with Indian tribes regarding its pipeline in Appendices 4A and 4D of Resource Report 4, which was attached to its June 2013 application to the FERC in Docket No. CP13-492-000. On November 13, 2012, Pacific Connector sent letters to the Coquille Tribe, Cow Creek Tribe, Grand Ronde Tribes, Klamath Tribes, and Siletz Tribes informing them of about the pipeline project proposed under Docket Nos. PF12-17-000 and CP13-492-000, and requested comments. No responses to those letters have been filed with the FERC to date.

In a data request issued on August 16, 2013, we asked Pacific Connector to document recent communications with the Klamath Tribes, and file copies of any agreements reached. Pacific Connector indicated that it had written a letter to the Klamath Tribes in June 2013, and had its consultant (HRA) provide the tribe with a copy of the Unanticipated Discovery Plan (attached as Appendix 4H in Resource Report 4 of its application to the FERC).

Although the FERC requested that Pacific Connector meet with the Cow Creek Tribe and the Klamath Tribes to work out agreements regarding cultural resources issues, those meetings have not yet taken place, and no agreements have been reached between Pacific Connector and any tribes to date. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary documentation of meetings with the Cow Creek Tribe and the Klamath Tribes, and copies of any agreements reached with the tribes.**

4.11.1.3 Communications with Other Agencies and the Public

The BLM, Forest Service, and Reclamation are cooperating agencies in the production of this EIS, and consulting parties with regard to the Section 106 compliance process. The federal land managing agencies provided the FERC staff with their opinions on NRHP eligibility and pipeline

[155] Jordan Cove addressed this issue in a filing with the FERC on April 20, 2015.

effects for sites on federal land. In addition, they signed the MOA executed in June 2011 for the Pacific Connector Pipeline Project originally authorized by the FERC in Docket No. CP07-441-000 (we discuss this MOA in section 4.11.5).

Other agencies and members of the public commented on cultural resources issues during the pre-filing scoping period, as discussed below. In response to our August 2, 2012 NOI for this Project, the NPS wrote a letter to the FERC dated August 20, 2012. The NPS stated that the Pacific Connector pipeline route may cross the Applegate branch of the California National Historic Trail at two locations. Pacific Connector provided the NPS with additional data regarding where the Applegate Trail would cross the pipeline route. One crossing would be where the trail was mapped following Dole Road, and the other would be north of the proposed Klamath Compressor Station. At both locations modern roads have removed traces of the historic trail. In a letter to Pacific Connector, the NPS concurred that the Project would have no adverse visual impacts on the two known crossing remnants of the Applegate Trail.[156] In a February 11, 2015, letter to the FERC commenting on the DEIS, the NPS clarified that there could be other intact segments of the trail in the project area that are not visible to the eye but could be detected with LiDAR or other geophysical techniques. However, the NPS indicated that conclusions about Project effects on the trail should be left to the company, the lead federal agency, and the SHPO to determine. It is our determination that the Project would have no adverse effects upon known crossing elements of the Applegate Trail. Impacts on historic trails are further discussed in section 4.8.1.2.

In its response to our NOI for this Project, on October 29, 2012, the EPA requested that our EIS describe our consultations with the SHPO during the process of complying with Section 106 of the NHPA, and the process and outcome of government-to-government consultations with Indian tribes. These issues are addressed in sections 4.11.1 and 4.11.5.

Table 4.11.1.3-1 lists scoping comments we received from non-governmental organizations (NGO) and members of the public. On September 4, 2012, Nancy Shinn noted that there may be Native American burials archaeological sites and burials within the Jordan Cove LNG terminal tract, and stated that Haynes Inlet and the Coos Bay estuary are of archaeological importance. In a letter dated October 25, 2012, Michelle Zink stated that the pipeline route would cross her family's historic homestead. Betty McRoberts, in an October 26, 2012, letter, noted that there are Native American artifacts and burials and an historic cemetery near her family's farmstead in the vicinity of the community of Dora.[157] Carol Ampel, in an October 29, 2012, filing, observed that Coos Bay supports a fishery used by Native Americans. We address issues related to the fishery in Coos Bay in sections 4.4, 4.6, 4.8, and 4.9.

[156] A copy of the NPS letter was filed by Pacific Connector on July 22, 2013.

[157] The Pacific Connector pipeline would avoid impacting the Dora Cemetery. The route near the community of Dora and the crossing of the East Fork of the Coquille River was surveyed for cultural resources by Pacific Connector's contractor (HRA) and one prehistoric site (35CS223) was identified, which still requires archaeological testing.

TABLE 4.11.1.3-1

Public and Non-Governmental Organization Scoping Comments on Cultural Resources Issues

Date	Individual/Organization(s)	Comment
09/04/2012	Nancy Shinn	The Jordan Cove LNG terminal tract may contain Native American archaeological sites and burials, and Haynes Inlet and the Coos Bay estuary are of archeological importance.
10/25/12	Michelle Zink	The Pacific Connector pipeline route would cross her family's historic homestead.
10/26/2012	Betty McRoberts	The EIS should discuss Coquille Indians who historically lived in the vicinity of the community of Dora. Native American artifacts and burials are located near her family's historic farmstead. The pipeline route should avoid the Dora Cemetery.
10/26/2012	Rogue Riverkeeper et al.	The EIS should document compliance with the NHPA, including consultations with agencies, the identification of cultural resources within the area of potential effect, and how impacts on historic properties would be avoided or mitigated.
10/30/2012	Carol D. Ampel	The Coos Bay estuary contains a fishery used by Native Americans.
10/31/2012	Citizens Against LNG	Known archaeological sites are located on Jordan Point, Haynes Inlet, and Graveyard Point.

On October 29, 2012, a letter was filed by the Rogue Riverkeeper, et al. in response to our NOI for the Project. The NGO requested that our EIS address compliance with the NHPA, including consultations with agencies, the identification of cultural resources within the area of potential effect (APE), and how impacts on historic properties would be avoided or mitigated. On October 31, 2012, Citizens Against LNG submitted a letter to the FERC commenting on cultural resources issues. The NGO indicated that known archaeological sites are located on Jordan Point, Haynes Inlet, and Graveyard Point. The filing included copies of letters dated May 13 and June 10, 2010, from the Coos Tribes to the Coos County Planning Department.

This EIS discloses our NHPA compliance process in section 4.11.5. Results of cultural resources identification efforts are outlined in section 4.11.3. Consultation efforts are addressed in section 4.11.1.

Jordan Cove's Communications with Other Agencies

Because Jordan Cove owns or would lease from private landowners all of the property where the proposed facilities would be located, there was no need for Jordan Cove to confer with federal land managers regarding cultural resources issues.

Pacific Connector's Communications with Other Agencies

Pacific Connector needed to obtain permits under the FLPMA and Archaeological Resources Protection Act from federal land managing agencies prior to conducting archaeological field work on federal lands. In addition, Pacific Connector submitted draft and final reports to federal land managing agencies, and solicited their comments on recommendations of eligibility and effect for sites on federal lands. Communications between Pacific Connector and federal land managing agencies between 2006 and 2009 were summarized in section 4.10.1.3 of the May 2009 final EIS produced by the FERC for Docket Nos. CP07-441-000 and CP07-444-000. Communications between Pacific Connector and federal land managing agencies since May 2009 are listed below in table 4.11.1.3-2. Pacific Connector has indicated that it received permits for its 2013 archaeological field work from the BLM and Forest Service in March and April 2013.

TABLE 4.11.1.3-2

Communications Between Pacific Connector and Federal Land Managing Agencies Since 2009

Agency Addressed	Date/From (Representing)	Issue	Agency Responses
Forest Service – Umpqua National Forest c/o Debra Barner, Archaeologist	9/21/09 email from Christopher Kelly (Forest Service) to Debra Barner	New site 1502602	Needs to be evaluated
BLM – Medford District	1/7/10 Site Reviews	Reviews of sites 35JA682,35JA686, 35JA739, 35JA751, 35JA759	Determinations of eligibility and effect
Forest Service – Winema National Forest c/o John Kaiser, Archaeologist	7/6/10 email from John Kaiser to Debra Barner	Dead Indian Memorial Highway	Not a site, not eligible, no effect if pipeline put beneath it
BLM – Roseburg District c/o Isaac Barner, Archaeologist	10/20/10 email from Isaac Barner to HRA	Review of treatment plans for sites 35DO1104, 35DO1105, 35DO1106, 35DO1110, and 35DO1117	Found treatment plans acceptable

4.11.2 Area of Potential Effect

As stated in our NOI, we define the APE as all areas subject to ground disturbance, including the construction right-of-way, temporary extra work spaces, contractor/pipe storage yards, disposal areas, aboveground facilities, and new or to-be-improved access roads. In the case of the Jordan Cove facilities, the APE includes the tracts that would be affected by construction of the LNG terminal, South Dunes Power Plant, SORSC, NPWHC, and wetland mitigation areas (see table 2.3.1-1). For the Pacific Connector pipeline the APE includes the pipeline right-of-way, TEWAs, UCSAs, disposal areas, contractor and pipe yards, access roads, and aboveground facilities (see table 2.3.1-2). The general location of the facilities proposed by Jordan Cove is illustrated on figure 2.1-1. Detailed location maps are included in appendix C of this EIS.

4.11.3 Results of Overviews, Inventories, and Testing

Both applicants have conducted cultural resources investigations of their proposed facilities, as described below.

4.11.3.1 Jordan Cove LNG Terminal

Jordan Cove's cultural resources consultant (Byram) communicated with relevant Indian tribes and conducted site file and literature reviews, and archival research to identify previously recorded archaeological sites within the APE for the LNG terminal and related facilities. Based on ethnographic data, the Native American village known as "Quonatitch" may have been located around geographic Jordan Cove, in the vicinity of the South Dune Power Plant. In addition, an unrecorded prehistoric cemetery may be located north of the South Dune Power Plant, and there are also anecdotal reports of burials being disturbed during construction of the Menasha mill (Byram 2006a).

Archaeological surveys of the Coos Bay region conducted by Lloyd Collins in the early 1950s recorded two archaeological sites (35CS26 and 35CS27) on the North Spit.[158] Site 35CS26 is a shell midden located on the east side of geographic Jordan Cove, south of the South Dune Power Plant. This site was not relocated during surveys conducted by Byram (Byram and Purdy 2007)

[158] Site 35CS27 is located well southwest and outside the APE for the Jordan Cove terminal.

and HRA (Bowden et al. 2009), with testing conducted at this location in 2013 also having negative results (Ragsdale et al. 2013).

The U.S. Coast and Geodetic Survey map of 1889 illustrated buildings on the north shore of geographic Jordan Cove that probably relate to the historic Jordan Ranch. James Jordan, from Kentucky, ran a bar in Empire and hunted meat for the local sawmills, married a Coos woman, and established his ranch on the North Spit in the 1860s.[159] A number of male American settlers at Coos Bay married Indian women in the 1850s and 1860s, and the North Spit became a refuge where native people were hidden from U.S. soldiers seeking to place them on reservations.[160] The Jordan Ranch became the center of a native community around Haynes Inlet.[161]

A recent archaeological survey (Byram and Purdy 2007) of the location of the South Dune Power Plant did not find any cultural deposits that can be associated with the Native American village of Quanatitch and its related cemetery. During the survey for the Pacific Connector pipeline, HRA recorded site 35CS227 as a prehistoric shell midden and historic glass scatter, on the north shore of geographic Jordan Cove (Bowden et al. 2009). This was at the same location where Byram (2006b) identified R3, the previously reported but unrecorded site of the Jordan Ranch and a possible native village. The Pacific Connector pipeline route has been modified for the current proposal under CP13-492-000 and would avoid this site. However, site 35CS227 is situated south of the SORSC and Jordan Cove's proposed utility corridor. While Byram did not relocate site 35CS227 during the survey of Jordan Cove's utility corridor, monitoring of construction activities in this area was recommended (Byram and Shindruk 2012).

The area of the natural gas processing plant and the South Dunes Power Plant was once the location of the Menasha-Weyerhaeuser linerboard mill that operated between 1961 and 2003. The mill buildings have been removed, although asphalt parking lots and concrete remains are visible. This relatively modern industrial facility was not recorded or evaluated as an historic site.

Ward Tonsfeldt recorded the remains of a 1939 COE railroad on the North Spit for the BLM. However, Byram did not relocate the COE railroad site during the survey of the South Dunes Power Plant location.

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[159] Dodge (1898) noted that: "John Henderson, H.H. Barnett, and James Jordan had located on Coos Bay opposite but above Empire City." Land records show that Jordan purchased property in 1866 and 1869 on the north shore of Jordan Cove on the North Spit (Byram 2006a) in the vicinity of the South Dune Power Plant. The 1870 census listed James Jordan as a 43-year-old farmer, living with his 25-year-old native wife Jane, and five children between the ages of 13 and 1 years old. Henry Barnett also had an Indian wife, and acquired a homestead in 1872 to the east of the Jordan Cove terminal tract.

[160] This was documented in Bensell (1959) and Youst (1997) and the Reports of the Commissioner of Indian Affairs. One report (J.B. Sykes to E. Geary, November 16, 1860, *Letters Received by the Office of Indian Affairs*), described how William Luse hid Indians from U.S. agents. William Luse, who also had an Indian wife, was the son of H. H. Luse, who owned the sawmill at Empire (Dodge 1898), and the Luse family later put together a ranch on the North Spit that included the original Jordan, Henderson, Barnett, and Crawford places. J.A. Yoakum, an early settler near the mouth of the Coos River, stated that of the almost 300 single white men in the Coos Bay area in the late 1850s all but about five lived with Indian women (Douthit 2002).

[161] Coquille Tribe Vice-Chair Tom Younker recalled that Indian events were held at Jordan Cove. Besides the Jordan, Barnett, Crawford and Luse families, which included Indian wives, the ethnographer John Harrington noted that Charlie Collins, Fuller Sprage, and Gus Sandrell were Coos Indians who lived at Jordan Cove (Byram 2006a). The Coos informant Annie Peterson stated that she resided among the Haynes Inlet Indian community in the 1880s, together with her native grandmother, mother, aunt and uncle, and niece (Youst 1997).

The 1889 U.S. Coast and Geodetic Survey map also showed buildings associated with the historic Henderson Ranch on the north shore of Coos Bay east of Henderson Marsh, where the Jordan Cove terminal marine slip would be located. This land was purchased as a cash entry by John Henderson in 1866 and 1868 (Byram 2006a). A part of this ranch was recorded by Byram as archaeological site 35CS221, as further discussed below.

Byram (2006b) identified two previously reported but unrecorded prehistoric sites within the Roseburg Forest Products tract and the Ingram Yard. Site R7 appears to be located along the route for Jordan Cove's proposed haul road through the Roseburg Forest Products property. While no archaeological remains were found in this area during Byram's survey, monitoring of ground disturbing activities was recommended. Site R6 was mapped on the east side of Henderson Marsh, within Jordan Cove's proposed marine slip. Ron Stubbs of Southwest Oregon Community College indicated that he had conducted surface surveys in the late 1960s on the edge of Henderson Marsh and found chips and scrapers indicative of a Native American occupation in this area. This was where Byram recorded site 35CS221, including a building feature and a scatter of historic artifacts that may be related to the Henderson Ranch. Archaeological testing was recommended at this site to assess its eligibility for the NRHP (Byram 2006a).

Table 4.11.3.1-1 lists the archaeological surveys that cover the Jordan Cove facilities. The Byram 2005-2006 surveys covered about 280 acres at the LNG terminal and the West Jordan Cove wetland mitigation area, with transects varying between 20 meters and more than 30 meters apart (Byram 2006a, 2006b). As part of this survey, Byram examined a portion of the inter-tidal margin in Coos Bay by boat during a low "minus tide," overlapping the access channel to the LNG terminal. No cultural resources were found in that portion of the APE. Although a set of pilings, likely associated with a former dock or small landing, was noted outside of the APE, it was not recorded as an archeological site. Historical aerial photos (USACE 1942, 1954 as cited in Byram 2006a) indicate the majority of this area was intertidal prior to 1954, and that sands accumulated in the area between 1942 and 1955 as a result of aeolian processes and/or deposition of dredge spoils. The likelihood of surface artifacts in the area is therefore considered to be very low, although buried intertidal deposits, such as fishing weirs, may be present. In a review of the 2004-2006 survey report, the SHPO, in a letter dated October 2, 2006, concurred with the recommendations for additional testing and monitoring. We agree.

In 2007, Byram surveyed about 92 acres in the vicinity of the gas processing plant, the South Dunes Power Plant, and related facilities (Byram and Purdy 2007). No cultural remains were found. In a letter dated December 26, 2007, reviewing that report, the SHPO stated that activities within this area would have no adverse effects on known sites. We agree.

Also in 2007, Byram surveyed the route of the construction haul road and the slurry and water return pipelines, from the Jordan Cove terminal marine slip to the South Dunes Power Plant, across the Roseburg Forest Products property. Although no cultural resources were found, it was recommended that construction should be monitored near the crossing of existing Jordan Cove Road (Byram 2008). We agree.

TABLE 4.11.3.1-1

Cultural Resources Surveys of Jordan Cove's Proposed Facilities

Facility or Use Area	Cultural Resources Survey	Sites Identified
Access Channel	Byram 2006a	–
Marine Slip	Byram 2006a, 2006b	35CS221
Barge Dock	Byram 2006a, 2006b	–
LNG Loading Platform and Transfer Pipeline	Byram 2006a, 2006b	–
LNG Storage Tank Area	Byram 2006a, 2006b	–
Liquefaction Process Area	Byram 2006a, 2006b	–
Refrigerant Storage Area	Byram 2006a, 2006b	–
Terminal Ground Flare	Byram 2006a, 2006b	–
Terminal Fire Water Ponds	Byram 2006a, 2006b	–
North Terminal Access	Byram 2006a, 2006b	–
Terminal Operator Building and Warehouse	Byram and Shindruk 2012	–
Utility Corridor and Access Road	Byram and Shindruk 2012	–
Dredge Slurry and Return Water Pipelines	Byram 2006a, 2006b; and Byram 2008	–
Construction Haul Road	Byram 2006a, 2006b; and Byram 2008	–
Roseburg Forest Products Water Tanks Removal	Byram 2006a, 2006b	–
Roseburg Forest Products Construction Staging	Byram 2006a, 2006b	–
CBNBWD Pipeline Removal and Relocation	Byram 2006a, 2006b	–
SORSC	Byram and Shindruk 2012; Bowden et al. 2009	35CS227
Gas Processing Area	Byram and Purdy 2007	–
South Dunes Power Plant	Byram and Purdy 2007	–
South Dunes Administrative and Support Buildings	Byram and Purdy 2007	–
South Dunes Stormwater Pond	Byram and Purdy 2007	–
South Dunes Construction Laydown Areas	Byram and Purdy 2007	–
North Point Workforce Housing Complex and Parking Lot, Mill Casino Parking Lot, and Myrtlewood RV Camp Parking Lot	Pending	–
West Jordan Cove Wetland Mitigation Area	Byram 2006a, 2006b	–
West Bridge Wetland Mitigation Area	Byram and Shindruk 2012	–
Kentuck Slough Wetland Mitigation Area	Byram and Walker 2010	35CS263

In 2010, Byram surveyed about 55 acres at the Kentuck Slough wetland mitigation area. One site was recorded (35CS263). This is a prehistoric fishing weir. This site is outside of the APE and should be avoided during LNG terminal construction activities (Byram and Walker 2010). The SHPO commented on the report in a letter dated April 13, 2011, concurring that the Project would have no adverse effect on cultural resources within this portion of the APE. Further, the SHPO agreed that monitoring should be conducted in areas where excavations at Kentuck Slough may extend below three feet MSL in the intertidal zone. We concur.

In 2012, Byram surveyed the route of the Jordan Cove utility corridor between the terminal and the power plant. This inventory also covered the West Bridge wetland mitigation area. No archaeological sites were found during this survey. However, additional archaeological testing was recommended at the haul road overpass near the northwest corner of geographic Jordan Cove, in the vicinity of previously recorded site 35CS227 (Byram and Shindruk 2012). The SHPO commented on the report in a letter dated October 30, 2012, concurring with the report's finding that no historic properties would be affected within the area surveyed. We agree.

The NPWHC area includes two dredge fill islands and related utility and transportation corridor improvements. The entire area was surveyed in 2014, and the results will be included in a compilation report due for completion in late 2015 or early 2016. The footprint of the housing

area is an area of dredge materials fill to a depth of 20-25 feet, overlying tidal flats, and has a low potential for containing cultural deposits.

The only archaeological sites recorded within the APE during the surveys at the Jordan Cove terminal were 35CS221 and 35CS227, as discussed above. We find both sites 35CS221 and 35CS227 to be of undetermined NRHP eligibility pending additional investigations, as recommended by the cultural resources consultants and concurred with by the SHPO. It is possible that impacts on site 35CS227 could be avoided during construction of the terminal and related facilities. Site 35CS263 should be avoided by work at the Kentuck Slough wetland mitigation area; however, an archaeologist should monitor that site location.

4.11.3.2 Pacific Connector Pipeline Project

Pacific Connector hired HRA to coordinate its cultural resources investigations. HRA conducted a site file search and literature review to identify previously recorded archaeological sites within the APE of the Pacific Connector Pipeline Project. The earliest archaeological work in Coos County was conducted by students of Luther Cressman of the University of Oregon in the late 1930s. Archaeological surveys were conducted in the Camas Valley in the 1980s by Thomas Connolly of the University of Oregon. Cressman did salvage archaeology at burials on the south bank of the Rogue River near the town of Gold Hill in the early 1930s. Federal dam projects on the Rogue and Applegate Rivers spurred further research. Several sites along the upper Rogue River drainage were tested in the 1960s in anticipation of the construction of the Lost Creek Lake Dam. Also near this dam, the Oregon State Museum excavated sites 35JA189 and 35JA190. The ODOT sponsored excavations at site 35JA42 near the Applegate Dam. In the Klamath Basin, Cressman excavated the Narrows site and the Cove site in the 1930s and 1940s. In the 1950s, Cressman directed excavations for the John C. Boyle Dam, and excavated Medicine Rock Cave and Kawumkam Springs Midden on the Williamson and Sprague Rivers (Bowden et al. 2009).

HRA estimated that at least 125 archaeological surveys have been conducted in the project area, documenting at least 143 sites (Bowden et al. 2009). However, only 23 previously recorded archaeological sites were identified in the APE, as listed below in table 4.11.3.2-1.

TABLE 4.11.3.2-1

Previously Recorded Sites Within the Pacific Connector Pipeline Project APE

Site No.	Type	Recorder (date)	Facility	Evaluation	Further Work
35CS26	Prehistoric shell midden	Collins (1951)	Pipeline	Potentially eligible	Tested by HRA in 2013 with negative results
35CS50	Prehistoric lithic scatter	Draper (1979)	Yard	Unevaluated	Additional survey and testing
35DO35	Prehistoric lithic scatter	Unknown (1966)	Access Road	Unevaluated	Road will not be improved. No further work necessary.
35DO32	Prehistoric lithic scatter	Unknown (1966)	Access Road	Unevaluated	Road will not be improved. No further work necessary
35DO313	Multi-component: prehistoric camp and historic artifact scatter	Connolly (1984)	Pipeline	Eligible	Mitigate (data recovery)
35DO314	Prehistoric	Connolly (1984)	Pipeline	Unevaluated	Testing
35DO435	Prehistoric	Barner (1989)	Road	Undetermined	Additional survey and testing
OR-110-1293	Historic fence	Unknown	Pipeline	Unknown	No further work

TABLE 4.11.3.2-1

Previously Recorded Sites Within the Pacific Connector Pipeline Project APE

Site No.	Type	Recorder (date)	Facility	Evaluation	Further Work
35KL57	Unknown	Cannon (1977)	Access Road	Undetermined	Additional survey and testing
35Kl1408	Multi-component	AINW (1993)	Access Road	Undetermined	Survey to determine if outside APE
35KL1458	Multi-component: prehistoric lithic scatter and historic canal	AINW (1993)	Pipeline	Potentially eligible	Avoid by HDD
35KL1469	Multi-component	AINW (1993)	Access Road	Unevaluated	Additional survey and testing
35KL1475	Multi-component	AINW (1993)	Access Road	Unevaluated	Survey to determine if outside APE.
35KL1941	Multi-component	Matsumoto (1996)	TEWA	Undetermined	Additional survey and testing needed
35KL1943	Prehistoric village	Mack (1997)	Access Road/TEWA	Undetermined	Survey to determine if outside APE
35KL2425	Multi-component	Unknown	Access Road	Unevaluated	Additional survey and testing
35KL2831	Historic lumber mill	AINW (1993)	Pipeline	Eligible	Need an avoidance plan
35KL2848	Historic canal	Reno and Obemayr (1993); Mikesell (n.d.); Habmaier (2009); Bowden et al. (2013); Ragsdale et al. (2013)	TEWA	Not eligible	No further work

Between 2006 and 2009, HRA surveyed a 400-foot-wide corridor along 212 miles of the 2009 route for the original LNG import project and associated Pacific Connector send-out pipeline proposed in Docket No. CP07-441-000, totaling 10,288 acres. An additional 111 temporary construction areas outside of the pipeline route corridor, including TEWAs, UCSAs, and quarry/disposal areas, were inventoried by 2009, totaling 360 acres. Also, 28 pipe or contractor yard locations, totaling about 723 acres, were examined during that period. Partial surveys were also conducted along 584 access roads, for a total of about 535 miles, covering 972 acres. The SHPO commented on HRA's 2009 final survey report in a letter to the FERC dated September 25, 2009, including their opinions on eligibility and effect.

The current location of the Jordan Cove Meter Station, as proposed in Pacific Connector's June 2013 application to the FERC in Docket No. CP13-492-000, was investigated in 2007 during the inventory of the South Dunes Power Plant area. No cultural resources were found in this area (Byram and Purdy 2007). The SHPO reviewed that report in a letter dated December 26, 2007.

In 2010, HRA conducted a combination boat and pedestrian survey of at least a 400-foot-wide corridor along the pipeline route crossing of Haynes Inlet of Coos Bay, between about MPs 1.7R and 4.1R. A total of nine new archaeological sites were recorded during that survey; eight of these are prehistoric fishing weir sites, and one is the remains of an historic wooden dock (Knutson et al. 2010). Only three of those weir sites appear to be within the APE. The SHPO commented on HRA's second addendum report in a letter to the FERC dated April 18, 2011.

Between 2010 and May 2013, HRA conducted additional cultural resources surveys of pieces of the Pacific Connector Pipeline Project. This included portions of two variations that were included with the 2013 pipeline route in Docket No. CP13-492-000: the Weaver Ridge segment between about MPs 46.3 and 47.9; and the McLaughlin Lane segment between about MPs 187.4

and 191.0. In addition, 66 acres at the location of the Klamath Compressor Station (MP 228) was inventoried. No cultural resources were found in those areas. Also, 33 additional TEWAs, 2 UCSAs, 3 rock source/disposal areas, 1 hydrostatic test water discharge area, and 2 pipe yards were inventoried. Those surveys recorded two new isolated finds; and one previously recorded site was revisited (Bowden et al. 2013). The SHPO reviewed HRA's 2013 Addendum in a letter to the FERC dated August 5, 2013.

In December 2013, Pacific Connector filed two additional cultural resources reports. One report documented surveys conducted by HRA between May and November 2013, at 11 locations, covering a total about 6.7 miles. In addition, 9 TEWAs, 2 roads, and 2 rock sources were inventoried. Combined these surveys examined 303 acres; and 379 shovel probes were excavated. Two new isolated finds and an historic site (HRA-1227-503) were recorded. The investigations included deep testing on the east side of the new crossing location of the South Umpqua River, at the proposed site of the new Clarks Branch Meter Station near MP 71.4. Testing was also conducted at the location of previously recorded site 35CS26 on the east side of geographic Jordan Cove near MP 1.7. No buried cultural remains were found at either testing location (Ragsdale et al. 2013). Pacific Connector has not yet filed the SHPO review of that report.

The other recently filed report, documented archaeological testing at site 35DO1284. Only 11 lithic artifacts were recovered during the testing. HRA evaluated the site as not eligible for the NRHP, requiring no further work (Willis et al. 2013). Pacific Connector has not yet filed the BLM and SHPO review of that testing report.

In March 2010, HRA produced a report that documented testing at 36 sites (Bowden et al. 2010). The SHPO commented on that report in a letter to the FERC dated December 13, 2010.

Pacific Connector stated that as of May 2013 about 201 miles of the pipeline route proposed in its June 2013 application to the FERC in Docket No. CP13-492-000 were covered by cultural resources surveys. Ninety-two TEWAs were completely covered and 6 TEWAs partly surveyed, for a total of about 188 acres. Inventories were completed for 497 proposed access road segments, totaling about 475 miles. Twenty-six proposed pipe or contractor yards have been inventoried. Sixteen proposed rock source or disposal areas were examined. The June 2013 proposed locations for MLVs were covered by surveys of the pipeline corridor. The proposed locations for the Klamath Compressor Station, the associated Klamath-Beaver and Klamath-Eagle Meter Stations, and the Jordan Cove Meter Station have also been surveyed. Pacific Connector has not indicated whether or not the proposed locations for communication towers have been covered by cultural resources investigations.

The inventories for the Pacific Connector Project identified 103 sites within the APE: 89 sites along the proposed pipeline route, and 14 sites along access roads, within TEWAs or UCWAs, rock source or disposal areas, or yards. Archaeological surveys also resulted in the identification of 152 isolated finds (Bowden et al. 2009, 2013). None of the isolated finds meet minimum NRHP eligibility criteria and no avoidance or protection measures are needed. However, archaeological monitoring during pipeline construction may target specific locations.

Of the 79 sites identified to date within the APE on non-federal land, we have determined (in consultation with the SHPO) that 29 resources are not eligible for the NRHP and require no

further work. There are 19 sites on non-federal lands that can be avoided, or where the Project would have no adverse effects. Pacific Connector needs to produce detailed site-specific avoidance and protection plans for inclusion in its revised final HPMP. As listed in table 4.11.3.2-2, there are 18 sites on non-federal lands of undetermined or unevaluated eligibility to the NRHP that may be affected by the pipeline project and require additional investigations. Nineteen sites on non-federal land are potentially eligible for the NRHP, cannot be avoided, and require additional testing to determine their NRHP eligibility. Testing plans will be completed by Pacific Connector's cultural resources contractor after the Certificate is issued and prior to construction. These will require approval by the SHPO and the FERC. Thirteen sites on non-federal land are eligible for the NRHP, cannot be avoided, and require treatment in the form of future data recovery excavations. Pacific Connector's cultural resources contractor prepared treatment plans for data recovery excavations at the eligible sites (HRA 2010), and these plans were approved by the SHPO and the FERC.

TABLE 4.11.3.2-2

NRHP-Eligible and Unevaluated Sites On Non-Federal Lands That May Be Affected by the Pacific Connector Pipeline Project and Require Additional Investigations

Site No.	Cultural Type	Landowner	Evaluation	Recommended Work
35CS50	Prehistoric lithic scatter	Private	Undetermined	Additional survey and testing
35CS223	Prehistoric lithic scatter	Private	Potentially eligible	Testing
35CS225	Multi-component: Prehistoric camp and Historic artifact scatter	Private	Potentially eligible	Testing
35CS226	Prehistoric lithic scatter	Private	Potentially eligible	Testing
35CS264	Prehistoric fishing weir	State – ODSL	Potentially eligible	Testing
35SC265	Prehistoric fishing weir	State – ODSL	Potentially eligible	Testing
35CS268	Prehistoric fishing weir	State – ODSL	Potentially eligible	Testing
LM-3	Unknown	Unknown	Undetermined	Additional survey and testing
35DO313	Multi-component: Prehistoric camp and Historic artifact scatter	Private	Eligible	Data recovery
35DO314	Prehistoric	Private	Undetermined	Testing
35DO1051	Multi-component: Prehistoric lithic scatter and Historic artifact scatter	Private	Potentially eligible	Testing
35DO1052	Prehistoric camp	Private	Eligible	Data recovery
35DO1053	Multi-component: Prehistoric camp and Historic ceremony site	Private	Eligible	Data recovery
35DO1054	Prehistoric camp	Private	Potentially eligible	Testing
35DO1058	Prehistoric camp	Private	Eligible	Data recovery
35DO1068	Prehistoric lithic scatter	Private	Potentially eligible	Testing
35DO1070	Prehistoric camp	Private	Eligible	Data recovery
35DO1074	Prehistoric camp	Private	Eligible	Data recovery
35DO1075	Prehistoric camp	Private	Eligible	Data recovery
35DO1092	Multi-component: Prehistoric camp and Historic artifact scatter	Private	Eligible	Data recovery
35DO1093	Prehistoric lithic scatter	Private	Potentially eligible	Testing
35DO1095	Multi-component: Prehistoric lithic scatter and Historic artifact scatter	Private	Potentially eligible	Testing
35DO1096	Prehistoric lithic scatter	Private	Potentially eligible	Testing
35DO1103	Prehistoric lithic scatter	Private	Undetermined	Testing
35DO1116	Prehistoric lithic scatter	Private	Potentially eligible	Testing
35DO1119	Prehistoric lithic scatter	Private	Potentially eligible	Testing

TABLE 4.11.3.2-2

NRHP-Eligible and Unevaluated Sites On Non-Federal Lands That May Be Affected by the Pacific Connector Pipeline Project and Require Additional Investigations

Site No.	Cultural Type	Landowner	Evaluation	Recommended Work
35JA675	Prehistoric lithic scatter and quarry	Private	Potentially eligible	Testing
35JA680	Prehistoric lithic scatter	Private	Potentially eligible	Testing
35JA688	Prehistoric camp	Private	Potentially eligible	Testing
35JA740	Prehistoric camp	Private	Eligible	Data recovery
35JA741	Prehistoric camp	Private	Eligible	Data recovery
35JA742	Multi-component: Prehistoric camp and Historic foundation	Private	Eligible	Data recovery
35JA752	Prehistoric lithic scatter	Private	Eligible	Data recovery
Medford Canals	Historic irrigation feature	Unknown	Undetermined	Additional survey
N. Hanley Ditch	Historic irrigation feature	Unknown	Undetermined	Additional survey
S. Hanley Ditch	Historic irrigation feature	Unknown	Undetermined	Additional survey
35KL2425	Multi-component	Private	Undetermined	Additional survey
35KL2848	Historic irrigation feature	Private	Undetermined	Need site form and evaluation
35KL3046	Multi-component: Prehistoric lithic scatter and Historic artifact scatter	Private	Potentially eligible	Testing

4.11.3.3 Federal Lands

The Jordan Cove LNG terminal would not directly affect any federal lands, and therefore cultural resources identified within that tract are not discussed below. The proposed Pacific Connector pipeline route, however, would cross about 71 miles of federal lands, administered by the BLM, Forest Service, and Reclamation. Twenty-five archaeological sites were identified on federal lands within the Pacific Connector Pipeline Project APE, as listed in table 4.11.3.3-1.

TABLE 4.11.3.3-1

Archaeological Sites On Federal Lands Within The Pacific Connector Pipeline Project APE

Site No./Name	Cultural Type	Agency	Evaluation	Recommendations
HRA-1227-503	Historic building remains	BLM – Coos Bay	Not eligible	No further work
35DO1071	Prehistoric	BLM – Roseburg	Unevaluated	Should be avoided
35DO1104	Multi-component: Prehistoric lithic scatter and Historic logging refuse	BLM – Roseburg	Eligible	Data recovery
35DO1105	Prehistoric	BLM – Roseburg	Eligible	Data recovery
35DO1106	Prehistoric	BLM – Roseburg	Eligible	Data recovery
35DO1107	Historic fire lookout	Forest Service – Umpqua National Forest	Eligible	Should be avoided
35DO1109	Prehistoric	BLM – Roseburg	Not eligible	No further work
35DO1110	Prehistoric	BLM – Roseburg	Eligible	Data recovery
35DO1111	Prehistoric	BLM – Roseburg	Not eligible	No further work
35DO1112	Prehistoric	BLM – Roseburg	Not eligible	No further work
35DO1113	Prehistoric	BLM – Roseburg	Not eligible	No further work
35DO1114	Prehistoric	BLM – Roseburg	Not eligible	No further work
35DO1117	Prehistoric	BLM – Roseburg	Eligible	Data recovery
35DO1135	Prehistoric	BLM – Roseburg	Not eligible	No further work
35DO1136	Historic artifact scatter	BLM – Roseburg	Not eligible	No further work
35DO1284	Prehistoric	Forest Service – Umpqua National Forest	Not eligible	No further work
35DO1426	Historic spring associated with the Peavine Camp	Forest Service – Umpqua National Forest	Unevaluated	Should be avoided
LM-36	Historic Dead Indian Memorial Highway	Forest Service – Winema National Forest	Eligible	Restore after construction for no adverse effect

TABLE 4.11.3.3-1

Archaeological Sites On Federal Lands Within The Pacific Connector Pipeline Project APE

Site No./Name	Cultural Type	Agency	Evaluation	Recommendations
35JA682 a/	Prehistoric	BLM – Medford	Not eligible (BLM), Potentially eligible (SHPO)	Possible testing
35JA686 a/	Prehistoric lithic scatter and quarry	BLM – Medford	Not eligible (BLM), Potentially eligible (SHPO)	Possible testing
35JA739 a/	Prehistoric lithic scatter and quarry	BLM – Medford	Not eligible (BLM), Potentially eligible (SHPO)	Possible testing
35JA758	Historic artifact scatter	Forest Service – Umpqua National Forest	Not eligible	No further work
OR-110-1293	Historic fence line	BLM – Medford	Not eligible	No further work
35KL2888	Historic	BLM-Klamath Falls	Undetermined	Should be avoided
35KL3040	Historic rock walls	BLM – Klamath Falls	Not eligible	No further work
Klamath Canal System	Historic irrigation features	Reclamation – Klamath Office	Eligible	Restore after construction for no adverse effect

a/ BLM –Medford District and SHPO disagree on eligibility of 35JA682, 35JA686, and 35JA739. BLM says not eligible, SHPO determined site "potentially eligible". BLM is working the SHPO to determine what, if any, additional work will be necessary for these resources.

BLM Sites

Twenty archaeological sites are on BLM lands. Twelve of these have been evaluated as not eligible for the NRHP and require no further work. However, the SHPO has indicated disagreement with the BLM's "not eligible" determination for three of these sites (35JA682, 35JA686, and 35JA739). The BLM is currently working with the SHPO to resolve this disagreement. Two sites on BLM lands are unevaluated or have undetermined NRHP-eligibility. Two sites should be avoided. Five sites are eligible for the NRHP and cannot be avoided. Those five historic properties would require data recovery excavations to mitigate adverse effects, according to treatment plans previously approved by the BLM (HRA 2010).

Forest Service Sites

Five sites are on NFS lands. Two sites are evaluated as not eligible for the NRHP and require no further work. Two sites are eligible for the NRHP; however, one should be avoided. The Project's crossing of the remaining NRHP-eligible site (historic Dead Indian Memorial Highway) would have no adverse effects. The final site is unevaluated for NRHP eligibility, but should be avoided.

Reclamation Sites

The Pacific Connector pipeline route would cross 19 irrigation features (some multiple times) associated with the Klamath Project that are under the jurisdiction of Reclamation.[162] The historic ditches and canals crossed by the Pacific Connector pipeline route were constructed between about 1905 and 1930. The Klamath Project has been determined eligible for inclusion on the NRHP. Reclamation is currently conducting an inventory of the features of the Klamath Project in an effort to prepare a NRHP nomination. The SHPO, in a letter dated December 30, 2008, indicated that the Pacific Connector pipeline should have no adverse effects on the

[162] The Klamath Project was authorized in 1905. It currently includes 8 dams, 19 canals, 3 pumping plants,2 tunnels, and a drain that irrigate about 210,000 acres.

Klamath Canal System, because the pipeline would be installed underneath the canals during the winter via dry open cut, when they contain little or no water, and the canals would be restored after construction. We concur.

4.11.4 Unanticipated Discovery Plans

Jordan Cove included a *Plan and Procedures Addressing Unanticipated Discoveries of Cultural Resources and Human Remains* (Discovery Plan) as Appendix B.4 in Resource Report 4 of its May 21, 2013, application to the FERC in Docket No. CP13-483-000. A copy of its Discovery Plan was submitted to SHPO and interested Indian tribes on April 29, 2013. The SHPO commented on the Discovery Plan in a letter to the FERC dated August 8, 2013. On August 29, 2013, Jordan Cove filed copies of comments on the Discovery Plan it received from the Coos Tribes, Coquille Tribe, and Siletz Tribes. In that same filing, Jordan Cove provided a revised Discovery Plan that addressed the comments of the SHPO and tribes. We find this revised Discovery Plan to be acceptable.

Pacific Connector included a copy of its final June 2011 *Unanticipated Discovery Plan* as Appendix 4H in Resource Report 4 included with its June 6, 2013, application to the FERC in Docket No. CP13-492-000. The SHPO commented on that plan in a letter to the FERC dated August 8, 2013. If Pacific Connector revises its Discovery Plan to address the SHPO's comments, we would find the plan acceptable.

4.11.5 Compliance with the NHPA

The entire APE for the JCE & PCGP Project has not yet been completely inventoried. Jordan Cove has not yet documented a cultural resources survey that covers the NPWHC and parking lot, Mill Casino parking lot, and the Myrtlewood RV Camp parking lot. Jordan Cove has committed to testing at site 35CS221, and monitoring construction activities along the proposed utility corridor near previously recorded site 35SC227, along the haul road through the Roseburg Forest Products property, at the crossing of Jordan Cove Road, and at the Kentuck Slough wetland mitigation area.

Pacific Connector indicated that about 31 miles of the June 2013 pipeline route has not yet been inventoried; mostly for lack of access. In addition, 74 TEWAs, 3 UCSAs, 5 quarries or rock disposal areas, 11 yards, 1 PAR, 11 TARs, and 280 segments of existing access roads that would be improved remain to be inventoried. Parcels where landowners denied access cannot be surveyed until after the FERC authorizes the pipeline project, and Pacific Connector would have the power of eminent domain. Pacific Connector has also indicated that, where landowner access has been granted, survey work may be completed by October 2015.

Pacific Connector intends to conduct deep geoarchaeological testing at the three river crossings where HDDs would be used (Coos River, Rogue River, and Klamath River). Also, Pacific Connector would have an archaeologist monitor construction at 17 stream crossing that have potential for buried remains, but where previous shovel testing was negative.

Additional investigations are necessary at 27 archaeological sites on non-federal lands. Twelve sites on non-federal land and five sites on federal land have been determined eligible for the NRHP, cannot be avoided by the Project, and require data recovery excavations to mitigate adverse effects in accordance with approved treatment plans. The resolution of adverse effects at the affected historic properties was spelled out in the MOA produced in June 2011 for Docket

Nos. CP07-441-000 and CP07-444-000, and filed with the ACHP in August 2011. That MOA also outlined procedures for conducting phased additional surveys on lands where access was previously denied, and future evaluative testing. If the JCE & PCGP Project in Docket Nos. CP13-483-000 and CP13-492-000 is authorized by the Commission, the MOA would be updated and amended to account for differences between the LNG import and export proposals and the associated Pacific Connector pipeline.

To ensure that the Commission's responsibilities under the NHPA and its implementing regulations are met, **we recommend that:**

- **Jordan Cove and Pacific Connector should <u>not begin construction of facilities and/or use</u> all staging, storage, or temporary work areas and new or to-be-improved access roads <u>until</u>:**

  a. **Jordan Cove and Pacific Connector each file with the Secretary:**

     1. **remaining cultural resources inventory reports for areas not previously surveyed;**

     2. **site evaluation and monitoring reports, as necessary;**

     3. **avoidance and treatment plans, as required, and a final HPMP; and**

     4. **comments on the cultural resources reports and plans from the SHPO, applicable federal land managing agencies, and interested Indian tribes.**

  b. **the FERC amends the MOA, and affords the ACHP an opportunity to comment; and**

  c. **the FERC staff reviews and the Director of OEP approves all cultural resources reports and plans, and notifies Jordan Cove and Pacific Connector in writing that treatment plans may be implemented and/or construction may proceed.**

  All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE."

4.12 AIR QUALITY AND NOISE

4.12.1 Air Quality

Construction and operation of the Project can potentially affect local and regional air quality. The climatic conditions can significantly change how emissions of pollutants impact local air quality. The term "air quality" refers to relative concentrations of pollutants in the ambient air. The subsections below describe well-established air quality concepts that are applied to characterize air quality and to determine the significance of increases in air pollution. This includes metrics for specific air pollutants known as ambient air quality standards (AAQS), regional designations to manage air quality known as Air Quality Control Regions (AQCRs), and efforts to monitor ambient air concentrations.

Air quality impacts are spatially dependent, and therefore this section is divided into subsections as follows:

- Impacts in the Coos Bay area associated with the Jordan Cove LNG terminal (including the South Dunes Power Plant) and marine vessels on the waterway are discussed in section 4.12.1.1.
- Impacts associated with the Pacific Connector pipeline—for which the key air pollution sources are emissions from construction and operation of the compressor station in Klamath County—are discussed in section 4.12.1.2.
- Environmental consequences on federal lands are summarized in section 4.12.1.3.
- GHG emissions are discussed in section 4.12.1.4.

4.12.1.1 Jordan Cove LNG Terminal

Climate

The State of Oregon is divided into nine climate zones as established by the National Climactic Data Center (NCDC). The Jordan Cove LNG terminal and the waterway used by the LNG marine traffic lies in the southern part of Zone 1 – The Oregon Coast. The climate of the Project area is characterized by wet winters, relatively dry summers, and mild temperatures year round. Terrain features include the coastal plain, which extends from less than a mile to a few tens of miles in width, numerous coastal valleys, and the Coast Range, whose peaks range from 2,000 to 5,500 feet above sea level. The National Weather Service (NWS) maintains a climate station at the Southwest Oregon Regional Airport in Coos County. Climate data from this station should be representative of conditions in the area of the LNG terminal.

The heaviest precipitation in this zone occurs mainly during the winter months when moist air masses move off the Pacific Ocean onto land. Normal annual precipitation (as measured at the Southwest Oregon Regional Airport) is approximately 65 inches, with normal annual snowfall of approximately 1 inch. The highest monthly precipitation values occur during the months of November, December, and January.

The mean maximum temperature in North Bend/Coos Bay is approximately 60°F, the mean minimum temperature is approximately 46°F, and the mean temperature is approximately 53°F. Temperatures of 90°F or higher occur less than once per year, on average, and freezing temperatures are infrequent, with killing frosts being even less frequent. The area around the airport averages approximately 303 days (growing season) between the last occurrence (in spring) and the first occurrence (in fall) of 28°F temperatures.

Strong winds occur occasionally, usually in advance of winter storms. These winds can exceed hurricane force, and have been known to cause significant damage to structures and vegetation. Such events, however, are typically short-lived, and last less than one day. Partly cloudy skies are prevalent during the summer. Winter skies are likely to be cloudy. As a result of the persistent cloudiness, total solar radiation is relatively low in this zone.

Existing Air Quality

Existing air quality is typically characterized relative to EPA's National Ambient Air Quality Standards (NAAQS), which exist for seven pollutants:

- Oxides of sulfur (measured as sulfur dioxide, SO_2)
- Carbon monoxide (CO)
- Oxides of nitrogen (measured as nitrogen dioxide, NO_2)
- Ozone
- Particulate matter smaller than 10 micrometers (PM_{10})
- Particulate matter smaller than 2.5 micrometers ($PM_{2.5}$)
- Lead and its compounds (measured as lead)

These pollutants are referred to as "criteria pollutants" because EPA is required to periodically identify air quality criteria which reflect the latest scientific knowledge (including knowledge regarding the effects on children, asthmatics, and the elderly), and revise the NAAQS accordingly. The CAA requires EPA to set both primary NAAQS (which are necessary to protect human health, allowing an adequate margin of safety) and secondary NAAQS (necessary to protect the public welfare from any known or anticipated adverse effects; this includes effects on wildlife and vegetation). Emissions of other non-criteria pollutants are also regulated by EPA and state/local environmental agencies, even though NAAQS are not developed for them.

The NAAQS and the highest recently measured ambient concentrations of criteria pollutants at the nearest ambient air monitoring stations are shown in table 4.12.1.1-1. All areas of the United States are classified as being "attainment," "unclassified," or "nonattainment" with respect to the NAAQS. "Nonattainment" areas are required to develop plans to meet the standards by specified deadlines, and after meeting the standards are classified as "maintenance areas" (a subcategory of attainment areas, for areas previously designated as nonattainment). Coos County is part of the Southwest Oregon Interstate AQCR and is designated as "attainment" or "unclassifiable" (with no maintenance areas) for all of the NAAQS.

In addition to the NAAQS identified in table 4.12.1.1-1, states are allowed to set more stringent ambient air quality standards. Oregon has set more stringent ambient air quality standards for SO_2: i.e., a 24-hour average standard of 0.10 part per million (ppm) = 260 $\mu g/m^3$, and an annual average standard of 0.020 ppm = 52 $\mu g/m^3$. Oregon has also retained the annual PM_{10} standard of 50 $\mu g/m^3$, which was originally an NAAQS but was subsequently revoked by EPA.

Each of the criteria pollutants in table 4.12.1.1-1 except ozone are emitted directly; ozone can also be emitted directly by a few sources but is predominantly a result of reactions between oxides of nitrogen (NO_x)—predominantly NO_2 and nitrogen oxide (NO)—and VOCs in the air, particularly in the warmer months. For this reason, emissions inventories often refer to NO_x and VOCs as criteria pollutants as well.

TABLE 4.12.1.1-1

Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality Near Terminal

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Highest Recent Concentration h/	Background as Fraction of NAAQS
SO_2 (μg/m^3)	1-Hour a/	197	NA	Portland	22.7	0.12
	3-Hour b/	NA	1,300		21.0	0.02
	24-Hour b/	365	NA		10.5	0.03
	Annual	80	NA		4.2	0.05
CO (μg/m^3)	1-Hour b/	40,000	NA	Eugene	2,415	0.06
	8-Hour b/	10,000	NA		1,840	0.18
NO_2 (μg/m^3)	1-Hour c/	188	NA	Portland	66.4	0.35
	Annual	100	100		19	0.19
Ozone (ppm)	8-Hour d/	0.075	0.075	Lane County	0.061	0.81
PM_{10} (μg/m^3)	24-Hour b/	150	150	Eugene	55	0.37
$PM_{2.5}$ (μg/m^3)	24-Hour e/	35	35	Lane County	23	0.66
	Annual f/	12.0	12.0		7.5	0.62
Lead (μg/m^3)	3-Month g/	0.15	0.15	Eugene	0.002	0.01

a/ NAAQS applies to the 3-year average of the annual (99th percentile) of the daily max.1-hour avg. concentration.
b/ NAAQS is not to be exceeded more than once per calendar year.
c/ NAAQS applies to the 3-year average of the annual (98th percentile) of the daily max. 1-hour avg. concentration.
d/ NAAQS applies to the 3-year average of the annual 4th highest daily max. 8-hour avg. concentration.
e/ NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
f/ NAAQS applies to the 3-year average of annual concentrations.
g/ NAAQS applies to the maximum arithmetic 3-month mean for a 3-year period.
h/ For 1-hr SO2, 1-hr NO_2 , and $PM_{2.5}$ (24-hour and annual) the values in this column are the 3-year (2009–2011) averages that the NAAQS applies to. For other pollutants the annual values shown in this column represent the maximum concentrations seen in 2009–2011 and the shorter-term values are high second-high concentrations.

In addition to the criteria pollutants, other types of air pollutants include "air toxics" (as defined by ODEQ 340-246)—which include but are not limited to chemicals designated as Hazardous Air Pollutants (HAPs) by EPA—and greenhouse gases. Air toxics are a set of chemicals and chemical classes that often have carcinogenic, mutagenic, or other especially hazardous properties; most are subsets of criteria pollutants (i.e., several air toxics exist in the form of particulate matter and/or can be classified as VOCs). Ambient air quality standards do not typically exist for these pollutants; ODEQ regulations identify "ambient benchmarks" for some, but not all, and existing monitoring stations do not monitor all of these chemicals either. Aggregate impacts of air toxics are often assessed in terms of the lifetime cancer risk and respiratory hazard index, which are calculated based on conservatively determined cancer risk factors and reference exposure levels. EPA's latest National Air Toxics Assessment (for calendar year 2005) shows that regionally, the lifetime cancer risk associated with ambient air toxics concentrations in Coos Bay and the surrounding area is less than 100 in a million and the respiratory hazard index is between 1 and 10 (EPA 2011).

The term "greenhouse gases" (GHG) refers to the gases and aerosols that have been identified as the main cause of observed climate change over the past 50 years through radiative "forcing," which is an imbalance of heat trapped by the atmosphere compared to an equilibrium state (NCADAC 2013). The primary GHGs are CO_2, methane (CH_4), and nitrous oxide (N_2O). Climate change is a global issue although there are not specific "ambient standards" for these pollutants. However, unlike criteria pollutants and air toxics, GHG concentrations have been increasing over time and are continuing to increase. Criteria pollutants, air toxics, and GHGs have been associated with detrimental impacts.

Regulatory Requirements for Air Quality

Regulatory requirements for air quality—aside from the requirement that the overall project not contribute to a condition of air pollution (as defined by the NAAQS)—depend upon the equipment that is proposed to be constructed and the associated emissions. Sources of air pollution at the Jordan Cove LNG terminal and in the associated waterway include the following:

- LNG vessels and support vessels;
- gas conditioning systems (controlled by thermal oxidizers);
- emergency equipment (two flares, two diesel generators, four fire water pumps);
- two 160,000 m^3 capacity LNG storage tanks; and
- fugitive emission sources (valves, flanges, and other equipment).

In addition, the six natural gas-fired combined-cycle turbines and an emergency generator at the South Dunes Power Plant are considered part of the facility for air pollution regulatory purposes (even though approval of the power plant is not subject to the FERC's jurisdiction).

The LNG terminal air emission sources are regulated at the federal level and at the state level. Applicable federal and state air quality regulations are summarized below.

Federal and International Air Quality Requirements

Applicable and potentially applicable federal air quality regulations include:

- New Source Review (NSR)/Prevention of Significant Deterioration (PSD) preconstruction permit requirements;
- General Conformity;
- Title V Operating Permit requirements;
- New Source Performance Standards;
- National Emissions Standards for HAPs;
- Chemical Accident Prevention; and
- Mobile Source Regulations.

NSR/PSD Preconstruction Permit Requirements

The federal NSR preconstruction permit program is administered by ODEQ under OAR 340-224 and includes two components: Nonattainment NSR (NNSR), which applies to "major" stationary sources located in nonattainment areas, and PSD, which applies to "major" stationary sources located in attainment or unclassifiable areas. Because existing air quality is classified as "attainment" or "unclassifiable" for all NAAQS pollutants, only PSD regulations are applicable to this project, which is considered "major" and submitted a PSD permit application to ODEQ in March 2013.

A PSD permit must be obtained prior to commencing construction of a facility. Key requirements that must be met in order to obtain the permit include (a) application of "Best Available Control Technology" (BACT) for all pollutants that the facility has the potential to emit in significant amounts; and (b) a demonstration (using dispersion modeling) that maximum impacts from the maximum emissions from the facility comply with the NAAQS and do not result in "significant deterioration" of air quality.

The requirement to prevent significant deterioration of air quality was a result of recognition that if compliance with the NAAQS was the sole criteria for air quality, air quality could potentially deteriorate all the way up to the NAAQS. Therefore, cumulative impacts of sources constructed after a designated baseline year are not allowed to exceed the baseline concentration by more than a specified maximum increment. Increments are smaller for certain areas where air quality is considered a special feature of the area—i.e., areas designated as "Class I", which include international parks and various national wilderness areas and parks above specified sizes—than in other areas, which are designated as "Class II". Projects that have significant impacts are required to use dispersion models to determine whether the cumulative impacts of stationary sources that have been built or modified since specified baseline dates exceed the baseline concentrations by more than a specified maximum increment. PSD baseline dates and increments for criteria pollutants are shown in table 4.12.1.1-2. Increments are not identified for ozone, carbon monoxide, or lead; however, dispersion modeling does not apply to ozone (because ozone is primarily formed by reactions between other pollutants rather than being emitted directly) and emissions of carbon monoxide and lead have decreased dramatically over the years (primarily as a result of better vehicle emissions standards and the phaseout of leaded gasoline).

TABLE 4.12.1.1-2

PSD Baseline Dates and Increments for Criteria Pollutants

Air Pollutant	Averaging Period	Baseline Year	Class I Increment	Class II Increment
SO_2 (μg/m^3)	3-Hour	1978	25	512
	24-Hour	1978	5	91
	Annual	1978	2	20
NO_2 (μg/m^3)	Annual	1988	2.5	25
PM_{10} (μg/m^3)	24-Hour	1978	8	30
	Annual a/	1978	4	17
$PM_{2.5}$ (μg/m^3)	24-Hour	2007	2	9
	Annual	2007	1	4

μg/m^3 = microgram per cubic meter
a/ The NAAQS for annual-average PM_{10} concentrations no longer exists, but regulations still identify a maximum increment.

PSD permit regulations require sources that are sufficiently large and/or close to Class I areas to conduct refined Class I area analyses, including a quantitative of impacts on air quality related values (AQRV) such as visibility. The nearest Class I areas to the site of the LNG terminal are:

- Kalmiopsis Wilderness Area (Oregon), at a distance of 110 km;
- Diamond Peak Wilderness Area (Oregon), 164 km;
- Crater Lake National Park (Oregon), 165 km;
- Redwood National Park (California), 177 km;
- Three Sisters Wilderness Area (Oregon), 184 km; and
- Mountain Lakes Wilderness Area (Oregon), 185 km.

The Project's PSD permit application demonstrates compliance with all of the abovementioned requirements, and ODEQ would ensure compliance with these requirements before issuing a preconstruction permit.

General Conformity

For proposed activities that are not covered by NSR/PSD permits—such as construction activities—General Conformity requirements can apply in areas designated as "nonattainment"

or "maintenance" areas with respect to the NAAQS. However, as there are no such areas within the vicinity of the LNG terminal or along construction routes, these requirements do not apply.

Title V Operating Permit

Facilities that have the potential to emit at least 100 tons per year (TPY) of any criteria pollutant are required to obtain Title V Operating Permits, which are implemented by ODEQ under OAR 340-218. Since this project's emissions exceed that threshold, it will be required to apply for a Title V Operating Permit. For new sources (such as the ones proposed here), applications for these permits are due one year after the source commences operation.

The Title V Operating Permit will help ensure that the facility continues to comply with all applicable air regulations after it is built. These permits require periodic monitoring to ensure compliance with the permit, annual certification of compliance with all applicable air pollution regulatory requirements, and public comment on permit issuance/renewal and on significant modifications to the permit.

New Source Performance Standards

All new sources of air pollution are required to comply with applicable New Source Performance Standards (NSPS) regulations (40 CFR 60), which establish maximum emission limits for criteria pollutants (and their precursors) and also incorporate monitoring, reporting, and recordkeeping requirements. NSPS regulations that are applicable to the Project are discussed below.

The natural gas-fired turbines at the South Dunes Power Plant are subject to NSPS Subpart KKKK, which limits emissions of NO_x from the turbines (though this requirement is less stringent than the BACT requirement for PSD permitting).

The 2,500 kilowatt (kW) diesel emergency generator and five diesel fire pump engines (four at the LNG terminal and one at the South Dunes Power Plant) are subject to NSPS Subpart IIII, which requires that new or modified stationary engines meet the same emissions standards that manufacturers of comparable nonroad engines are required to comply with. Jordan Cove has committed to use only engines that meet EPA Tier 3 emissions standards or better.

New large storage tanks containing liquids that can emit significant amounts of VOCs—i.e., where the equilibrium partial pressure exerted by the VOC exceeds 3.5 kilopascals (kPa)—are subject to NSPS Subpart Kb. Historically, most if not all LNG tanks have not been subject to Subpart Kb because the storage temperatures are extremely cold, and the two largest constituents that exert partial pressure are methane and ethane (both of which are negligibly photochemically reactive and therefore exempt from the definition of VOC). However, for this facility, Jordan Cove has preliminarily identified that Subpart Kb does apply, and therefore Jordan Cove is proposing to install control equipment to reduce the VOC emissions by 95 percent.

National Emissions Standards for Hazardous Air Pollutants

New and existing sources of air pollution are required to comply with applicable National Emissions Standards for Hazardous Air Pollutants (NESHAP), many of which are also incorporated by reference into Oregon's regulations at OAR 340-244-0220. NESHAPs exist for the following source types included at the terminal and South Dunes Power Plant:

- Stationary Combustion Turbines (40 CFR 63, Subpart YYYY); and
- Stationary Reciprocating Internal Combustion Engines (40 CFR 63, Subpart ZZZZ).

For natural gas-fired turbines, the requirements of Subpart YYYY were stayed per 40 CFR 63.6095(d), and therefore, there are no applicable requirements. For the engines, compliance with NSPS Subpart IIII satisfies the requirements of 40 CFR 63 Subpart ZZZZ, and therefore, there are no additional applicable requirements.

Chemical Accident Prevention Provisions

LNG facilities are subject to safety regulations developed by the DOT (49 CFR 193) and the U.S. Department of Homeland Security (33 CFR 127). The EPA's Chemical Accident Prevention Provisions (40 CFR 68, which were developed in accordance with Section 112(r) of the CAA and referenced by Oregon regulations at OAR 340-244-0230) can also apply to owners or operators of stationary sources producing, processing, handling, or storing toxic or flammable substances. However, EPA's General Counsel has clarified that Section 112(r) and the associated regulations do not apply to LNG stored at terminals because the material is either being transported or stored incident to transportation (EPA 2006b).

Aside from LNG, which would be stored incident to transportation, the Project would not be storing hazardous or flammable substances in excess of any thresholds identified in 40 CFR 68, and therefore, those regulations do not apply. However, with regard to the storage of any small quantities of hazardous substances that are not being transported or stored incident to transportation, the 112(r)(1) general duty clause does apply:

> *The owners and operators of stationary sources producing, processing, handling or storing [hazardous] substances have a general duty in the same manner and to the same extent as section 654, title 29 of the United States Code, to identify hazards which may result from [accidental] releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.*

Mobile Source Regulations

International Maritime Organization (IMO) Standards for Ships – The IMO has officially designated waters off North American coasts as "Emission Control Areas" (ECAs) under Annex VI, which means that stringent international emission standards will apply to ships operating in these areas by the time the Project becomes operational. For example, effective in 2015, the sulfur content in marine fuels used in these waters will be required to contain no more than 0.1 percent sulfur (or else vessels can install control equipment to reduce emissions from fuels with higher sulfur contents to equivalent levels). In November 2011, IMO's Marine Environment Protection Committee adopted amendments that exempted boiler-propelled vessels "that were not originally designed for continued operation on marine distillate fuel or natural gas" (such as LNG vessels) from the fuel sulfur requirements until at least 2020 (IMO 2011). However, Jordan Cove has indicated that they would require vessels calling on the LNG terminal to meet the fuel sulfur requirements. In addition, diesel engines installed on vessels manufactured in 2016 or later are required to control NO_x emissions to levels that are approximately 80 percent lower than currently allowable levels ("Tier 1") when operating in ECAs (which in most cases will mean that NO_x control equipment will need to be installed). The IMO regulations also include requirements pertaining to emissions from shipboard incinerators

EPA Requirements for Marine Diesel Engines – All marine diesels larger than 37 kW that have been manufactured in the United States since January 1, 2004, are required to meet federal emissions standards identified in 40 CFR 94 or 40 CFR 1042; the newest engines are subject to the most stringent requirements ("Tier 4"). Although most engines on existing LNG vessels were not manufactured in the United States, some of the newer engines installed on tugs and other local support vessels may be subject to these regulations, and the Project's emissions calculations reflect the use of "Tier 2" or better diesel engines in the other marine equipment and "Tier 4" diesel engines in the tugboats.

EPA Requirements for Land-Based Engines and Vehicles – EPA has promulgated extensive regulations reducing emissions from new on-road vehicles and construction equipment, which has resulted in substantial emissions reductions over time in spite of increased equipment/vehicle populations and usage.

EPA Regulations on Fuels – Any diesel oil or gasoline sold in the United States that is used in or intended for use in marine engines or land-based engines is subject to federal regulations (40 CFR 80). Non-road, locomotive, and marine diesel sold in the United States must have a sulfur content no greater than 15 ppm (0.0015 percent) by weight. Although these requirements do not apply to diesel fuel (or boiler fuel) obtained by LNG vessels outside the United States, diesel fuel used by tugboats, support vessels, and construction equipment would need to meet these criteria. Gasoline is required to have a sulfur content of no more than 80 ppm per gallon, or more than 30 ppm on average for any given refinery or importer.

State Air Quality Requirements

In addition to the rules identified above, ODEQ has state-specific air quality requirements. Those that would be directly applicable to the Project, and those that have the appearance of being potentially applicable, are discussed below.

Oregon Construction Permit

Oregon requires that facilities subject to Title V Operating Permits obtain a Standard Air Contaminant Discharge Permit (ACDP) in accordance with OAR 340-216 prior to construction. As part of this permit, Plant Site Emission Limits are required to be obtained for all regulated pollutants, as per OAR 340-222-0020, and an air quality impact analysis must be conducted in accordance with OAR 340-216. Since the terminal is subject to the Title V Operating Permit regulations, an ACDP is required.

A Standard ACDP identifies all applicable requirements, identifies plant site emission limits (PSELs), and includes testing, recordkeeping, and reporting requirements sufficient to determine compliance with the PSEL. The PSD permit application for the terminal identifies that a Standard ACDP will be applied for.

Air Quality Impact Analysis

Oregon's PSD permit regulations cross-reference air quality analysis regulations in OAR 340-225-0050(1) and (2) and OAR 340-225-0060. These regulations are therefore applicable. With respect to the requirement for projects to demonstrate compliance with the NAAQS and PSD increments, ODEQ allows projects to show that their own impacts are below significant impact levels. Projects that cannot demonstrate impacts less than the significant impact levels must show that (a) modeled impacts from the proposed source and other PSD increment-consuming

sources are less than PSD increments, and (b) those impacts plus background concentrations are less than the NAAQS. As mentioned previously, the Project's PSD permit application demonstrates that the applicable requirements of these regulations are met.

Visible Emission and Nuisance Requirements

State visible emissions and nuisance abatement regulations are codified in OAR 340-208. Both construction and operation phases of the Project would be subject to visible emission limits stated in terms of opacity. The Project may not emit contaminants causing opacity to equal or exceed 20 percent in any period or periods aggregating more than 3 minutes in any hour. In addition, no person may create an observable deposition of particulate matter on another person's property (OAR 340-208-540).

This regulation prohibits nuisances, and requires that reasonable precautions be taken to minimize fugitive dust emissions in Special Control Areas (which include areas within 3 miles of the corporate limits of any city having a population of 4,000 or more).

Given that visible emissions from the combustion of gaseous fuels are typically far below 20 percent opacity and that the only fugitive dust emissions are likely to be those associated with construction, the project is not anticipated to have any difficulty meeting these regulations.

Construction Air Quality Impacts and Mitigation

During construction, a temporary reduction in ambient air quality may result from emissions and fugitive dust generated by construction equipment. Fugitive dust emission levels would vary in relation to moisture content, composition, and volume of soils disturbed. Fugitive dust and other emissions from construction activities generally do not result in a significant increase in regional pollutant levels, although local pollutant levels could increase temporarily.

Construction air pollutant emissions include exhaust and crankcase emissions from construction equipment, vehicles that transport workers and materials, vessels that transport equipment and constructing materials. Emissions of criteria pollutants from pile driving (for the LNG vessel berth and tug boat dock) and concrete batch plant are shown in table 4.12.1.1-3; emissions of criteria pollutants from other construction activities by year are shown in table 4.12.1.1-4. Emissions would occur over the duration of construction activity.

TABLE 4.12.1.1-3

Criteria Pollutant Emissions from Pile Driving and Concrete Batch Plant (tons)

Source	CO	NO_x	SO_2	VOC	PM (total)
Pile Driving	3.2	9.5	0.014	0.64	0.43
Concrete Batch Plant	-	-	-	-	1.0

TABLE 4.12.1.1-4

Criteria Pollutant Emissions from Other Terminal Construction Activities, By Year (tons)

Year	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$
One	3.57	6.76	0.014	0.55	91.52	9.52
Two	8.84	14.79	0.027	1.21	183.01	19.00
Three	10.72	15.27	0.039	1.28	182.95	18.93
Four	7.10	8.07	0.025	0.81	167.42	17.08
Five	0.23	0.31	0.001	0.02	0.01	0.01
Total	**30.46**	**45.20**	**0.106**	**3.86**	**624.91**	**64.54**

To mitigate construction-related emissions, all construction equipment would be maintained in accordance with manufacturers' recommendations and engine idling time would be minimized. As required by Federal regulations, construction equipment would combust diesel fuel with no more than 0.0015 percent sulfur, and vessels would combust fuel that complies with International Convention for the Prevention of Pollution from Ships and EPA standards for sulfur content.

Proven construction practices, such as water sprays and dust suppressants, would be employed to mitigate fugitive dust emissions during construction. The particular frequencies and methods employed would depend on the specific construction activities, terrain, soil conditions, and weather conditions.

Impacts from construction equipment would be temporary and would not result in a significant impact on regional air quality or result in any violation of an applicable ambient air quality standard. Measures to mitigate the air emissions during Project construction include the following:

Fugitive Dust Source Controls:

- Stabilization of open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions. Installing wind fencing, and phase grading operations, where appropriate, and operate water trucks for stabilization of surfaces under windy conditions.
- When hauling material and operating non-earthmoving equipment, prevent spillage, and limit speeds to 15 mph. Limit speed of earth-moving equipment to 10 mph.

Mobile and Stationary Source Controls:

- Reduce use, trips, and unnecessary idling of heavy equipment.
- Maintain and tune engines per manufacturer's specifications to perform EPA certification levels, where applicable, and to perform at verified standards applicable to retrofit technologies. Employ periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications.
- Prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations.
- Use construction equipment engines that incorporate modern pollution control technology. If practicable, lease new, clean equipment meeting the most stringent of applicable federal or state standards.

Therefore, we conclude that impacts from construction equipment would be temporary. While nearby residents may notice a localized increase in dust near the project area, no dust deposition on property would be allowed, and there would not be a significant impact on regional air quality or any violation of an applicable ambient air quality standard.

Operational Air Impacts and Mitigation

Operational emissions from the Project include those from the Jordan Cove LNG terminal and South Dunes Power Plant, those from the LNG vessels (including emissions in the waterway), and those from the transport of dredged materials to the open sea disposal site. These emissions are summarized in table 4.12.1.1-5.

TABLE 4.12.1.1-5

Criteria Pollutant Emissions During Operation of the LNG Terminal (tons per year)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$
Power Plant Turbines a/	132.3	154.1	46.1	74.8	180.4	180.4
Fugitive Emissions	0	0	0	131.05	0	0
Other Terminal/Power Plant Sources a/	23.8	66.9	17.4	3.45	1.5	1.5
LNG Vessels/Tugs b/	48.58	58.03	9.73	7.22	3.4	3.4
Transport of Dredged Materials c/	12.95	18.64	0.13	0.70	0.52	0.52
Total	**217.63**	**297.67**	**73.36**	**217.22**	**185.82**	**185.82**

a/ Based on maximum possible capacity of equipment to emit pollutants (potential to emit)
b/ Emissions include 1.5 hours of transit time to and from the berthing area; values are based on 90 vessel calls (by vessels with capacities of 148,000 cubic meters) per year, assuming worst-case emissions (i.e., vessel type with the highest emissions) for each pollutant.
c/ Based on the maximum yearly amount of expected maintenance dredging (36,700 cubic yards).

We received a comment during scoping asking if hydrogen sulfide would be present in the air emissions during operation of the facility. Very low concentrations of reduced sulfur compounds are present in pipeline natural gas coming into the terminal; specifically, hydrogen sulfide (H_2S) in gas obtained from (or stored) underground is generated by underground organisms (most but not all is removed by gas conditioning systems at production/storage sites). When natural gas is burned, essentially all of these sulfur compounds are oxidized to SO_2 (and calculations of SO_2 emissions from natural gas combustion are based on this assumption; i.e., 0.0006 pounds of SO_2 per thousand standard cubic feet of natural gas). Similarly, sulfur that is removed from the natural gas for the liquefaction process will be first scavenged (to a condensed phase) using the Ultrafab Sweet 100 Process (and subsequently disposed of off-site), and then any remaining sulfur not captured by that process will be oxidized to SO_2 using the thermal oxidizers. No detectable emissions of H_2S or other reduced sulfur compounds are expected to be produced during construction or operation of the facilities.

For the criteria pollutants, dispersion modeling of the combined impacts of the terminal, power plants, and LNG vessels/tugs was conducted using version 12345 of EPA's preferred dispersion model (AERMOD).[163] Secondary formation of PM was also accounted for in accordance with ODEQ guidance, by assuming that 1 percent of the NO_x emissions and 1 percent of the SO_2 emissions were converted to PM. For the permitting of just the stationary sources (i.e., terminal and power plants), regulations state that if worst-case impacts from worst-case project emissions are below the "significant" levels identified in OAR 240-200-0020 Table 1 (which are well below the NAAQS standards in table 4.12.1.1-1 and the PSD increments in 4.12.1.1-2), there is no need to quantitatively model impacts from other nearby sources as well. The PSD permit application showed that all CO impacts and annual impacts from SO_2, NO_2, and PM_{10} were below "significant" levels. However, since other impacts were "significant", multisource modeling was conducted which incorporated emissions from 12 other nearby facilities (Roseburg

[163] As mentioned previously, ozone is not modeled because it is not emitted directly; lead was not modeled because lead emissions from the Project are essentially nonexistent.

Forest Products, Bay Area Hospital, two Southport Forest Products facilities, Coastal Cremation and Funeral Services, Georgia Pacific West, three LTM facilities, Lower Umpqua Crematory, Laskey Clifton, and Oregon Resources Corp.). Because NEPA also required consideration of the LNG vessels/tugs, the multisource modeling also included emissions from these sources. Results are shown in table 4.12.1.1-6.

TABLE 4.12.1.1-6

Maximum Combined Impacts of Terminal, Power Plant, Marine Vessels, and Nearby Major Sources

Air Pollutant	Averaging Period	Maximum Cumulative Impact	Class II Increment	Maximum Cumulative Impact + Background	AAQS
SO_2 (μg/m^3)	1-Hour	57	NA	80	197
	3-Hour	23	512	44	1,300
	24-Hour	9	91	19	262
	Annual	0.3	20	5	52
CO (μg/m^3)	1-Hour	890	NA	3,305	40,000
	8-Hour	107	NA	1,947	10,000
NO_2 (μg/m^3)	1-Hour	114	NA	180	188
	Annual	1	25	20	100
PM_{10} (μg/m^3)	24-Hour	9	30	64	150
$PM_{2.5}$ (μg/m^3)	24-Hour	6.5	9	30	35
	Annual	0.8	4	8.3	12.0

μg/m^3 = microgram per cubic meter
a/ NAAQS applies to the 3-year average of the annual (99th percentile) of the daily maximum 1-hour average concentration.

For all pollutants, the combined impacts at the points of highest concentration are well below the applicable NAAQS and the PSD increments. Impacts on the distant Class I areas are discussed in section 4.12.1.3. Therefore, we conclude that there would be no significant impacts on regional air quality.

4.12.1.2 Pacific Connector Pipeline

Climate

As identified in section 4.12.1.1, the State of Oregon is divided into nine climate zones as established by the NCDC. The pipeline runs from Zone 1 (the Oregon Coast; as described in section 4.12.1.1) through Zone 3 (Oregon Southwestern Valleys) to Zone 7 (The South Central Oregon climate region; NCDC 1994). The primary source of air pollutants associated with Project operation is the proposed Klamath Compressor Station, which lies in Zone 7. The region surrounding the Klamath Compressor Station receives an annual average of 14.2 inches of precipitation per year (based on data from the Western Regional Climatic Center [WRCC] at the Klamath Falls 2 SSW weather station for the period January 1981 through December 2010). Average daily temperature is 50.4°F from the same station and reporting period. The prevailing wind direction is from the west at an average daily speed of 6.3 mph, as recorded at the Klamath Falls Airport Weather Station, from November 1997 to December 2008.

The air temperature extreme in Klamath Falls ranges from -10°F to 100°F. For the period 1997 to 2008, an air temperature below 0°F was recorded on average 1.3 days per year (i.e., at least one hourly reading was below 0°F on average 1.3 days per year) (WRCC 2012). Hourly meteorological data for Klamath Falls were obtained from the NCDC for the most recent five-year period (2008 to 2012) (NCDC 2013). During the 2008–2012 period, ambient air temperature at or below 0°F occurred for 84 hours for an average of approximately 17 hours (0.7 day) per year.

Ambient Air Quality Standards

The federal and Oregon ambient air quality standards applicable to the Pacific Connector Pipeline Project are identified in section 4.12.1.1.

Existing Air Quality

The Pacific Connector pipeline would pass through predominantly rural areas in Coos, Douglas, Jackson, and Klamath Counties. The Klamath Compressor Station would be located within an agricultural area approximately 1.8 miles northeast of Malin in Klamath County. The areas through which the pipeline would pass and in which the compressor station would be located all attain all ambient air quality standards (see section 4.12.1.1), with the exception that approximately 4.3 miles of pipeline would be located within the Klamath Falls $PM_{2.5}$ nonattainment area. In addition, approximately 325 feet of that section of pipeline would be located within the Klamath Falls PM_{10} maintenance area (i.e., an area that currently attains the PM_{10} standard, but was formerly designated as a nonattainment area). The compressor station would be located approximately 14 miles to the southeast of the southeast corner of the nonattainment area.

Background air quality data near the compressor station are presented in table 4.12.1.2-1. For $PM_{2.5}$ and NO_2, because the nearest monitors were not representative of the rural area where the compressor station is proposed to be located, ODEQ recommended values predicted by NW AIRQUEST (2013) Criteria Pollutant Design Value maps and lookup tables.

TABLE 4.12.1.2-1

Existing Air Quality Near Proposed Compressor Station

Air Pollutant	Averaging Period	Most Stringent AAQS	Background Concentration	Background Based On
SO_2 (μg/m^3)	1-Hour a/	197	22.7	Data from Nearest Monitoring Site (Portland) for 2009-2011
	3-Hour b/	1,300	21.0	
	24-Hour b/	260	10.5	
	Annual	52	4.2	
CO (μg/m^3)	1-Hour b/	40,000	8,278	Estimated using NW AIRQUEST (2013)
	8-Hour b/	10,000	6,229	
NO_2 (μg/m^3)	1-Hour c/	188	6.5	Estimated using NW AIRQUEST (2013)
	Annual	100	0.76	
Ozone (ppm)	8-Hour d/	0.075	0.061	Data from Nearest Monitoring Site (Medford) for 2011
PM_{10} (μg/m^3)	24-Hour b/	150	50	Data for Western Oregon for 2011
	Annual	50	-	(no record)
$PM_{2.5}$ (μg/m^3)	24-Hour e/	35	21	Estimated using NW AIRQUEST (2013)
	Annual f/	12.0	6.3	
Lead (μg/m^3)	3-Month g/	0.15	0.002	Data from Nearest Monitoring Sites (Klamath Falls and Medford) for 2009–2011

μg/m^3 = microgram per cubic meter
a/ AAQS applies to the 3-year average of the annual (99th percentile) of the daily max.1-hour avg. concentration.
b/ AAQS is not to be exceeded more than once per calendar year.
c/ AAQS applies to the 3-year average of the annual (98th percentile) of the daily max. 1-hour avg. concentration.
d/ AAQS applies to the 3-year average of the annual 4th highest daily max. 8-hour avg. concentration.
e/ AAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
f/ AAQS applies to the 3-year average of annual concentrations.
g/ AAQS applies to the maximum arithmetic 3-month mean for a 3-year period.
h/ Data not from NW AIRQUEST (2013) are from ODEQ (2012e).

Regulatory Requirements for Air Quality

Regulatory requirements for air quality depend in part upon the equipment that is proposed to be constructed and the associated emissions. Sources of air pollution at the compressor station would include:

- three Solar Titan 130-20502S natural gas-fired combustion turbines, each rated for 122 MMBtu/hr heat input at 60°F (the air permit would limit operation to only two turbines at a time; the third is solely for reliability to maintain maximum throughput for the pipeline at times when one of the two operating units is offline for maintenance);
- one 3 MMBtu/hr gas-fired hot water heater; and possibly
- one 800 kW natural gas-fired spark-ignition standby generator, limited to no more than 500 hours per year of operation.

The Pacific Connector Project air emission sources are regulated at the federal level and at the state level. Applicable federal and state air quality regulations are summarized below.

Federal Air Quality Requirements

The federal regulations that are applicable to the Pacific Connector pipeline include:

- NSR/PSD preconstruction permit requirements
- General Conformity requirements
- Title V Operating Permit requirements
- NSPS;
- National Emissions Standards for HAPs; and
- Mobile Source Regulations.

NSR/PSD Preconstruction Permit Requirements

As explained in section 4.12.1.1, federal NSR preconstruction permits are only required for "Federal major" sources, as defined by those regulations; for criteria pollutants in attainment areas, the "major source" thresholds are 100 TPY (or more, for some source types). Criteria pollutant emissions from the compressor station would be well below major source thresholds. Although GHGs are above previously identified major source thresholds, the Supreme Court made a ruling on June 23, 2014 (*Utility Air Regulatory Group [UARG] v. EPA [No. 12-1146])* that effectively disallowed the triggering of NSR/PSD based on the significance of GHG emissions alone. Therefore, the Pacific Connector Pipeline Project is not expected to trigger NSR/PSD.

General Conformity

For proposed activities that are not covered by air permits—such as construction activities—General Conformity requirements can apply in areas designated as "nonattainment" or "maintenance" areas with respect to the NAAQS. As mentioned above, approximately 4 miles of pipeline would be located within the Klamath Falls $PM_{2.5}$ nonattainment area, and approximately 300 feet of pipeline would be located within the PM_{10} maintenance area.

Federal regulations at 40 CFR 93 Subpart B require a General Conformity analysis for $PM_{2.5}$ nonattainment areas when emissions of $PM_{2.5}$ or $PM_{2.5}$ precursors—including SO_2, NO_x (unless NO_x is determined not to be a significant precursor), and VOC (only if VOC is determined to be

a significant precursor) exceed 100 TPY. Estimated emissions from construction activities are far below the General Conformity Applicability Threshold and therefore the General Conformity requirements do not apply.

Title V Operating Permit

Facilities that trigger PSD permitting, such as this one, are required to obtain Title V Operating Permits, which are implemented by ODEQ under OAR 340-218. The project would therefore be required to apply for a Title V Operating Permit. For new sources (such as the ones proposed here), applications for these permits are due one year after the source commences operation.

The Title V Operating Permit would help ensure that the facility continues to comply with all applicable air regulations after it is built. These permits require periodic monitoring to ensure compliance with the permit, annual certification of compliance with all applicable air pollution regulatory requirements, and public comment on permit issuance/renewal and on significant modifications to the permit.

New Source Performance Standards

The gas-fired combustion turbines located at the Klamath Compressor Station would be new and subject to NSPS Subpart KKKK (and are therefore specifically exempted from NSPS Subpart GG for stationary combustion turbines, as per 40 CFR 60.4305(b)). They would be required to meet an NO_x emission standard of 25 ppm by volume, dry basis, corrected to 15 percent oxygen (ppmvd @ 15 percent O_2) or approximately 1.2 pounds NO_x per megawatt hour generated (lb/MWh).

The potential spark-ignition emergency generator at the compressor station would be manufactured after June 12, 2006, and therefore would be subject to NSPS Subpart JJJJ, which requires that NO_x emissions be no higher than 2.0 grams per horsepower per hour (g/hp-hr) = 160 ppmvd @ 15% O_2 and that CO emissions be no higher than 4.0 g/hp-hr = 540 ppmvd @ 15% O_2.

National Emissions Standards for Hazardous Air Pollutants

New and existing sources of air pollution are required to comply with applicable NESHAPs, many of which are also incorporated by reference into Oregon's regulations at OAR 340-244-0220. NESHAPs exist for the following source types included at the compressor station:

- Stationary Combustion Turbines (40 CFR 63, Subpart YYYY); and
- Stationary Reciprocating Internal Combustion Engines (40 CFR 63, Subpart ZZZZ).

For natural gas-fired turbines, the requirements of Subpart YYYY were stayed per 40 CFR 63.6095(d), and therefore there are no applicable requirements. For the engines, compliance with NSPS Subpart JJJJ satisfies the requirements of 40 CFR 63 Subpart ZZZZ, and therefore there are no additional applicable requirements.

Mobile Source Regulations

The mobile source regulations are the same as identified in section 4.12.1.1, except that those pertaining to marine vessels are not applicable to the Pacific Connector Project.

State Air Quality Requirements

In addition to the rules identified above, ODEQ has state-specific air quality requirements. Those that would be directly applicable to the Project, and those that have the appearance of being potentially applicable, are discussed below.

Oregon Construction Permit

Oregon requires that facilities subject to NSPS regulations with emissions greater than 10 TPY obtain a Standard Air Contaminant Discharge Permit in accordance with OAR 340-216 prior to construction. As part of this permit, Plant Site Emission Limits are required to be obtained for all regulated pollutants, as per OAR 340-222-0020, and an air quality impact analysis must be conducted in accordance with OAR 340-216.

General Emission Standards

Under OAR 340-226, sources that are not already subject to NSPS requirements (as identified above) or other new source standard and have the potential to emit at least 1 TPY of any criteria pollutant must meet the requirements for Typically Achievable Control Technologies.

Air Quality Impact Analysis

Oregon's air quality impact analysis regulations are described in section 4.12.1.1.

Visible Emission and Nuisance Requirements

Oregon's visible emission and nuisance regulations are described in section 4.12.1.1.

Oregon Title V Permit

Oregon's Title V permit regulations are described in section 4.12.1.1.

Construction

Emissions from construction equipment have been reduced over time as a result of the federal regulations for mobile engines and fuels, and measures would be taken by Pacific Connector to minimize fugitive dust. Criteria pollutant emissions from construction are detailed in table 4.12.1.2-2; total emissions of the most prevalent HAP (aldehydes) would be 19 tons. Helicopter activity is uncertain and emissions from helicopters were not quantified, but these are not anticipated to be significant compared to the emissions shown in table 4.12.1.2-2. Pipeline construction spread activities would occur in sequence or in assembly-line fashion along the right-of-way with one crew following the next from clearing until final cleanup. Emissions from any given stage of construction would therefore be spread out along the construction corridor due to the sequence/assembly-line nature of the work, rather than being concentrated in a specific stationary location. As work proceeds, there are often small periods between job tasks when work at a specific location on the right-of-way is delayed such as between trenching and pipe stringing or pipe stringing and welding. As the work crews move along the corridor, the construction equipment would produce emissions and these emission sources would move along the corridor as work progresses.

TABLE 4.12.1.2-2

Criteria Pollutant Emissions from Compressor Station and Pipeline Construction (tons)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$
Compressor Station – Fugitive Dust on Unpaved Roads	0	0	0	0	4.67	0.47
Compressor Station – Fugitive Dust from Materials Handling	0	0	0	0	2.04	2.04
Compressor Station – Construction Equipment Exhaust	1.48	1.52	0.07	0.29	0.21	0.20
Pipeline – Fugitive Dust from Materials Handling	0	0	0	0	146.32	146.32
Pipeline – Fugitive Dust from Roads	0	0	0	0	123.45	12.55
Timber Removal – Fugitive Dust from Roads	0	0	0	0	30.92	3.22
Pipeline (Spread 1) – Construction Equipment Exhaust	17.38	35.39	2.39	4.40	4.36	4.23
Pipeline (Spread 2) – Construction Equipment Exhaust	18.01	32.82	31.35	4.06	3.99	3.87
Pipeline (Spread 3) – Construction Equipment Exhaust	16.97	25.77	21.09	3.10	3.02	2.93
Pipeline (Spread 4) – Construction Equipment Exhaust	12.55	23.56	16.11	2.79	2.82	2.73
Pipeline (Spread 5) – Construction Equipment Exhaust	12.49	20.11	20.78	2.50	2.46	2.39
Total	**78.88**	**139.17**	**91.79**	**17.14**	**324.26**	**180.95**

Comparing emissions (from mobile equipment) in table 4.12.1.2-2 to the NAAQS (values and averaging times) in table 4.12.1.1-1, the most important pollutants are likely to be NO_2 and SO_2 (which have 1-hour average NAAQS), which are emitted predominantly from fuel combustion in construction equipment, and PM (for which there are 24-hour average NAAQS of 35 $\mu g/m^3$ $PM_{2.5}$ and 150 $\mu g/m^3$ PM_{10}). The fuel combustion emissions from construction are far lower than those for freeways and highways in areas that EPA has designated as attainment areas, and the predominant source of PM is fugitive dust (for which emissions estimation procedures have typically largely over-predicted emissions compared to what is seen in ambient measurements) (Watson and Chow 2000; Countess Environmental 2001). Therefore, impacts from construction equipment would be temporary and are not likely to result in a significant impact on regional air quality or result in any violation of applicable ambient air quality standard. As is discussed above, measures to mitigate the air emissions during pipeline construction would include the following:

Fugitive Dust Source Controls:

- Stabilization of open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions.
- Installing wind fencing, and phase grading operations, where appropriate, and operate water trucks for stabilization of surfaces under windy conditions.
- When hauling material and operating non-earthmoving equipment, prevent spillage, and limit speeds to 15 mph. Limit speed of earth-moving equipment to 10 mph.

Mobile and Stationary Source Controls:

- Reduce use, trips, and unnecessary idling of heavy equipment.
- Maintain and tune engines per manufacturer's specifications to perform EPA certification levels, where applicable, and to perform at verified standards applicable to retrofit technologies. Employ periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications.
- Prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations

- Use construction equipment engines that incorporate modern pollution control technology. If practicable, lease new, clean equipment meeting the most stringent of applicable federal or state standards.

Local residents nearby to construction may notice a localized increase in dust (i.e., directly around the project area) from construction activities; however, no dust deposition on property would be allowed, and Pacific Connector would spray water on the right-of-way, and perhaps use Dustlock®, in addition to water, for dust control. Pipeline construction crews would move quickly down the right-of-way in a linear fashion, and few locations would see sustained construction for significant lengths of time. Therefore, we conclude that impacts from construction equipment would be temporary and would not result in a significant impact on regional air quality or result in any violation of applicable ambient air quality standard.

Operation Air Quality Impacts and Mitigation

Emissions of criteria pollutants from operation of the compressor station and pipeline are shown in table 4.12.1.2-3. Potential emissions of HAP from the turbines, boiler, and generator are estimated to be just 1.3 TPY.

TABLE 4.12.1.2-3

Criteria Pollutant Emissions from Operation of Compressor Station and Pipeline (tons per year)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$
Compressor Station Turbines a/	65	64	4.1	7.4	7.9	7.9
Compressor Station Fugitive Emissions	0	0	0	4	0	0
Boiler and Generator a/	2.1	1.1	0.01	0.4	0.11	0.11
Pipeline Fugitive Emissions	0	0	0	0	0	0
Total	**67.1**	**65.1**	**4.11**	**11.8**	**8.01**	**8.01**

a/ Based on maximum possible capacity of equipment to emit pollutants (potential to emit), with the exception that turbine operation at temperatures below 0 degrees Fahrenheit is excluded.

For the pollutants emitted from the turbine in the greatest quantities (i.e., CO and NO_2) a screening model (AERSCREEN) assessment was made, and the maximum results are shown in table 4.12.1.2-4. Emissions of other pollutants were below Significant Emissions Rates identified by ODEQ as a trigger for dispersion modeling. Pacific Connector has not yet filed an air permit application and the model has not yet been reviewed by ODEQ; however, ODEQ would only issue the project a permit if the applicant can demonstrate compliance with the NAAQS to ODEQ's satisfaction.

TABLE 4.12.1.2-4

Screening-Level CO and NO_2 Impacts from Compressor Station Turbines

Air Pollutant	Averaging Period	Maximum Impact	Background	Maximum Cumulative Impact Background	AAQS
CO (μg/m^3)	1-Hour	159	8,278	8,437	40,000
	8-Hour	143	6,229	6,372	10,000
NO_2 (μg/m^3)	1-Hour	178 a/	6.5	184.5	188
	Annual	18 a/	0.76	19	100

a/ Based on an assumption that 10% of NO_x emissions are NO_2. Another reference (Wehrum et al. 2011) has identified that for the turbines proposed here—Solar Titan 130-20502S—19% of the NO_x emissions are NO_2. As Pacific Connector develops the air permit application and modeling protocol for the Klamath compressor station and Solar provides refined compressor turbine data, a site-specific NO_2/NO_x ratio would be developed.

Based on this preliminary analysis, the compressor station could have 1-hour NO_2 impacts that approach the NAAQS; however, the screening model is highly conservative and the applicant would be required to address this issue as part of the air permitting process. Pacific Connector would not be issued an air permit if it caused an exceedance of the NAAQS. We conclude that because the highly conservative screening model identifies impacts on air quality to be below the NAAQS, the Project would not have a significant impact on regional air quality.

4.12.1.3 Environmental Consequences on Federal Lands

Potential emissions from the LNG terminal and South Dunes Power Plant were high enough to trigger a quantitative analysis of air quality impacts on the nearest Class I areas, even though these areas are quite distant. A screening evaluation for just these sources (but not the marine vessels or other major sources that obtained permits since the baseline dates) was conducted by conservatively calculating impacts at a distance of just 50 km (about 31 miles) in accordance with ODEQ guidance; results are shown in table 4.12.1.3-1. Although the impacts of the marine vessels and other major sources near the LNG terminal were not quantified, the results in table 4.12.1.3-1, coupled with the relative quantities of emissions identified in section 4.12.1.1, and the fact that all of the Class I areas are actually more than 100 km (about 62 miles) distant, indicated that combined impacts at the Class I areas would still be well below the increments. Federal land managers reviewed the Project's details and confirmed that a refined Class I AQRV analysis was not required (Cummings 2013).

TABLE 4.12.1.3-1

Maximum Impacts of Terminal and Power Plant at a Distance of 50 km

Air Pollutant	Averaging Period	Maximum Impact	Class I Increment	Maximum Cumulative Impact Background	AAQS
SO_2 (µg/m^3)	3-Hour	1.1	25	44	1,300
	24-Hour	0.2	5	19	262
	Annual	0.01	2	5	52
NO_2 (µg/m^3)	Annual	0.03	2.5	20	100
PM_{10} (µg/m^3)	24-Hour	0.9	8	64	150
	Annual	0.04	4	4.0	(N/A)
$PM_{2.5}$ (µg/m^3)	24-Hour	0.9	2	30	35
	Annual	0.04	1	8.3	12.0

µg/m^3 = microgram per cubic meter
a/ NAAQS applies to the 3-year average of the annual (99th percentile) of the daily max.1-hour avg. concentration.

Air pollution regulations treat other (Class II) federal lands in the same manner as non-federal Class II lands. The nearest federal lands in the vicinity of the Jordan Cove terminal include the ODNRA immediately north, and COE and BLM land on the North Spit. The pipeline route would cross various parcels of Class II areas administered by the BLM, Forest Service, and Reclamation. Dispersion modeling of terminal operations illustrated that impacts at the locations nearest the terminal would be less than the maximum Class II impacts identified above.

The closest Class I area to the Klamath Compressor Station is Lava Beds National Monument in California. This Class I area is approximately 35 km (about 22 miles) to the southwest of the compressor station site. A screening analysis of the potential impact from compressor station operational emissions on Lava Beds National Monument was performed using guidance found in the Federal Land Managers AQRV Workgroup Phase I Report (Forest Service et al. 2010), and it was shown that the screening value for the compressor station is far below the screening criteria; therefore, no additional analysis was conducted.

The pipeline route would pass closest to the Mountain Lakes Wilderness Class I area. The shortest distance between the Mountain Lakes Wilderness boundary and the pipeline is 4.5 miles (7.3 km), located at about MP 172.5. Pipeline construction spread 4 would operate between MPs 132.1 and 188.6, a total distance of 56.5 miles (90.9 km). Thus, emission sources for construction spread 4 would vary in distance from Mountain Lakes as the spread moves along the right-of-way. The potential air quality impact on Mountain Lakes would decrease as the distance between construction spread activity and Mountain Lakes increases (as the spread moves away from the closest point to Mountain Lakes). Pipeline construction would generally occur at a steady pace; therefore, it is reasonable to expect that these construction emissions for spread 4 (shown in table 4.12.1.2-4) would be evenly distributed throughout the spread 4 construction corridor (except for in areas where terrain or other factors slow the rate of construction). For the pollutants of highest concern, emissions expected per kilometer of pipeline route would only be 0.26 ton/km of NO_x, 0.18 ton/km of SO_2, and 0.42 ton/km of PM_{10}. Applying the Forest Service et al. (2010) screening analysis mentioned above to these emissions again results in impacts far below the screening criteria. Pacific Connector would consult with the federal land managers of Class I areas during the air permit process. For the Class II federal lands areas that are crossed by the pipeline, construction sources would have only a temporary impact on air quality and there are no operational sources of emissions located in those areas (i.e., the terminal and compressor station are not located on or near federal lands).

Terminal sources are distant from federal lands. The nearest Class I area is more than 100 km away, and even a very conservative screening analysis shows that impacts from the LNG terminal would not be significant on federal lands. While about 71 miles of pipeline route would cross federal lands, the closest Class I area would be within 10 km of one point. Emissions associated with pipeline construction activities are very low; and these activities would be temporary and transient as crews move in a linear fashion along the right-of-way. Therefore, we conclude that the analysis illustrates that the Project would not adversely affect air quality on federal lands.

4.12.1.4 Climate Change and Greenhouse Gas Emissions

Climate change is a significant global environmental issue. As identified in the White House CEQ Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts, "*climate impacts are not attributable to any single action*", and "*in light of the difficulties in attributing specific climate impacts to individual projects, CEQ recommends agencies use the projected GHG emissions…as the proxy for assessing a proposed action's potential climate change impacts*" (CEQ 2014: 8–9). This is the approach taken in this EIS (i.e., this section addresses the issue of GHG emissions, and the cumulative impacts of climate change are discussed in section 4.14.3.12).

The Intergovernmental Panel on Climate Change (IPCC) is the leading international, multi-governmental scientific body for the assessment of climate change. The United States is a member of the IPCC and participates in the IPCC working groups. The IPCC's latest assessment has identified that "*it is assessed that more than half of the observed increase in global average surface temperature from 1951 to 2010 is very likely [90-100% probability] due to the observed anthropogenic increase in [well-mixed] GHG concentrations*" (Stocker et al. 2013). This conclusion is also supported by the leading United States scientific body on climate change, the United States Global Change Research Program (USGCRP), in which 13 federal departments

and agencies participate (Melillo et al. 2014: 20). The principal well-mixed GHGs are CO_2, CH_4, N_2O, and specific fluorinated gases which trap heat in the atmosphere.

Assessing Impacts of Different GHGs

To account for the fact that each gas has a different impact, GHGs are expressed in "carbon dioxide equivalents" (CO_2e or CO_2eq). For example, if a project's CO_2 emissions were 1 million tons per year and emissions of another GHG are 0.01 million tons per year, but the other GHG has 20 times the impact of CO_2, the emissions of the second GHG are weighted by a factor of 20, and total impacts would be identified as (1 million tons) + (20 × 0.01 million tons) = 1.2 million tons CO_2e.

Traditionally, the weighting factors used have been Global Warming Potentials (GWPs) identified by the IPCC. The IPCC's latest (fifth) Assessment Report (AR5) identifies a new type of weighting factor, the Global Temperature change Potential (GTP), which includes physical processes that the GWP does not, including climate sensitivity and the exchange of heat between the atmosphere and the oceans (Myhre et al. 2013: 711–712). Several commenters on the DEIS were interested in the weighting factor applied for methane, which is typically the second-most important GHG compared to CO_2; the values for the GWP and GTP of methane identified in IPCC's AR5 range from 4 to 84, for time horizons ranging between 20 years and 100 years. IPCC noted that "[t]here are significant uncertainties related to both GWP and GTP, and the relative uncertainties are larger for GTP" and that "[a]ll choices of [weighting factor] contain implicit value-related [judgments] such as type of effect considered and weighting of effects over time" (Myhre et al. 2013: 663).

Traditionally, the weighting factors used have been GWPs for 100-year time horizons. Although IPCC has identified that GWPs have usually been integrated over 20, 100, or 500 years and that "[t]here is no scientific argument for selecting 100 years compared with other choices" (Myhre et al. 2013: 711), this report continues the tradition of using 100-year GWPs, partly since this is the convention used by nearly every (if not every) emissions assessment (and therefore allows for comparable context) and partly because historically the 100-year time horizon values for methane lie between the 20-year and 500-year values.

An issue raised by commenters was whether to use 100-year GWP values from IPCC's Second Assessment Report (AR2) (which are cited by the Kyoto Protocol, were used to create the figure from ODEQ's 2013 GHG emissions inventory report that is referenced later in this section, and are also used in California's mandatory GHG reporting program), Fourth Assessment Report (AR4) (which are currently used in EPA's mandatory GHG reporting program), or AR5 (which ODEQ has identified that their next inventory report will use) (Allaway 2015). For methane, the values from AR2, AR3, AR4, and AR5 are 21, 23, 25, and 28, respectively. Different analyses cited by the EIS have been based on different GWPs, and it is neither practical nor advisable to convert the results of all of these analyses, given both (a) the lack of a scientific argument for selecting one over another and (b) the fact that for the sources identified for this Project, the GHG emissions are dominated by CO_2 regardless of which set of 100-year GWPs are selected. However, to be clear, this EIS makes an effort to cite which GWPs were used in which cited references, when this information is readily available.

Context

IPCC identified that worldwide anthropogenic (man-made) GHG emissions were 49 gigatonnes (49,000 million metric tonnes) of CO_2e in 2010 (IPCC 2014: 7).[164] The Technical Summary for Working Group III (Mitigation) also noted the following:

> *Between 2000 and 2010, increased use of coal relative to other energy sources has reversed a long-standing pattern of gradual decarbonization of the world's energy supply (high confidence). Increased use of coal, especially in developing Asia, is exacerbating the burden of energy-related GHG emissions.* (Edenhofer et al. 2014: 48)

This is consistent with Asian Development Bank's Energy Outlook for Asia and the Pacific 2010-2035, which predicts that "Asia and the Pacific's energy demand [is] set to sharply outpace the rest of the world's over the next two decades" and that fossil fuels—primarily coal—will continue to dominate the energy mix (Asian Development Bank 2013). IPCC's Working Group III also concluded that:

> *GHG emissions from energy supply can be reduced significantly by replacing current world average coal-fired power plants with modern, highly efficient natural gas combined cycle power plants or combined heat and power (CHP) plants, provided that natural gas is available and the fugitive emissions associated with its extraction and supply are low or mitigated (robust evidence, high agreement).* (Edenhofer et al. 2014: 70)

The FERC is aware of a well-publicized study that identified that EPA emission factors for leakage from existing natural gas systems may be low; however, that same study still concluded that while "*diligence will be required to ensure that leakage rates are low enough to achieve sustainability goals, ... assessments using 100-year impact indicators show system-wide leakage is unlikely to be large enough to negate climate benefits of coal-to-[natural gas] substitution*" (Brandt et al. 2014).[1644] Both the EPA and the natural gas industry have prioritized methane leak reduction (EPA 2014; INGAA 2014). It is also recognized that exported natural gas could potentially replace lower emitting energy sources (e.g., solar and wind) instead of coal. Although this is theoretically possible; FERC maintains that exact quantitation of the extent to which different types of sources would or could be offset depends on a variety of socioeconomic factors and is speculative in nature.

Nationally, in calendar year 2011, GHG emissions from all sources within the U.S. were 6.7 gigatonnes (6,700 million metric tonnes, or 7.4 billion short tons) of CO_2e (EPA 2013b).[1644]

On August 6, 2007, Oregon's Governor signed House Bill 3543, which established the following GHG emissions reductions goals for the state:

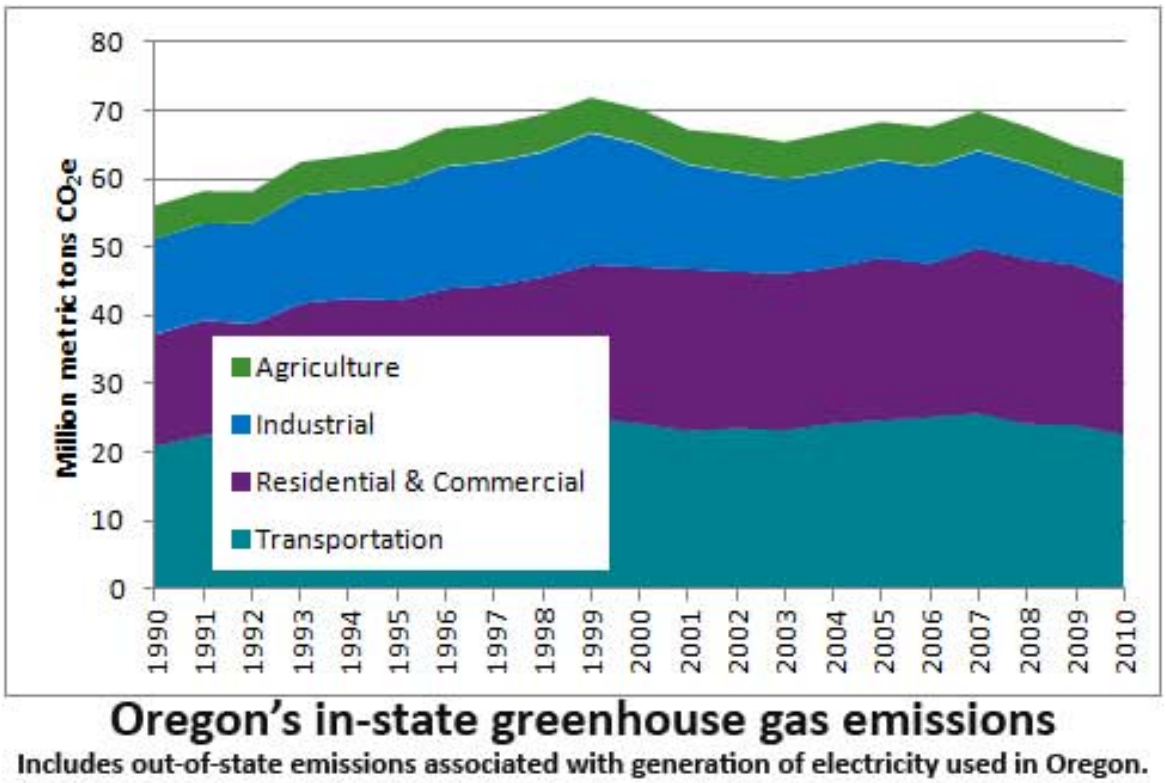
a) By 2010, arrest the growth of Oregon's greenhouse gas emissions and begin to reduce GHG emissions.
b) By 2020, achieve GHG levels that are 10 percent below 1990 levels.
c) By 2050, achieve GHG levels that are at least 75 percent below 1990 levels.

[164] Calculation of CO_2e based on AR2 100-year GWPs (21 for methane, 310 for N_2O).

In 2013, a joint report was published by ODEQ, ODE, and ODOT identifying Oregon's GHG emissions between 1990 and 2010 (ODEQ et al. 2013). Figure 4.12-1 indicates that the growth of Oregon's GHG emissions has been arrested as planned. The report also notes how natural gas has contributed significantly to GHG emissions reductions during that time period:

> *Similar to residential and commercial activities, emissions from the industrial sector come primarily from electricity generation and natural gas combustion. Emissions from petroleum combustion have declined since the late 1990s largely because many facilities transitioned from distillate fuels to natural gas and from structural changes in Oregon's industrial base.* (ODEQ et al. 2013: 19)

The report also notes that "there are significant potentials for reducing trucking emissions by using cleaner fuels such as liquefied natural gas (LNG) and shifting some cargo movements to freight modes that emit fewer emissions."



(Source: ODEQ et al. 2013)

Figure 4.12-1. Trends in Oregon's In-State GHG Emissions[1644]

Emissions from Proposed Project and Related Actions

GHG emissions associated with construction and operation are shown in tables 4.12.1.4-1 and 4.12.1.4-2, respectively.[1644] The transmission of natural gas in Pacific Connector's welded steel underground pipeline is not likely to leak significant amounts of methane into the atmosphere.

TABLE 4.12.1.4-1

Emissions of Greenhouse Gases from Construction

Source	Total CO_2 Equivalents (metric tonnes)
GHG Emissions from Terminal Construction (Pile Driving)	1,157
GHG Emissions from Terminal Construction (Other Fuel Combustion)	12,146
GHG Emissions from Pipeline Construction (Fuel Combustion)	49,275
GHG Emissions from Timber Removal (Fuel Combustion)	1,011
GHG Emissions from Pipeline Combustion (Slash Burning)	1,555
Total	**65,144**

Tables 4.12.1.4-1 and 4.12.1.4-2 do not include emissions associated with transoceanic voyages of LNG vessels. Because the Project is proposed to export LNG "for shipment to customers around the Pacific Rim," it can be construed that emissions from trans-Pacific voyages of LNG vessels are "connected actions" as defined by NEPA—i.e., to the degree that they "cannot or will not proceed unless other actions (in this case, project construction) are taken previously or simultaneously" and "are interdependent parts of a larger action and depend on the larger action for their justification" (40 CFR 1508.25(a)(1)). NEPA does not, however, require agencies to engage in speculative analyses or provide information that will not meaningfully inform the decision-making process. Even if we were to find a sufficient connected relationship between the Project and the downstream LNG vessel transit to Asia, it would still be difficult to meaningfully consider these downstream impacts, primarily because emission estimates would vary for a broad range of LNG vessel transit destinations, industry activities, and emissions factors associated with those activities. For these reasons, we believe that any life-cycle analysis of the emissions from the LNG vessel transits to possible Asian markets or the emissions resulting from the end use combustion of natural gas is too speculative to permit any meaningful consideration. For informational purposes, LNG vessel emissions have been estimated at between 7,800 and 11,430 metric tonnes CO_2 per one-way route (for a distance of approximately 9,100 miles = 7,908 nmi each way) (Heede 2006).[165] For the estimated 90 calls per year at the Jordan Cove LNG terminal, this corresponds to approximately 180 roundtrips or approximately 1.4 to 2.1 million metric tonnes CO_2 per year, but actual numbers may vary depending on the destination of the vessels and advances in vessel technology.

TABLE 4.12.1.4-2

Emissions of Greenhouse Gases from Operation

Source	Total CO_2 Equivalents (metric tonnes/yr)
Power Plant Turbines	1,538,170
Fugitive Emissions from Terminal/Power Plant	3,220
Other Terminal/Power Plant Sources	423,517
LNG Vessels/Tugs	4,813
Transport of Dredged Materials (Combustion)	950
Compressor Station (Combustion)	122,636
Compressor Station (Blowdowns and fugitive leaks)	7,298
Pipeline (Blowdowns and fugitive leaks)	149
Total	**2,100,753**

In addition, it is very likely that the natural gas would be combusted by end users. Again, the extent to which end-use combustion in Asian markets is impacted by this Project is speculative, given that there is currently a significant extent of coal combustion (which emits considerably

[165] Calculation of CO_2e based on AR3 100-year GWP (23 for methane).

more GHG than gas) in Asia, and natural gas could come from other sources. However, for context, GHG emissions from the end use of natural gas are approximately 53.8 kg CO_2e per million Btu of natural gas (40 CFR 98). The quantity of natural gas associated with the estimated 90 LNG vessels per year—assuming a maximum LNG vessel size of 148,000 m^3—is approximately 470 million ft^3/yr, and the heating value of LNG is approximately 600,000 Btu/ft^3. Therefore, the end-use GHG emissions associated with this quantity of natural gas are approximately 15 million mt/yr of CO_2e. We believe that any life-cycle analysis of the potential emissions from the end use combustion is too speculative to permit any meaningful consideration.

Several commenters on the DEIS raised the issue of the extent to which this proposed Project would induce domestic natural gas production and cause environmental impacts from increased hydraulic fracturing. DOE has gone beyond what is required by NEPA by drafting an "Addendum to Environmental Review Documents Concerning Exports of Natural Gas from the United States" (DOE 2014) for the purpose of providing additional information regarding the potential environmental impacts of unconventional natural gas production activities. That being said, DOE notes that:

> *Fundamental uncertainties constrain the ability to predict what, if any, domestic natural gas production would be induced by granting any specific authorization or authorization to export LNG to non-FTA countries….The current rapid development of unconventional natural gas resources will likely continue, with or without the export of natural gas….Exporting natural gas may accelerate the timing of the development [of] unconventional resources and the associated potential impacts. However, it is not reasonable to assume that unconventional natural gas production and the associated potential impacts will not occur if natural gas exports to non-FTA countries are prohibited.* (DOE 2014: 1-2).

Given the global nature of GHG emissions, there has been interest in "life-cycle analysis" evaluations of GHG. For example, in 2008, ODE evaluated life-cycle GHG emissions for LNG import terminals by estimating the GHG emissions associated with energy required to produce LNG, ship it long distances in LNG vessels, and vaporize it back into natural gas at an import terminal (ODE 2008). ODE concluded that for combustion in a conventional power plant, life-cycle GHG emissions associated with use of LNG were between 6 and 12 percent higher than those associated with domestic natural gas sources, approximately the same as those associated with syngas combustion (downstream of carbon capture and sequestration), and 39 to 48 percent less than those associated with coal.[166] A recent study for the DOE by the National Energy Technology Laboratory (NETL 2014) estimated that even based on the worst-case (highest) methane weighting factor (i.e., the 20-year GWP of 84, from IPCC's AR5), life-cycle GHG emissions of exporting LNG from New Orleans, Louisiana to Shanghai, China to use as fuel to burn in an electric power plant would be 824 kg CO_2e/MWh, which is lower than using coal from China (1,095 kg CO_2e/MWh) or natural gas transported by pipeline from Yamal, Russia (1,009 kg CO_2e/MWh). NETL did not model life-cycle GHG emissions resulting from exporting LNG from the West Coast of the United States to Asian markets, but it is likely that these would be lower than exporting LNG from New Orleans given the geographical proximity.

[166] This report did not reference the GWPs used to calculate CO_2e.

Mitigation

As identified by IPCC, increased use of coal, especially in developing Asia, is exacerbating the burden of energy-related GHG emissions, and these emissions can be reduced significantly by replacing current world average coal-fired power plants with modern, highly efficient natural gas combined cycle power plants or combined heat and power plants, provided that natural gas is available and the fugitive emissions associated with its extraction and supply are low or mitigated. So to the extent that this Project would provide natural gas to Asian markets and the fact that the U.S. is actively addressing fugitive emissions associated with natural gas production is itself a mitigation measure for those emissions.

Mitigation of the Jordan Cove LNG terminal's own GHG emissions is mandated by the PSD permitting process; i.e., that process requires the demonstration of BACT to ODEQ. This mitigation was demonstrated as being (a) the use of natural gas as a fuel; (b) specification of new, efficient equipment; and (c) good operating practices to minimize losses in efficiency. Carbon capture and sequestration was identified as not being feasible, for a variety of reasons identified in the permit application.

GHG emissions from the pipeline and compressor station are not subject to the regulatory BACT requirement; however, GHG emissions from the pipeline and compressor station will be minimized by using welded steel pipe and new compressors, valves, and fittings, and will be required to be reported in accordance with 40 CFR 98.

4.12.2 Noise and Vibration

Noise would affect the local environment during both the construction and operation of the JCE & PCGP Project. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. For construction activities, this variation in noise levels is caused primarily by changes in equipment operations and activity locations. For operational noise conditions, this variation is caused in part by variations in operational activities, changing weather conditions, and the effects of seasonal vegetative cover. Two measures commonly used by federal agencies to relate the time-varying quality of environmental noise to its known effect on people are the 24-hour equivalent sound level ($L_{eq(24)}$) and the day-night sound level (L_{dn}). The $L_{eq(24)}$ is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the $L_{eq(24)}$ with 10 dBA added to the nighttime sound levels between the hours of 10 p.m. and 7 a.m. to account for the greater sensitivity of people to sound during the nighttime hours. The human ear's threshold of perception for noise change is considered to be 3 dBA; 6 dBA is clearly noticeable to the human ear, and 9 dBA is perceived as a doubling of noise.

4.12.2.1 Federal Noise and Vibration Criteria

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. The FERC has adopted this criterion for new compression and associated pipeline facilities, and it is used here to evaluate the potential noise impact from operation of the JCE &

PCGP Project. An L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA for facilities that operate at a constant level of noise.

The Commission has regulations in 18 CFR 380.12k(4)(v)(B) that state that any new or modified facility may not result in an increase in perceived vibration. In addition, the American National Standards Institute (ANSI) published ANSI S12.2-2008 that identifies criteria for sound pressure levels that should not be exceeded to avoid moderately perceptible vibration and rattle inside a room. These criteria are 65 dB and 70 dB in the 31.5 hertz (Hz) and 63 Hz octave bands, respectively, and are used to assess the potential for vibration impacts.

4.12.2.2 State Noise and Vibration Standards

The State of Oregon has established statewide noise limits for industrial and commercial noise sources (OAR, Chapter 340, Division 35). No statewide vibration limits have been established. The specified noise limits apply to either the property line location closest to the noise source or to locations 25 feet toward the noise source from the noise-sensitive building, whichever distance from the noise source is greater. Noise-sensitive property includes residences and other facilities normally used for sleeping, schools, churches, hospitals, and public libraries. The primary noise limits set by the Oregon regulations are based on the statistical distribution of varying noise levels during daytime and nighttime hours. Noise limits are specified in terms of three percentile levels: L_{50}, the noise level exceeded 50 percent of the time; L_{10}, the noise level exceeded 10 percent of the time, and L_{01}, the noise level exceeded 1 percent of the time. In addition to noise limits for noise-sensitive properties, Oregon noise regulations establish additional noise limits for industrial and commercial noise sources in or near designated quiet areas. Quiet areas are defined as land or facilities where the qualities of serenity, tranquility, and quiet are of extraordinary importance and serve a public need. The State of Oregon has not designated any quiet areas, but some local noise ordinances have done so (Beyer 2007). Noise limits established by the Oregon noise control regulations are summarized in table 4.12.2.2-1. OAR Chapter 340, Division 13 establishes a separate noise limit for sources located in federal wilderness areas: 50 dBA at a distance of 50 feet from the noise source unless a permit is issued allowing noise levels of up to 75 dBA at a distance of 50 feet from the noise source.

TABLE 4.12.2.2-1

Oregon Noise Limits For Industrial and Commercial Noise Sources

Percentile Noise Level In Any One Hour	Noise-Sensitive Properties Located Outside Designated Quiet Areas		Within Designated Quiet Areas at a Point 400 Feet or More From the Noise Source	
	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.
L_{50}	55 dBA	50 dBA	50 dBA	45 dBA
L_{10}	60 dBA	55 dBA	55 dBA	50 dBA
L_{01}	75 dBA	60 dBA	60 dBA	55 dBA

Notes: The noise limits in this table do not apply to noise from construction sites, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, and various other exempt sources.
Source: OAR 340-035-0035(1)(a), 340-035-0035(1)(b), and 340-035-0035(1)(c).

In addition to the overall dBA limits summarized in table 4.12.2.2-1, the Oregon noise regulations establish additional limits for discrete tones from industrial and commercial noise sources. These octave band noise limits are summarized in table 4.12.2.2-2.

TABLE 4.12.2.2-2

Octave Band Noise Limits For Industrial and Commercial Noise Sources

Center Frequency of Octave Band (Hertz)	Median Sound Pressure Level Limit a/	
	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.
31.5 Hz	68 dB	65 dB
63 Hz	65 dB	62 dB
125 Hz	61 dB	56 dB
250 Hz	55 dB	50 dB
500Hz	52 dB	46 dB
1,000 Hz	49 dB	43 dB
2,000 Hz	46 dB	40 dB
4,000 Hz	43 dB	37 dB
8,000 Hz	40 dB	34 dB

a/ The noise limits in this table do not apply to noise from construction sites, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, and various other exempt sources.
The noise limits in this table apply to either the property line location closest to the noise source or to locations 25 feet toward the noise source from the noise-sensitive building, whichever distance from the noise source is greater.
If noise levels for any 1/3 octave band exceeds the encompassing octave band limit by more than 10 dB, additional limitations may apply.

Source: OAR 340-035-0035(1)(f).

Oregon noise regulations also establish a numerical noise level increase standard for new industrial or commercial noise sources located on a previously unused site. The regulations limit the increase in hourly L_{10} and L_{50} noise levels as measured at noise-sensitive properties to 10 dBA above the ambient background L_{10} and L_{50} noise levels (OAR 340-035-0035(1)(b)(B)(i)). The 10 dBA operational noise increment standard does not apply to noise from construction activities, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, or various other exempt sources.

Oregon regulations also establish additional noise limits for blasting and impulsive noise sources associated with industrial and commercial operations. Noise limits for blasting operations are based on C-weighted decibel (dBC) measurements in the slow response setting while the noise limits for other impulse sounds is based on unweighted decibel measurements in the peak response setting. The noise limits for blasting operations are 98 dBC for 7 a.m. to 10 p.m., and 93 dBC for 10 p.m. to 7 a.m. as measured at noise sensitive properties (OAR 340-035-0035(1)(d)(A)). The noise limits for other impulse sound from industrial and commercial operations are 100 dB (peak) for 7 a.m. to 10 p.m., and 80 dB (peak) for 10 p.m. to 7 a.m. as measured at noise sensitive properties (OAR 340-035-0035(1)(d)(B)). The blasting and impulse sound limits do not apply to construction sites, agricultural operations, forestry operations, or various other exempt sources. Even though these noise limits do not apply in a regulatory context to construction activities, they provide additional criteria for judging blasting or impulse noise (such as pile driving) associated with construction activities.

4.12.2.3 Local Noise Standards

The City of North Bend has a noise ordinance that prohibits the making of "unnecessary noise," but the ordinance does not establish specific numerical noise limits (North Bend City Code, Section 9.04.030). Daytime construction activity between the hours of 7 a.m. and 6 p.m. is exempt from the City of North Bend noise ordinance. The counties of Coos, Douglas, and Jackson, Oregon, do not have local noise ordinances. Klamath County cites compliance to occur when federal and/or state noise regulations are met (Klamath County 2010, Policy 5):

To meet all Federal and State environmental protection statutes and to ensure that future County development will not threaten to violate these statutes.

4.12.2.4 Noise Levels

Existing noise levels are variable depending on location relative to the JCE & PCGP Project. Therefore, the existing sound environment is broken down by the area near the Jordan Cove LNG terminal facilities and the areas near the Pacific Connector pipeline portions of the Project.

Jordan Cove LNG Terminal and South Dunes Power Plant

The major existing anthropogenic noise sources in the vicinity of the LNG terminal include vehicle traffic on the Trans-Pacific Parkway and U.S. Highway 101, RV use in the ODNRA, and boat traffic on Coos Bay. Aircraft operations at the Southwest Oregon Regional Airport in North Bend are an additional intermittent anthropogenic noise source. Wind, birds, and insects contribute to natural background noise levels. There are no NSAs within 1 mile of the LNG terminal site. The nearest NSAs are single-family homes in the city of North Bend along the south side of Coos Bay about 1.4 miles south of the center of the LNG terminal site (figure 4.12-2). The nearest NSAs to the east of the terminal site are single-family homes on Russell Point, east of U.S. Highway 101 and about 2.3 miles from the center of the terminal.

Jordan Cove monitored the ambient noise levels at the two nearest NSA areas over a 24-hour period in 2005 and then again in 2012. Table 4.12.2.4-1 summarizes the data collected at the south and east NSAs.

TABLE 4.12.2.4-1

Ambient Noise Levels for the Jordan Cove LNG Terminal Measured at Nearby NSAs

Date	Metric	Hourly L_{eq} at NSA1, 1.4 miles south (dBA)	Hourly L_{eq} at NSA2, 2.3 miles east (dBA)
Aug-Sep 2005	$L_{eq(24)}$	49.4	62.7
	L_{dn}	53.7	65.7
April 2013	$L_{eq(24)}$	31.9 – 57.6	42.6 – 63.7
	L_{dn}	47.7 – 51.6	59.8 – 62.2

The 2005 survey took place over a 24-hour period starting on August 31 and ending September 1 during which there was no precipitation and temperatures ranged from 55 to 64°F. Skies were clear during the day, with heavy fog forming at night. Winds were generally light, ranging from calm to about 8 mph from the northwest. Hourly average noise (L_{eq}) levels at NSA 1 ranged from 35.1 dBA to 53.8 dBA, with an overall L_{dn} value of 53.7 dBA at NSA 1. NSA 1 was at the corner of Colorado Avenue and Arthur Street. Prominent noise sources at this location included infrequent local traffic during the day and the sound of ocean surf at night. Shorter-term monitoring was conducted at NSA 2 on East Bay Street about 200 feet east of U.S. Highway 101, where levels were significantly higher than at NSA 1 due to the increased traffic on U.S. 101. The monitored L_{eq} ranged from 48.7 dBA between 1 and 2 a.m. to 66.4 dBA between 9 and 10 a.m., and the computed L_{dn} was 65.7 dBA.

Figure 4.12-2
Noise Sensitive Areas in the Vicinity of the Jordan Cove Site

The 2012 survey was conducted to verify that ambient sound levels had not changed greatly since 2005. Sound monitoring was conducted April 11 to April 18 with one significant precipitation event coinciding with the early hours of the monitoring period on April 15. Monitored sound levels during the precipitation event were not considered in setting baseline sound levels. Temperatures during the monitoring period ranged from 37 to 64°F. Sky cover ranged from clear to overcast, and winds were light, ranging from calm to about 10 mph from the northwest. Hourly average noise levels at NSA 1 ranged from 31.9 dBA to 57.6 dBA L_{eq}, with daily calculated L_{dn} values ranging from 47.4 dBA to 51.6 dBA. As in 2005, the prominent noise sources at NSA 1 included infrequent local traffic during the day and the sound of ocean surf at night. A difference of 2.1 dBA between the high L_{dn} of the 2013 survey and 53.7 dBA from the 2005 survey indicates that the ambient environment has not changed greatly since 2005. At NSA 2, sound levels were higher due to higher traffic volumes on U.S. Highway 101 with the L_{eq} ranging from 42.6 dBA to 63.7 dBA. The daily calculated L_{dn} ranged from 59.8 dBA to 62.2 dBA.

In addition to the continuous monitoring, two additional locations were chosen for short-term (5-minute) daytime measurements, one within the ODNRA and one at the BLM boat launch ramp. These locations were chosen in order to determine ambient sound levels at local recreation areas in proximity to the terminal site, and included the Boxcar Campground to the north and the boat launching area to the southwest.

Existing sounds in the area include traffic, distant industrial and construction noise, occasional recreational vehicle use, boat traffic in Coos Bay, and natural sounds such as birds. Measurements at these locations were taken on April 11, 17, and 18, 2013. Measured L_{eq} sound levels at the campgrounds ranged from 55.3 to 59.9 dBA, and sound levels at the boat launch parking lot ranged from 40.8 to 47.6 dBA. The higher sound levels measured at the campground are due to frequent truck traffic on Horsfall Road.

Construction Noise

Construction of the LNG terminal would occur over a period of about four years. Major components would include berth facilities, buildings, LNG storage tanks, and mechanical/electrical equipment. Noise associated with construction activities would be intermittent because equipment is operated on an as-needed basis and mostly during daylight hours. During the site grading and filling operations, the equipment may be operated on two 10-hour shifts, 6 days per week, with the potential to increase to a 24/7 schedule if required. Construction would not result in generation of, or exposure of persons to, excessive noise or vibration levels. No blasting is anticipated to be required for construction as the entire site area consists of sand.

The most prevalent sound source during construction is anticipated to be the internal combustion engines used to provide mobility and operating power to construction equipment. The sound level impacts at NSAs from construction operations would depend on the type of equipment used, the mode of operation of the equipment, the length of time the equipment is in use, the number of equipment used simultaneously, and the distance between the sound source and sensitive site. These factors would be constantly changing throughout the construction period, making it difficult to calculate an L_{dn} or L_{eq}, and hence, the quantification of impacts.

Construction noise levels for the LNG terminal are expected to be similar to typical commercial structure construction programs, which average from 47 to 57 dBA at 2,000 feet (H&K 1994). These levels would be reduced by more than 15 dBA at the 1.4-mile distance to the nearest NSA. Thus, expected Project construction noise levels at the NSA would range from 32 to 42 dBA. A noise contour map that depicts expected LNG terminal-only construction-related L_{dn} noise levels in 5 dB increments with the 55 dBA L_{dn} noise contour is provided in figure 4.12-3.

The most noticeable construction activity in regards to noise would be installation of the LNG vessel berth sheet pile wall and of the piles associated with the marine slip docks. All pile installation would be accomplished with a vibratory hammer. Piling installation activities would take place over approximately an 8-month period and are expected to occur on a daily schedule similar to that of other construction. Sheet pile installation would occur initially followed by marine slip dock structure installation.

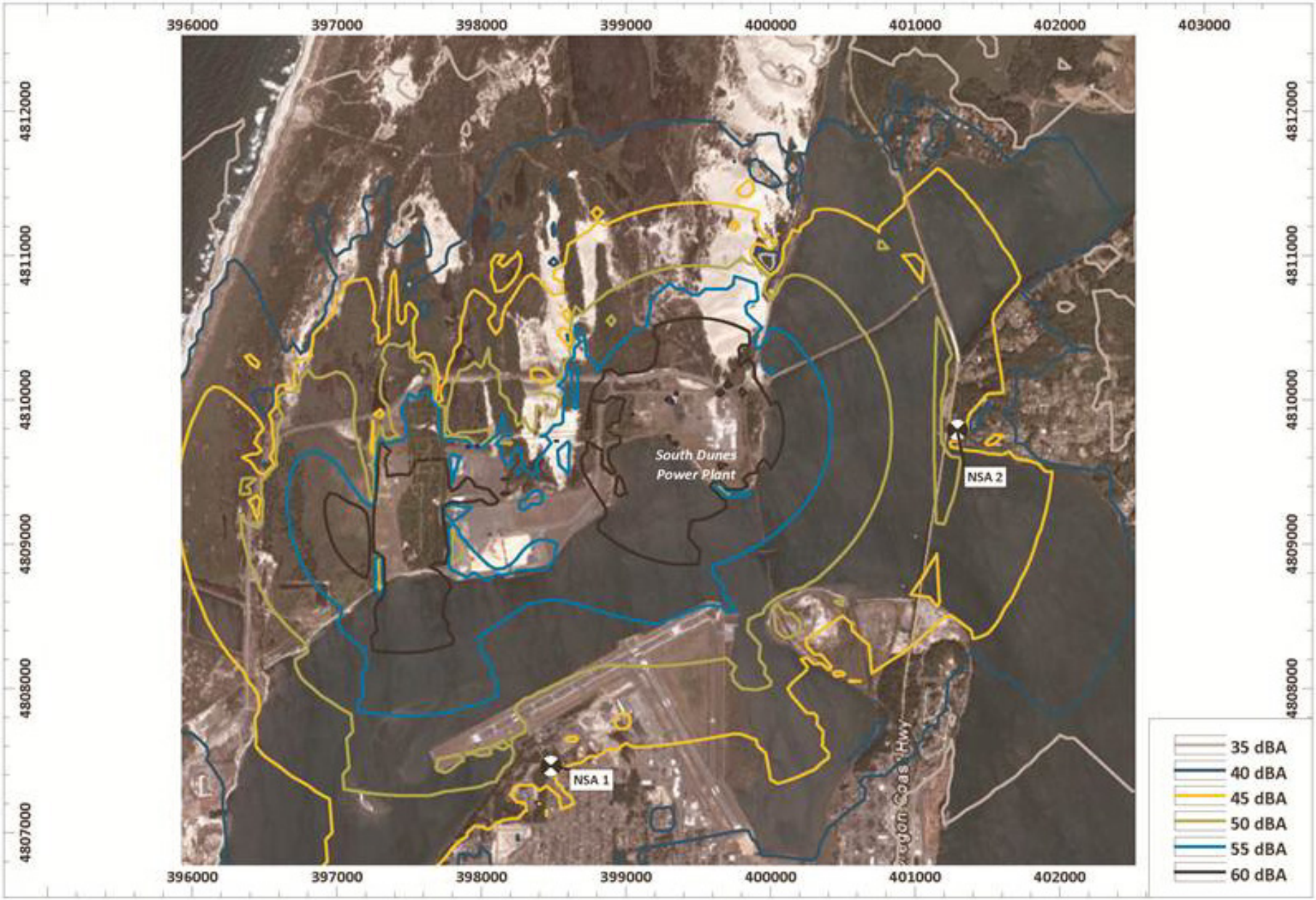


Figure 4.12-3
Estimated Noise Levels From General Construction Activities at the Jordan Cove Terminal Site

Predictions of construction noise levels during the pile installation and dredging activities were made using the noise emission levels in table 4.12.2.4-2.

TABLE 4.12.2.4-2

Construction Equipment Noise Emission Levels for Pile Installation and Dredging

Source	Number of Each	Noise Emission Level at 50 feet (dBA)	Usage Factor a/
Dump Trucks	15	84	40
Excavator	5	85	40
Dredge	2	77	100
Vibratory Sheet Pile Installer	4	88 b/	100

a/ Usage factor is the percentage of time that the equipment is operated at its maximum sound output level.
b/ Measured at 20 feet.

Noise modeling was conducted utilizing the commercially available computer aided noise abatement (CadnaA) noise prediction model. The software takes into account spreading losses, ground, and atmospheric effects, shielding from terrain, barriers and buildings, and reflections from surfaces. The software is standards based, and the International Organization for Standardization (ISO) 9613 Part 2 standard was used for air absorption and other noise propagation calculations. Standard atmospheric conditions were selected (temperature of 50°F and a relative humidity of 70 percent), which are favorable to the propagation of sound. All receptor locations were modeled as being downwind of all sources, and all of the above sources were assumed to be in operation simultaneously. The ground absorption coefficient for all water surfaces was set to highly acoustically reflective in the model (zero [0] setting). All remaining surfaces were set to partially acoustically absorptive (0.5 setting in the model).

Noise modeling was conducted assuming 24-hour pile installation and dredging activities. The noise modeling results at the nearest NSAs are provided in table 4.12.2.4-3. The existing measured ambient L_{dn} levels from the most recent ambient noise monitoring program are also included. A noise contour map that depicts the calculated L_{dn} sound levels over the entire Project area is provided as figure 4.12-3.

TABLE 4.12.2.4-3

Predicted Construction Noise Impacts of Jordan Cove LNG Terminal

NSA Location	Calculated Dredging and Pile Installation Noise Level (L_{dn} dBA)	Existing Measured Ambient L_{dn} (dBA)
NSA 1 – Colorado Avenue and Arthur Street	49.6	49.0 – 51.6
NSA 2 – East Bay Street/US 101	47.2	59.8 – 62.2

Calculated sound levels for the pile installation and dredging activities would generate sound levels below the FERC's 55 dBA L_{dn} guideline. Construction noise would also be at or below the existing measured ambient conditions at both NSA locations.

Dredging operations can generate underwater sound levels of up to 185 dB at 1 meter (CEDA 2011). These noise levels attenuate with distance. The Washington State Department of Transportation provides a methodology for determining the transmission loss of underwater

noise with distance. The equation utilized for predictions of underwater sound attenuation with distance is provided below:

$$R1 = (10(TL/15)*R2$$

Where:

R1 = distance (meters) to the required sound level
R2 = reference distance (meters) from the source of the sound
TL = required reduction in sound level (dB)

The NMFS has established recommended criteria for protecting cetaceans and pinnipeds, although no criteria for protecting fish were identified. The NMFS recommends for cetaceans and pinnipeds that maximum sound levels do not exceed 180 dB and 190 dB, respectively, in order to prevent permanent damage. A sound level of greater than 160 dB may cause harassment. Levels of less than 120 dB should not have any effect (LGL 2005). While no criteria were found for fish, CEDA (2011) stated that "it is very unlikely that underwater sound from dredging operations can cause injury. Behavioral reactions (startle or avoidance behavior) are possible."

Based on these criteria, dredging noise would not be expected to cause permanent damage to cetaceans or pinnipeds, even at close distances. It is likely that mobile marine species would avoid the area where dredging occurs. Utilizing the above algorithm, dredging noise would be reduced to the 160 dB harassment level at a distance of only 46 meters from the dredge.

We conclude that although some residents may hear the noise from construction, including pile-driving, the construction of the LNG terminal would not result in significant noise impacts.

Operational Noise

Operational noise impacts associated with the Jordan Cove Project (LNG facilities combined with the non-jurisdictional South Dunes Power Plant) were modeled using noise prediction software (CadnaA version 4.2.140) in accordance with ISO 9613. The model simulates the outdoor propagation of sound from each noise source and accounted for sound wave divergence, atmospheric and ground absorption, sound directivity, and shielding due to interceding barriers and terrain. A database was developed that specified the location, octave-band sound levels, and sound directivity of each noise source. The model calculates the A-weighted sound pressure levels from the Project at the NSA locations. Noise modeling was based on normal operation, which excludes intermittent activities such as start-up, shut down, and any other abnormal or upset operating conditions.

A constant sound level of less than 48.6 dBA would ensure compliance with the FERC requirement limiting the L_{dn} at the nearest NSAs to less than or equal to 55 dBA. Conversely, the OAR anti-degradation standard is more restrictive than the FERC requirement at NSA 1 because the lowest monitored 1-hour L_{eq}, which is used by the applicant as a surrogate to the L_{50}, was 31.9 dBA, which would limit the Jordan Cove LNG Terminal Project to increasing the total sound level by no more than 41.9 dBA. The 41.9 dBA L_{50}/L_{eq} anti-degradation limit is more restrictive than the 48.6 dBA L_{eq} FERC requirement. The results of the analysis (table 4.12.2.4-4) indicate that the predicted NSA sound levels are below 48.6 dBA; however, when the predicted sound level of 42 dBA L_{eq} is added to the lowest 1-hour existing L_{eq}/L_{50} the net increase is 10.5 dBA, which exceeds

the OAR anti-degradation standard. Also provided in table 4.12.2.4-3 are the calculated Project L_{dn} levels, the existing ambient L_{dn} levels, and the projected increases in future noise at each NSA.

TABLE 4.12.2.4-4

Predicted Project Noise Emissions at NSAs compared to Regulatory Limit for Jordan Cover LNG Terminal

Receptor	Predicted Project Sound Level (L_{eq})	Existing Lowest 1-hour L_{eq}/L_{50}	Increase Over Existing Ambient a/	Predicted Project Sound Level (L_{dn})	Existing Ambient L_{dn} b/	Future Level (Project + South Dunes + Ambient)	Increase Over Existing Ambient
NSA 1	42 dBA	31.9	**+10.5**	48.4	47.4	50.9	3.5
NSA 2	45 dBA	42.6	+2	51.4	59.8	60.4	0.6

a/ **Bold underline** indicates possible exceedance of anti-degradation standard.
b/ Lowest measured ambient L_{dn} from both monitoring programs.

In addition to the tabular data presented above, a noise contour map is also presented that depicts expected project-only L_{dn} noise levels in 5 dB increments with the 55 dBA L_{dn} noise contour clearly shown (figure 4.12-4).

In terms of environmental noise impacts, an increase to the ambient sound level of 3 dB is generally considered barely detectable by the human ear. The expected increases in L_{dn} noise levels at the nearest NSAs range from 0.6 dB to 3.5 dB during normal operation. Thus, operation of the Jordan Cove LNG terminal is not anticipated to result in significant noise impacts. However, to ensure that the noise impacts from operation of the Jordan Cove LNG terminal would not be significant, **we recommend that:**

- **Jordan Cove should file a full load noise survey for the LNG terminal no later than 60 days after placing the plant into service. If a full load noise survey is not possible, Jordan Cove should file an interim survey at the maximum possible operation within 60 days of placing the LNG terminal into service and file the full operational surveys within 6 months. If the noise attributable to the operation of all the equipment of the LNG terminal at full operation exceeds 55 dBA L_{dn} at any nearby NSAs, Jordan Cove should install additional noise controls to meet the level within 6 months of the in-service date. Jordan Cove should confirm compliance with this requirement by filing a second full power noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

During operation of the Jordan Cove LNG terminal, noise would also be generated by the LNG vessels transiting the Coos Bay navigation channel. The addition of approximately 90 additional LNG vessels on an annual basis would add some noise to the existing environment specifically within 0.3 mile. Since the additional LNG vessel traffic, when combined with the existing ship traffic, would still be less than the number of ships that once called on the Port (200 ships approximately 10 years ago compared to 60 ships currently), the effect of the increase in noise is predicted to be insignificant. Specifically, the addition of approximately 90 LNG vessels to the existing average traffic of 60 ships per year is predicted to increase the in-water sound level by 4.5 dB. The 4.5 dBA level reflects the increase in average ship noise levels over the course of one year. The increase is derived based on the assumption that noise levels from all large ships that traverse the waterway generate essentially the same underwater sound levels, which is supported by research conducted by McKenna (2011). The increase in the average annual noise

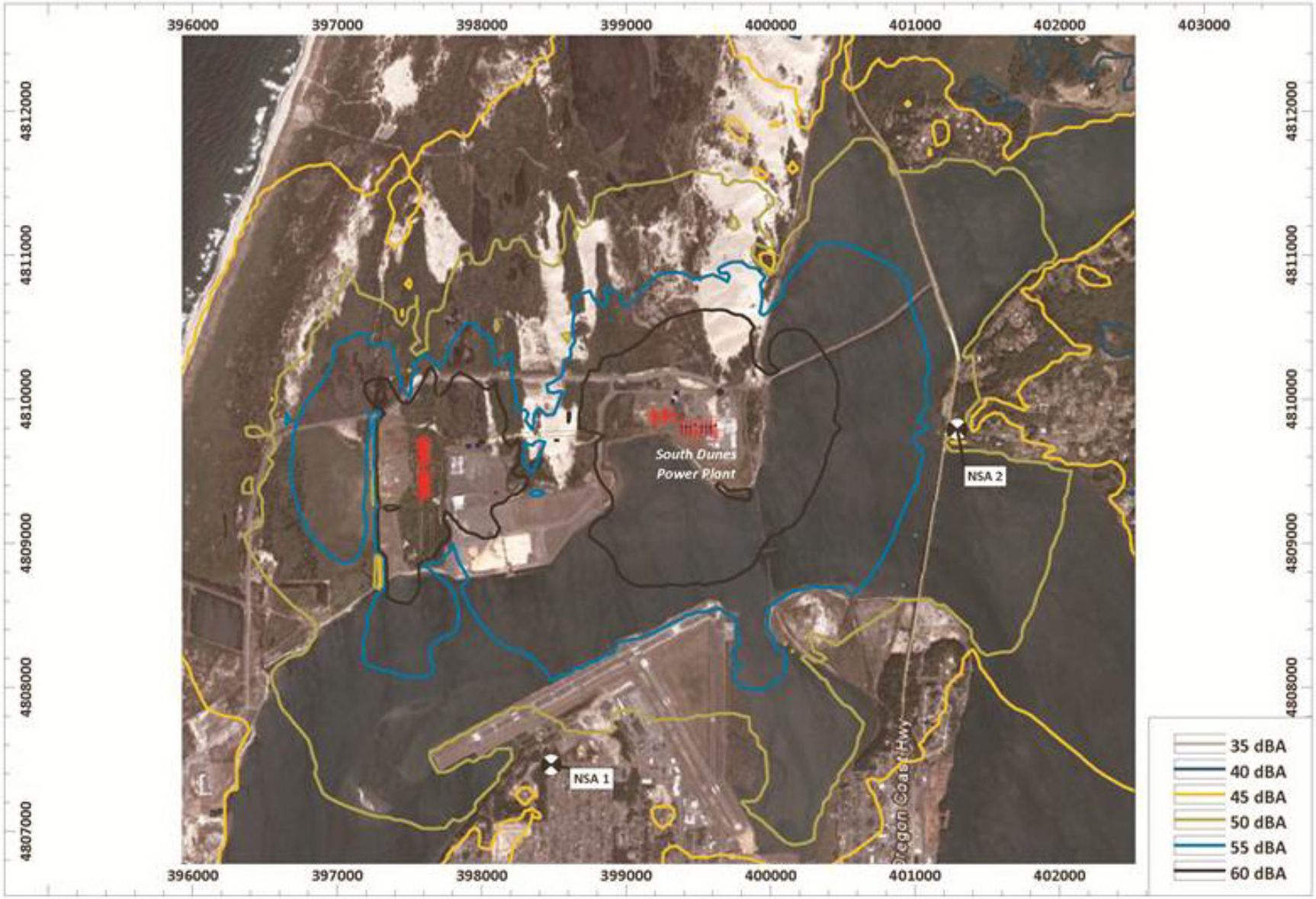


Figure 4.12-4
Estimated Noise Levels From LNG Terminal Operations

level due to shipping is subsequently based on the increase in ship traffic. A doubling of ship traffic would result in a 3 dBA increase in noise. The increase in average sound levels is based on the following formula:

*Increase dBA = 10*log10(total ship traffic/existing ship traffic)*

Accordingly, the projected addition of 90 LNG vessels annually to the existing volume of 50 ships results in a 4.5 dB increase in the annual average underwater noise level due to shipping. Based on available information, the increase to underwater noise levels is not expected to result in aquatic wildlife behavioral changes.

In conclusion, Jordan Cove has proposed mitigation to minimize its operational noise, and our recommendations above would ensure that the 55 dBA L_{dn} noise standard is met for the LNG terminal. Therefore, we conclude that noise and vibration impacts associated with operation of the LNG terminal would not be significant at any NSAs.

Pacific Connector Pipeline

Construction and operation of the Pacific Connector pipeline would generate noise levels. Operational noise is confined to the compressor station and other above ground pipeline facilities such as MLVs and meter stations. Construction and operational noise levels associated with the Pacific Connector pipeline are discussed in the subsections that follow.

Construction Noise

During construction of the Pacific Connector pipeline, construction noise would be audible to NSRs in the vicinity of the construction right-of-way. Some of the land crossed by the pipeline is categorized as having residential, commercial, or industrial use. Over 100 structures have been identified as being within 150 feet of the pipeline right-of-way or TEWAs, and several residences have been identified as being within 50 feet of the pipeline construction right-of-way or TEWAs. See section 4.1 of this EIS for more information on land use. Due to the assembly-line nature of pipeline construction, activities in any area could occur intermittently over a period lasting from several weeks to a few months.

Construction equipment would be operated on an as-needed basis. Table 4.12.2.4-5 provides predicted construction noise levels at 50 feet, 100 feet, and 300 feet for typical pipeline construction equipment by construction phase, excluding HDD. Phase 6 includes rock blasting and represents the highest sound levels associated with pipeline construction. For this phase, sound levels at 50 feet are predicted to be 95 dBA L_{eq} and would attenuate to 87 dBA L_{eq} and 74 dBA L_{eq} at 100 feet and 300 feet, respectively. Noise would diminish rapidly as the distance from the noise source increases.

Access roads would be used by construction equipment to reach the right-of-way. There may be areas where access roads are limited in width, grade, or availability. Helicopters may be used during logging for right-of-way clearance. Helicopters that may be used for the Project are assumed to be at most 115 dBA at 50 feet (Michael Minor & Associates 2008), 112 dBA at 100 feet, and 98 dBA at 300 feet. The primary sources of wideband acoustic energy from helicopters are the main and tail rotor. Helicopters generally fly at low altitudes; therefore, potential temporary increases to ambient sound levels would occur in the area where helicopters are operating as well as along their flight path.

TABLE 4.12.2.4-5

Summary of Typical Non-HDD Pipeline Construction Noise Levels (L_{eq})

Phase Number a/	Pipeline Construction Sequence	Equipment Expected b/	Equipment Noise (dBA L_{max}) Level at 50 feet	Composite Noise (dBA L_{eq}) at 50 feet	Composite Noise (dBA L_{eq}) at 100 feet	Composite Noise (dBA L_{eq}) at 300 feet
1	Right-of-Way Acquisition and Survey	Pickup Truck Chain Saw	75 84	81	73	60
2	Clearing and Grading	Pickup Truck Chain Saw Excavator Dozer Flatbed Truck Loader Shovel Logger-Cutter Skidder Crawler-Chipper	75 84 81 82 74 79 87 84 84 79	87	79	67
3	Fencing	Pickup Truck Auger Drill Rig	75 84	78	70	57
4	Centerline Survey of Ditch	Pickup Truck	75	71	63	50
5	Ditching (Rock-Free)	Pickup Truck Backhoe Excavator Dozer Flatbed Truck Dump Truck Tracked Ditcher	75 78 81 82 74 76 80	83	75	63
6	Ditching (Rock)	Pickup Truck Backhoe Excavator Dozer Flatbed Truck Auger Drill Rig Impact Hammer Rock Drill Blasting (Mitigated) Dump Truck	75 78 81 82 74 84 90 81 98 76	95	87	74
7	Padding Ditch Bottom	Pickup Truck Backhoe Excavator Dump Truck	75 78 74 81	82	74	61
8	Stringing	Pickup Truck Excavator Flatbed Truck Crane	75 81 74 81	80	72	59
9	Bending	Pickup Truck Excavator Dozer	75 81 82	83	75	62
10	Line Up, Stringer Bead and Hot Pass	Pickup Truck Excavator Dozer Side-Boom Welder/Torch	75 81 82 75 74	82	74	61
11	Fill and Cap Weld	Pickup Truck Welder/Torch	75 74	77	69	56
12	As-Built Footage	Pickup Truck Welder/Torch	75 74	75	67	55
13	X-Ray and Weld Repair	Pickup Truck Welder/Torch	75 74	74	66	53

TABLE 4.12.2.4-5

Summary of Typical Non-HDD Pipeline Construction Noise Levels (L_{eq})

Phase Number a/	Pipeline Construction Sequence	Equipment Expected b/	Equipment Noise (dBA L_{max}) Level at 50 feet	Composite Noise (dBA L_{eq}) at 50 feet	Composite Noise (dBA L_{eq}) at 100 feet	Composite Noise (dBA L_{eq}) at 300 feet
14	Coating Field and Factory Welds	Pickup Truck Welder/Torch	75 74	74	66	53
15	Inspection (Jeeping) and Repair of Coating	Pickup Truck	75	71	63	50
16	Lowering In and Tie-Ins	Pickup Truck Backhoe Excavator Dozer	75 81 74 76	83	75	62
17	As-Built Survey	Pickup Truck	75	71	63	50
18	Pad and Backfill	Pickup Truck Backhoe Excavator Dozer Dump Truck	75 78 74 82 76	83	75	63
19	Test and Final Tie-In	Pickup Truck Backhoe Pumps	75 78 81	82	74	61
20	Replace Topsoil and Cleanup	Pickup Truck Backhoe Excavator Dozer Tractor	75 78 81 82 84	84	76	63

a/ Equipment expected, based on "typical" pipeline construction requirements at a given location.
b/ Estimated Cumulative Noise at 50 feet is based on equipment-specific noise values (WSDOT 2015; FHWA 2006).

In addition to temporary disturbance near residences or other noise-sensitive land uses, construction noise would have localized but temporary impacts on wildlife. In general, temporary noise from construction activities would result in some wildlife movements away from the pipeline corridor. See additional discussion of potential pipeline construction noise impacts on wildlife in sections 4.6 and 4.7 of this EIS.

Normally, there would be no nighttime noise from pipeline construction. Most pipeline construction, except for HDD operations, would be limited to daytime hours. No operational noise from the buried pipeline would be detectable.

Pacific Connector proposes to use HDD technology to cross under three rivers: the Coos River, Rogue River, and the Klamath River. Some portions of HDD operations would occur as 12-hour work shifts, while other activities would normally occur as 24-hour-per-day operations. The overall duration of HDD operations is site-specific and would be determined by the drilling contractor. It would not be unusual for HDD operations to take 2 to 4 weeks at each site. The western crossing of the South Umpqua River would be done using DP technology; and the noise associated with that operation is discussed below.

Coos River HDD Crossing

The Pacific Connector pipeline would cross under the Coos River using HDD technology at about MP 11.1. The Coos River HDD would require about 1,602 feet of drilling. Drilling would

start from the northern entry point and end at the southern exit point of the crossing. The closest residence to the Coos River HDD section is about 320 feet from the southern exit point.

Pacific Connector conducted a noise survey of the Coos River HDD area in May 2013 (see Appendix 9J of Pacific Connector's Resource Report 9). Daytime background noise levels at the four nearby residences ranged from 59.8 dBA L_{eq} to 65.3 dBA L_{eq}. Nighttime background noise levels at these residences ranged from 35.2 dBA L_{eq} to 40.5 dBA L_{eq}. Estimated L_{dn} levels at these residences ranged from 58 dBA to 63.3 dBA.

Noise sources associated with HDD operations are assumed to include the following equipment:

- two power units, 630 hp each;
- two mud pump units, 630 hp each;
- one centrifugal cleaner, 360 hp;
- one shale shaker; and
- one crane, 360 hp.

HDD operations would generate estimated L_{dn} levels of 59.6 to 72.7 dBA at the four nearest residences. HDD entry point sound levels are typically louder than exit sound levels; therefore, the NSAs on the northern side of the river would receive higher sound levels than those to the south. Pacific Connector has not provided analyses of sound levels from HDD exit equipment. Noise mitigation measures would be required to reduce noise impacts to an L_{dn} of 55 dBA and to keep nighttime noise levels from exceeding the state limit of 50 dBA.

Pacific Connector's noise study for the Coos River crossing recommends use of one of the following mitigation measures of HDD entry sound levels:

- Install a 20-foot-high barrier wall around the entire HDD site (STC-35 material with good acoustic absorption properties (0.75 factor or higher) on the equipment side of the wall; bottom of wall in contact with the ground); or
- Install a vinyl fabric acoustic tent (STC-21 or higher rating) over the entire HDD site, using minimum necessary openings and keeping the sidewall of the tent in contact with the ground.

Table 4.12.2.4-6 summarizes predicted HDD operational L_{dn} levels at NSAs with various mitigation measures. The noise study recommends the following mitigation measure:

- Install a special fabric acoustic tent (STC-30 or higher rating) over the entire HDD entry site, using minimum necessary openings and keeping the sidewall of the tent in contact with the ground.

TABLE 4.12.2.4-6

Summary of L_{dn} Levels, HDD Drilling from North Side of the Coos River

Mitigation Condition	NSA 1	NSA 2	NSA 3	NSA 4
No Mitigation	61.1	59.6	71.5	72.7
20-foot-high Barrier	38.1	36.3	50.7	53.1
Vinyl Acoustic Tent	44.4	45.6	53.8	55.9
Special Vinyl Acoustic Tent	39.2	40.5	47.5	49.6

Pacific Connector has stated that it would implement the noise mitigation measures as recommended in the Coos River HDD crossing noise study. We believe that with implementation of these measures, temporary noise impact on NSAs from pipeline construction would be acceptable.

Rogue River HDD Crossing

The Pacific Connector pipeline would cross under the Rogue River using HDD technology at about MP 122.7. The Rogue River HDD would require about 3,000 feet of drilling. Pacific Connector has not determined whether drilling would occur from the western or eastern end of the crossing. The closest existing residence to the west end of the Rogue River HDD section is about 740 feet from the probable equipment location. The closest residence to the eastern end of the Rogue River HDD section is about 340 feet from the probable equipment location.

Pacific Connector conducted a noise survey of the Rogue River HDD area in February 2007 (Maki Corporation 2007a). Daytime background noise levels at five nearby residences ranged from 35.7 dBA to 54.1 dBA. Nighttime rain conditions affected background noise levels at these residences. Nighttime background noise conditions without the effects of rain were estimated to be about 35 dBA. Estimated L_{dn} levels at these residences ranged from 41.5 dBA to 52.4 dBA.

Noise sources associated with HDD operations are assumed to include the following equipment:

- two power units, 630 hp each;
- two mud pump units, 630 hp each;
- one centrifugal cleaner, 360 hp;
- one shale shaker; and
- one crane, 360 hp.

If HDD operations were to occur from the west end of the HDD section, drilling operations would generate L_{dn} levels of 62.6 to 70.8 dBA at the three nearest residences. If HDD operations were to occur from the east end of the HDD section, drilling operations would generate L_{dn} levels of 67.6 to 78.5 dBA at the four nearest residences. In either case, noise mitigation measures would be required to reduce noise impacts to an L_{dn} of 55 dBA and to keep nighttime noise levels from exceeding the state limit of 50 dBA.

The noise study for the Rogue River HDD crossing (Maki Corporation 2007a) recommends use of one of the following mitigation measures if drilling occurs from the west side of Rogue River:

- Install a 20-foot-high barrier wall around the entire HDD site (STC-35 material with good acoustic absorption properties (0.75 factor or higher) on the equipment side of the wall; bottom of wall in contact with the ground); or
- Install a vinyl fabric acoustic tent (STC-21 or higher rating) over the entire HDD site, using minimum necessary openings and keeping the sidewall of the tent in contact with the ground.

Table 4.12.2.4-7 summarizes predicted L_{dn} levels at nearby residences if HDD drilling operations occur on the west side of the Rogue River.

TABLE 4.12.2.4-7

Summary of L_{dn} Levels, HDD Drilling from West Side of the Rogue River

Mitigation Condition	NSA 5	NSA 6	NSA 7
No Mitigation	62.6	70.8	57.1
20-foot-high Barrier	41.9	48.5	38.7
Vinyl Acoustic Tent	41.5	48.5	42.3

If drilling occurs from the east side of the Rogue River, the noise study recommends the following mitigation measure:

- Install a special fabric acoustic tent (STC-30 or higher rating) over the entire HDD site, using minimum necessary openings and keeping the sidewall of the tent in contact with the ground.

Table 4.12.2.4-8 summarizes predicted L_{dn} levels at nearby residences if HDD drilling operations occur on the east side of the Rogue River.

TABLE 4.12.2.4-8

Summary of L_{dn} Levels, HDD Drilling from East Side of the Rogue River

Mitigation Condition	NSA 1	NSA 2	NSA 3	NSA 4
No Mitigation	77.2	67.6	72.0	78.5
Special Acoustic Tent	51.2	42.6	46.5	52.4

Pacific Connector has stated that it would implement the noise mitigation measures as recommended in the Rogue River HDD crossing noise study. We believe that with implementation of these measures, temporary noise impact on NSAs from pipeline construction would be acceptable.

Klamath River HDD Crossing

The Pacific Connector pipeline would cross under the Klamath River using HDD technology at about MP 199.4. The Klamath River HDD would require about 2,500 feet of drilling. At present, it has not been determined whether drilling would occur from the western or eastern end of the crossing. The closest existing residence to the west end of the Klamath River HDD section is about 2,400 feet from the probable equipment location. The closest residence to the eastern end of the Klamath River HDD section is about 300 feet from the probable equipment location.

Pacific Connector conducted a noise survey of the Klamath River HDD area in February 2007 (Maki Corporation 2007b). Daytime background noise levels at the three closest residences ranged from 52.7 dBA to 62.1 dBA. Nighttime background noise levels at these residences ranged from 43.3 dBA to 46.6 dBA. Estimated L_{dn} levels at these residences ranged from 52.9 dBA to 60.6 dBA.

Noise sources associated with HDD operations are assumed to include the following equipment:

- two power units, 630 hp each;
- two mud pump units, 630 hp each;
- one centrifugal cleaner, 360 hp;

- one shale shaker; and
- one crane, 360 hp.

If HDD operations were to occur from the west end of HDD section, drilling operations would generate L_{dn} levels of 57 to 58.4 dBA at the three nearest residences. If HDD operations were to occur from the east end of the HDD section, drilling operations would generate L_{dn} levels of 68.3 to 79 dBA at the three nearest residences. In either case, noise mitigation measures would be required to reduce noise impacts to an L_{dn} of 55 dBA and to keep nighttime noise levels from exceeding the state limit of 50 dBA.

The noise study for the Klamath River HDD crossing (Maki Corporation 2007b) recommends use of one of the following mitigation measures if drilling occurs from the west side of Klamath River:

- Install a 20-foot-high barrier wall around the entire HDD site (STC-35 material with good acoustic absorption properties (0.75 factor or higher) on the equipment side of the wall; bottom of wall in contact with the ground); or
- Install a vinyl fabric acoustic tent (STC-21 or higher rating) over the entire HDD site, using minimum necessary openings and keeping the sidewall of the tent in contact with the ground.

Table 4.12.2.4-9 summarizes predicted L_{dn} levels at nearby residences if HDD drilling operations occur on the west side of the Klamath River.

TABLE 4.12.2.4-9

Summary of L_{dn} Levels, HDD Drilling from West Side of the Klamath River

Mitigation Condition	NSA 1	NSA 2	NSA 3
No Mitigation	57.0	57.0	52.0
20-foot-high Barrier	44.8	44.8	46.2
Vinyl Acoustic Tent	37.0	36.9	38.1

If drilling occurs from the east side of Klamath River, the noise study recommends the following mitigation measure:

- Install a special fabric acoustic tent (STC-30 or higher rating) over the entire HDD site, using minimum necessary openings and keeping the sidewall of the tent in contact with the ground.

Table 4.12.2.4-10 summarizes predicted L_{dn} levels at nearby residences if HDD drilling operations occur on the east side of the Klamath River.

TABLE 4.12.2.4-10

Summary of L_{dn} Levels, HDD Drilling from East Side of the Klamath River

Mitigation Condition	NSA 1	NSA 2	NSA 3
No Mitigation	79.0	68.3	69.5
Special Acoustic Tent	53.0	43.2	44.2

Pacific Connector has stated that it would implement the noise mitigation measures as recommended in the Klamath River HDD crossing noise study. We believe that with

implementation of these measures, temporary noise impact on NSAs from pipeline construction would be acceptable.

South Umpqua River DP Crossing

Pacific Connector would use DP technology to go under the western crossing of the South Umpqua River at about MP 71.3. The South Umpqua River DP would require about 1,700 feet of drilling. Drilling would start from the northern entry point and end at the southern exit point of the crossing. The closest existing residence to the northern side of the South Umpqua River DP section is about 800 feet east of the probable equipment location.

Pacific Connector conducted a noise survey of the South Umpqua River DP area in May 2013 (see Appendix 9J of Pacific Connector's Resource Report 9). Daytime background noise levels at the four nearby residences ranged from 53.4 dBA L_{eq} to 62.9 dBA L_{eq}. Nighttime background noise levels at these residences ranged from 49.8 dBA L_{eq} to 53 dBA L_{eq}. Estimated L_{dn} levels at these residences ranged from 56.9 dBA to 65.9 dBA.

Noise sources associated with DP operations are assumed to include the following equipment:

- two power units, 630 hp each;
- two mud pump units, 630 hp each;
- one centrifugal cleaner, 360 hp;
- one shale shaker; and
- one crane, 360 hp.

DP operations would generate L_{dn} levels of 34.2 to 55.0 dBA at the four nearest residences regardless, of the entry/exit point for this crossing. DP entry point sound levels are typically louder than exit sound levels; therefore, the NSAs on the western side of the river would receive higher sound levels than those to the east. Pacific Connector has not conducted analyses of sound levels from DP exit equipment. Although predicted L_{dn} levels would be at the FERC limit of 55 dBA, noise mitigation measures would be required to reduce noise impacts to an L_{dn} of lower than 55 dBA and to keep nighttime noise levels from exceeding the state limit of 50 dBA. Table 4.12.2.4-11 provides the modeled sound levels at the nearest NSAs with and without mitigation.

TABLE 4.12.2.4-11

Summary of L_{dn} Levels, DP Drilling from East side of the South Umpqua River

Mitigation Condition	NSA 1	NSA 2	NSA 3	NSA 4
No Mitigation	34.2	46.9	55.0	49.5
20-foot-high Barrier	33.2	45.7	49.6	49.9

Pacific Connector's noise study for the South Umpqua DP crossing recommends use of the following mitigation measures:

- Install a 20-foot-high barrier wall around the entire DP site (STC-35 material with good acoustic absorption properties (0.75 factor or higher) on the equipment side of the wall; bottom of wall in contact with the ground).

Pacific Connector has stated that it would implement the noise mitigation measures as recommended in the South Umpqua River DP crossing noise study. We believe that with implementation of these measures, temporary noise impact on the NSA from pipeline construction would be acceptable.

Conclusions on HDD and DP Noise

Without mitigation, it is expected that noise levels from HDD activities at the crossings of the Coos, Rogue, and Klamath rivers would exceed the FERC limit of 55 dBA Ldn at nearby NSAs. It is expected that noise from the DP crossing of the South Umpqua River crossing would be below that threshold. Pacific Connector has identified and proposed mitigation measures that would be used during construction, which if implemented would result in predicted noise levels at or below acceptable limits. However, to ensure that actual noise levels during construction are below an acceptable level at the HDD and DP river crossings, **we recommend that:**

- **Pacific Connector should include in its <u>weekly construction status reports</u> (see condition 10 in section 5.2) the following information for the HDD/DP entry points of the Coos River, South Umpqua River, Roque River, and Klamath River:**

  a. **noise measurements from the nearest NSA, obtained at <u>the start of drilling operations</u>;**

  b. **noise mitigation Pacific Connector implemented at <u>the start of drilling operations</u>; and**

  c. **any additional mitigation measures that Pacific Connector would implement if the initial noise measurements attributable to drilling operations exceeded an L_{dn} of 55 dBA at the nearest NSA.**

With the implementation of Pacific Connector's proposed mitigation measures and our recommendations, we conclude that noise impacts from construction would not be significant.

<u>Operational Noise</u>

Klamath Compressor Station

The Klamath Compressor Station would be located in a quiet rural area of Klamath County, Oregon, on a 31-acre parcel at about MP 228.1 on the Pacific Connector pipeline. The compressor station site is about 1.8 miles northeast of Malin, Oregon. Approximately 15 residences are located within 1 mile of the compressor station site, with the closest residential dwelling (currently not occupied) about 1,000 feet southeast of the site.

The compressor station would include three Solar Titan 130-20502S turbine-driven centrifugal compressor units. Two units are proposed for operation and the third would solely be used to maintain maximum throughput during times where one of the other turbines is offline. The maximum rating of the Titan 130 turbine is 18,035 hp at an elevation of 4,080 feet and a temperature of 0ºF. Pacific Connector conducted a noise survey of the compressor station area in November 2012 (see Appendix 9C of Pacific Connector's Resource Report 9). The existing acoustic environment could be classified as a quiet rural area with observed sounds from farm animals and equipment, vehicular traffic on local roads, birds, and barking dogs. Background L_{eq} noise levels with no traffic or aircraft contribution ranged from 38.7 dBA during the daytime

to 36.5 dBA at night at the nearest NSA (i.e., NSA 1) and the equivalent day-night sound level is approximately 43.3 L_{dn}. The L_{50} sound level for the nearest NSA is 31.4 dBA. Sound levels at each NSA are variable depending on site-specific sound sources present during each measurement. Table 4.12.2.4-12 provides existing sound levels at each NSA. Figure 4.12-5 shows the location of the NSAs near the Klamath Compressor Station.

TABLE 4.12.2.4-12

Predicted Operational Noise Impacts of the Klamath Compressor Station

Receptor Location	Distance and Direction	Existing L_{50} (dBA)	Predicted L_{eq} (dBA)	Predicted Increase Over Existing L_{50} (dBA)	Existing L_{dn} (dBA)	Predicted L_{dn} (dBA)	Predicted Increase Over Existing L_{dn} (dBA)
NSA 1	1,000 feet southeast	31.4	**49.7**	**+18.4**	43.3	**56.1**	+13
NSA 2	1,390 feet southwest	30.4	46.7	**+16.4**	37.1	53.1	+16.1
NSA 3	1,570 feet northwest	30.2	45.6	**+15.5**	38.7	52	+13.5
NSA 4	2,560 feet southwest	30.5	41.1	**+11**	36.9	47.5	+11
NSA 5	1,9360 feet southwest	33.3	43.6	**+10.7**	52	50	+2.1

Bold Underline indicates exceedance of the OAR anti-degradation standard or an exceedance of the FERC 55 dBA L_{dn} or 48.6 dBA L_{eq} threshold.

Construction of the compressor station would take approximately 8 months. Construction equipment noise levels would vary during the construction period, but the total L_{eq} sound level at the nearest NSA 1,000 feet away would be 64 dBA. Construction activity would generally be limited to daytime hours, but would often be above the 55 dBA threshold established by the EPA and FERC as an indicator for the onset of disruption or annoyance of outside activities in residential areas. Construction noise is not regulated at the state or local level.

FERC regulations require that during operation, compressor station noise increments not exceed an L_{dn} of 55 dBA (equivalent to a continuous noise level of 48.6 dBA) at the nearest NSA. Oregon noise regulations require that operational noise from new commercial or industrial facilities must not increase ambient L_{50} noise levels by more than 10 dBA. For a facility that operates continuously at a steady level, the L_{50} is often very similar to the L_{eq} level; therefore, predictions of compressor station sound levels are in L_{eq} but are comparable to L_{50} baseline sound levels. Because compressor stations operate continuously, the lowest monitored 1-hour L_{50} existing nighttime ambient noise conditions would determine the allowable future noise levels per the OAR. The applicant has provided the noise level of 31.4 dBA L_{50} at the nearest NSA which means that to comply with Oregon noise regulations, future noise levels at a point 25 feet from the NSA residence must not exceed 41.4 dBA. Therefore, for the compressor station to demonstrate compliance with the OAR, compressor station noise, in combination with the ambient noise level, cannot incrementally increase the sound level above 41.4 dBA L_{50}.

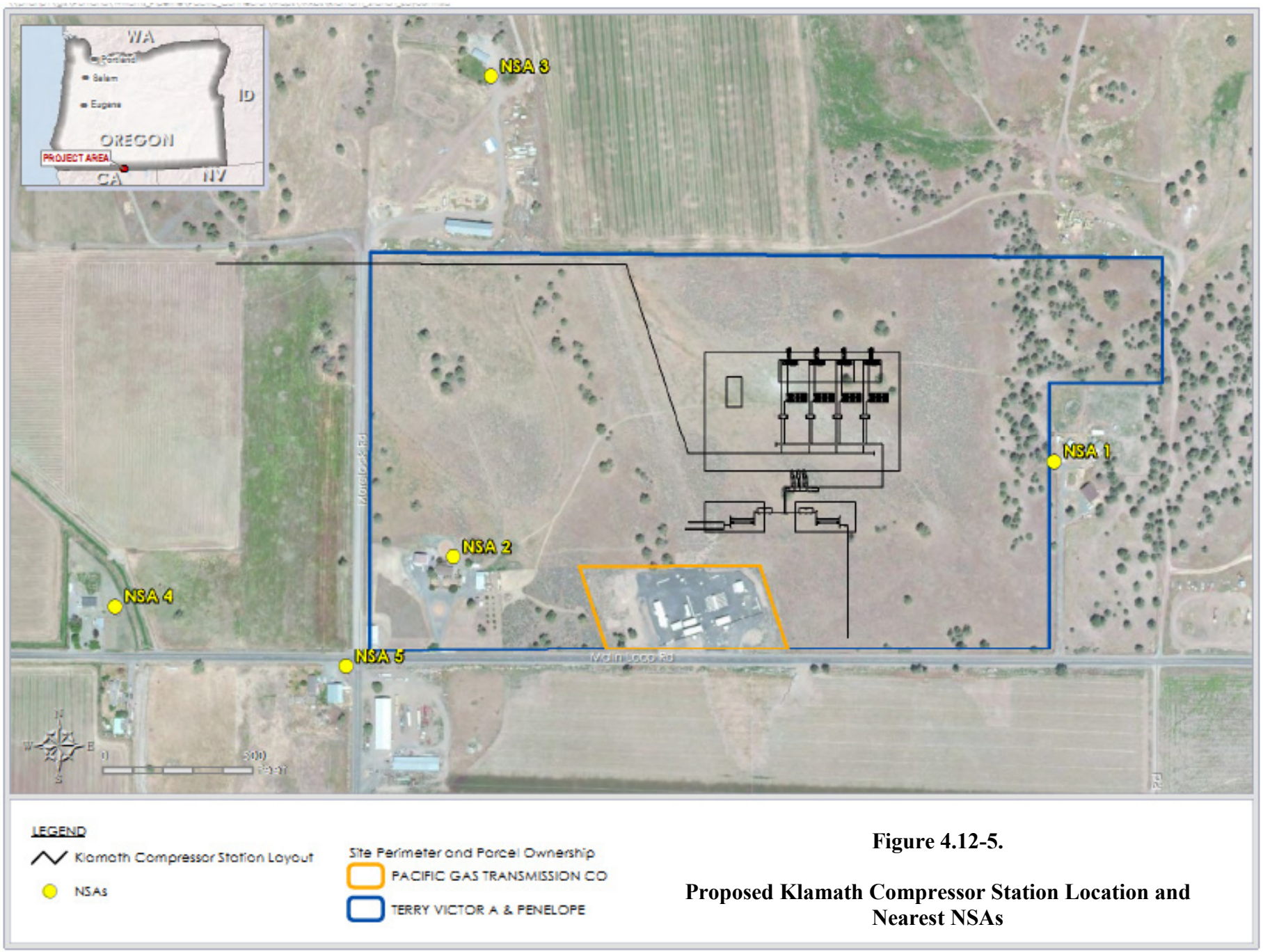


Figure 4.12-5.

Proposed Klamath Compressor Station Location and Nearest NSAs

Operational noise levels for the Klamath Compressor Station were predicted using noise prediction techniques consistent with ISO 9613 for sound propagation outdoor. These techniques take into account the noise generation of individual equipment items, shielding by buildings and barriers, spreading losses, ground and atmospheric effects, and reflections from surfaces. The predicted compressor station sound levels are provided in table 4.12.2.4-12. The noise modeling analysis for the Klamath Falls Compressor Station (see Appendix 9C of Pacific Connector's Resource Report 9) assumed the following noise mitigation measures for the facility:

- The turbine intake and/or exhaust systems should be equipped with silencers having greater insertion losses than the standard Solar Titan 130 silencers in order to reduce the noise contribution at the nearest NSA (NSA 1) to a level below L_{dn} 55 dBA.
- The turbine exhaust duct located between the compressor building wall and the silencer should be acoustically insulated.
- The turbine lube oil coolers should have noise levels approximately equal to Solar's 85 dBA cooler. The cooler noise level at a horizontal distance of 50 feet from the center of each cooler would be about 54 dBA.
- The gas after-coolers should be designed so that the noise levels at a horizontal distance of 50 feet from the center of each cooler would be about 60 dBA.
- Outdoor aboveground gas piping should be inserted underground soon after exiting the compressor building.
- The compressor building should be acoustically insulated with 6 inches of 8 lbs/cubic feet density mineral wool insulation. The building shell should have 22-gauge metal outer sheeting in the walls and roof and a 26-gauge perforated metal liner.
- The compressor building roll-up door should have a minimum noise reduction rating of STC-28 through the door (this may require a double door).
- Personnel doors should be standard insulated doors with an STC-26 noise reduction rating.
- The compressor building ventilation system has not yet been designed. The building ventilation openings should be acoustically designed so that they are compatible with the silencing in the rest of the station.
- The compressor impeller wheels have not yet been selected and the unit piping noise levels could not be evaluated. It is expected that the unit piping would require acoustic insulation.

Pacific Connector has committed to implementing all of the above recommended noise mitigation measures. Noise modeling results for predicted noise from operation of the Klamath Compressor Station at five nearby NSAs are summarized in table 4.12.2.4-12.

The analysis did not incorporate terrain effects; however, for most existing homes in the vicinity of the compressor station site, this is a conservative assumption. Terrain in the area of the compressor station is relatively flat, so terrain is thought to have little effect on attenuation rates. A more likely factor affecting noise levels in the general area would be nighttime temperature

inversions. Noise that is originally radiated upwards can be refracted back down toward the ground by temperature inversion conditions, resulting in somewhat higher noise levels than expected at moderate distances from a noise source.

The predicted L_{eq} levels at the NSAs surrounding the compressor station are all shown to result in increases over the baseline L_{50} sound levels in excess of 10 dBA, and thus, would not comply with the Oregon noise regulation requirement that new industrial facilities not increase ambient noise levels at noise-sensitive locations. The predicted L_{dn} levels at these NSAs are shown to be in compliance with the FERC L_{dn} limit of 55 dBA except at NSA 1. Pacific Connector recently reached agreements with the owners to purchase the residences at NSA 1 and NSA 2.

The predicted increase in noise levels over existing ambient noise would be clearly perceptible to the human ear at all NSAs when considering the L_{50} baseline sound levels. In comparison to existing L_{dn} sound levels, increases would be clearly perceptible at all NSAs except for NSA 5 where the increase would be barely perceptible. Note that a 10 dBA increase in sound level typically results in the perception of a doubling of sound. Consequently, the Klamath Compressor Station would have noise impacts on surrounding NSAs because of the very quiet existing ambient conditions. Based on the predictive noise modeling, Pacific Connector would need to implement mitigation measures adequate to ensure compliance with FERC regulations. Therefore, to ensure that actual operational noise is at or below the FERC-recommended limits, and that there would be no significant impact to noise quality at the nearest NSAs, **we recommend that:**

- **Pacific Connector should file a noise survey with the Secretary <u>no later than 60 days after placing the Klamath Compressor Station in service</u>. If a full load condition noise survey is not possible, Pacific Connector should provide an interim survey at the maximum possible horsepower load and provide the full load survey <u>within six months</u>. If the noise attributable to the operation of all of the equipment at the Klamath Compressor Station under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Pacific Connector should file a report on what changes are needed and shall install the additional noise controls to meet the level <u>within one year</u> of the in-service date. Pacific Connector should confirm compliance with the above requirement by filing a second noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

Other Aboveground Pipeline Facilities

In addition to the Klamath Compressor Station, aboveground facilities associated with the Pacific Connector pipeline would include meter stations, pig launchers/receivers co-located with other aboveground facilities, and MLVs spaced along the pipeline in accordance with DOT requirements. Meter stations and other aboveground facilities typically do not generate appreciable noise during normal operation. The source of noise at these facilities would be the sound of natural gas moving through underground piping, as transferred to the surface through valves and interconnecting piping. Noise would not be expected to be audible beyond the edge of the meter station sites or pipeline right-of-way.

4.12.2.5 Environmental Consequences on Federal Lands

The southern boundary of the ODNRA is about 1.8 miles north of the Jordan Cove LNG terminal site. As shown on the noise contour maps in figures 4.12-2 and 4.12-3, estimated noise from LNG

terminal construction and operation at the southern boundary of the recreation area would be well below an L_{dn} of 55 dBA (i.e., the noise level used by the EPA and FERC to protect the public from activity interference and annoyance outdoors in residential areas).

During pile driving for installation of berth facilities at the Jordan Cove marine slip, predicted noise levels at the BLM boat ramp located about 1 mile southwest of the terminal site would exceed 55 dBA (figure 4.12-3). Noise from pile driving would be noticeable to users of the BLM boat ramp during construction. Jordan Cove would limit pile driving to daytime periods, 5 days per week over a period of approximately 32 weeks. This impact would be a temporary annoyance to users of the boat ramp. During operation, predicted noise from operation of the LNG terminal would be below 55 dBA at the BLM boat ramp (figure 4.12-3), which would be below a noise level that would interfere or be an annoyance for users of the boat ramp.

During operation of the Jordan Cove LNG terminal, BLM and COE lands near the Coos Bay navigation channel would receive limited noise impacts from LNG vessels arriving at and departing from the terminal. An estimated 90 ships per year would call on the Jordan Cove LNG terminal. Noise levels during ship movements are estimated to be about 63 dBA at a distance of 300 feet during each passby event, which would be similar to noise generated from deep-draft cargo ships that currently traverse the Coos Bay navigation channel. Because the Coast Guard would impose a moving safety zone around LNG vessels, only one large vessel would be traversing any one location along the channel at any point in time. Current ship traffic at the Port is about 60 deep-draft commercial ship calls per year. The increase in the number of vessel calls at the Port resulting from operation of the Jordan Cove LNG terminal would be less than one ship movement per day. Noise from LNG vessels would not be expected to create a noticeable change in overall noise levels at BLM and COE lands along the Coos Bay navigation channel.

During construction of the Pacific Connector pipeline, there would be temporary noise impacts on federal lands crossed by the pipeline or crossed by construction access roads. Construction noise could have localized and temporary effects on recreational users and wildlife on federal lands. Pipeline construction would proceed in a linear fashion along the right-of-way, and equipment would be operated on an as-needed basis; therefore, exact noise at a particular point cannot be determined. However, we can estimate noise levels as a function of the distance of the receptor from the equipment. Table 4.12.2.4-4 provides predicted construction noise levels at 50 feet, 100 feet, and 300 feet for pipeline construction. Noise would diminish rapidly as the distance from the noise source increases.

During operation of the pipeline, there would be no noise generated from the buried pipeline. Aboveground MLVs would be located within BLM lands. During operation, sound is sometimes detectable within several feet of MLVs; however, any noise impact during operation of the MLVs would not be humanly perceptible beyond the operational right-of-way for the pipeline. The main source of noise from operation of the Pacific Connector would be from the Klamath Compressor Station, which would be located on private land, with no federal land adjacent or nearby. We conclude that construction and operation of the Pacific Connector Pipeline Project would not have significant adverse noise impacts on users of federal lands.

4.13 RELIABILITY AND SAFETY

4.13.1 Regulatory Agencies

Three federal agencies share regulatory authority over the siting, design, construction, and operation of LNG import and export terminals: the Coast Guard, the DOT, and the FERC. The Coast Guard has authority over the safety of an LNG facility's marine transfer area and LNG marine traffic, as well as over security plans for the entire LNG facility and LNG marine traffic. Those standards are codified in 33 CFR Parts 105 and 127. The DOT establishes federal safety standards for siting, construction, operation, and maintenance of onshore LNG facilities, as well as for the siting of marine cargo transfer systems at waterfront LNG plants. Those standards are codified in 49 CFR 193. Under the NGA and delegated authority from the DOE, the FERC authorizes the siting and construction of LNG import and export facilities.

In 1985, the FERC and DOT entered into a MOU regarding the execution of each agency's respective statutory responsibilities to ensure the safe siting and operation of LNG facilities. In addition to FERC's existing ability to impose requirements to ensure or enhance the operational reliability of LNG facilities, the MOU specified that FERC may, with appropriate consultation with DOT, impose more stringent safety requirements than those in Part 193.

In February 2004, the Coast Guard, DOT, and FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals, including terminal facilities and tanker operations, and maximizing the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. Under the Interagency Agreement, the FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The DOT and Coast Guard participate as cooperating agencies.

As part of the review required for a FERC authorization, Commission staff must assess whether all proposed facilities would be able to operate safely and securely. The design information that must be filed in the application to the Commission is specified by 18 CFR 380.12 (m) and (o). The level of detail necessary for this submittal requires the Project sponsor to perform substantial front-end engineering of the complete facility. The design information is required to be site-specific and developed to the extent that further detailed design would not result in changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which we considered during our review process.

The FERC's filing regulations also require each applicant to identify how its proposed design would comply with DOT's siting requirements of 49 CFR 193, Subpart B. As part of our NEPA review, we use this information from the applicant, developed to comply with DOT's regulations, to assess whether or not a facility would have a public safety impact. As a cooperating agency, DOT assists FERC staff in evaluating whether an applicant's proposed siting meets the DOT requirements. If a facility is constructed and becomes operational, the facility would be subject to DOT's inspection program. Final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by DOT staff.

In accordance with 33 CFR 127, the Coast Guard has reviewed the proposed liquefaction facilities and stated that adding the proposed export facility operations could be handled through Jordan Cove's annual WSA update. The current Letter of Intent, the Emergency Response Plan, the Operations Manual, and the Facility Security Plan for import operations would need to be amended to include export operations. In addition, the Coast Guard stated that waterway impacts associated with the export project should not change those envisioned in the import project EIS and related WSA.

Section 4.13.2 discusses the principal properties and hazards associated with LNG; section 4.13.3 discusses our technical review of the preliminary LNG terminal facilities design; section 4.13.4 discusses siting requirements for the Jordan Cove facilities; section 4.13.5 discusses the siting analysis of the LNG facility; section 4.13.6 discusses facility security and LNG vessel safety; section 4.13.7 discusses emergency response and evacuation planning; and section 4.13.8 provides conclusions regarding LNG facility reliability and safety. Section 4.13.9 discusses reliability and safety of the proposed pipeline facilities.

4.13.2 LNG Facility Hazards

With the exception of the October 20, 1944, failure at an LNG facility in Cleveland, Ohio, the operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.[167] The failure of the LNG storage tank was due to the use of materials inadequately suited for cryogenic temperatures. LNG migrating through streets and into underground sewers due to the lack of adequate spill impoundments at the site was also a contributing factor. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used and that spill impoundments are designed and constructed properly to contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG facility in Lusby, Maryland. A pump seal failure resulted in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, causing heavy damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident resulted in changing the national fire codes to better ensure that the situation would not occur again.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction facility, which killed 27 and injured 56 workers. No members of the public were injured. Findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed at the Project, Jordan Cove would install hazard detection

[167] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

devices at all combustion and ventilation air intake equipment to enable isolation and deactivation of any combustion equipment whose continued operation could add to, or sustain, an emergency.

On March 31, 2014, an explosion and fire occurred at Northwest Pipeline Corporation's LNG peak-shaving facility in Plymouth, Washington. The facility was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured. The accident investigation is still in progress. Once developed, measures to address any causal factors that led to this incident will be applied to all facilities under Commission jurisdiction.

4.13.2.1 Hazards Associated with the Proposed Equipment

Before liquefaction, Jordan Cove would pre-treat the feed gas for the removal of H_2S, CO_2, water, and mercury. The hazards associated with the removal of these substances from the feed gas stream result from the physical and chemical properties, flammability, and toxicity of mercury, hydrogen sulfide, and amine. Jordan Cove proposes a design capacity to handle up to 0.05 part per billion by volume (ppb-v) mercury, 4 parts per million by volume hydrogen sulfide, and 2 percent by volume (%-vol) CO_2. However, lower quantities and concentrations of these substances would be expected in the natural gas feed stream and would not pose a hazard to the public. CO_2 and H_2S would be removed from the feed gas by a closed-loop regenerative amine system using 40 percent by weight diglycolamine (amine) solution. As the CO_2 and H_2S are removed by the amine solution, these substances would accumulate within the amine solution and reduce the effectiveness of the system. Therefore, the amine solution would be regenerated periodically, where an acid gas stream with concentrations up to 492 parts per million by mole H_2S and 92 mole percent CO_2 would be separated from the contaminated amine solution and routed to the Hydrogen Sulfide Scavengers and Incinerator for further treatment prior to discharging to the atmosphere. The active component in the Hydrogen Sulfide Scavenger would react with sulfur to form a new compound. The spent H_2S Scavenger chemical would be stored on site in a storage tank and trucked off periodically to an approved disposal site. Mercury in the feed gas would be removed in the Mercury Removal Vessels. Jordan Cove would need to replace the mercury removal beds by the end of their service life. Maintenance and safety procedures would cover the proper replacement and disposal of spent materials. The amine solution would be contained, as discussed under "Impoundment Sizing" in section 4.13.5 and handled at temperatures below the point at which it could produce enough vapors to form a flammable mixture. Therefore, the amine solution would not pose a significant hazard to the public, which would have no access to the on-site areas.

Jordan Cove proposes to remove the heavy hydrocarbon components in the feed gas stream at midpoint of the liquefaction process using the Heavies Separators. During this removal process, liquid heavy hydrocarbon would be extracted and handled on-site at temperature and pressure conditions under which a loss of containment would result primarily in a vapor release of both flammable and toxic components and the ability to produce damaging overpressures. The principal hazards associated with the liquefaction and storage of LNG and refrigerants result from loss of containment, vapor dispersion characteristics, flammability, and the ability to produce damaging overpressures. The heavy hydrocarbon stream would contain toxic components including benzene, toluene, ethylbenzene, and xylene.

A loss of the containment provided by storage tanks or process piping would result in the formation of flammable vapor at the release location, as well as from any LNG or liquid flammable refrigerant that pooled. Releases occurring in the presence of an ignition source would most likely result in a fire at the vapor source. A spill without ignition would form a vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. In some instances, ignition of a vapor cloud may produce damaging overpressures. These hazards are described in more detail below.

Loss of Containment

A loss of the containment is the initial event that results in all other potential hazards. The initial loss of containment can result in a liquid and/or gaseous release with the formation of vapor at the release location, as well as from any liquid that pooled. The fluid released may present low or high temperature hazards, and may result in the formation of toxic and flammable vapors. The extent of the hazard will depend on the material released, the storage and process conditions, and the volumes released.

Jordan Cove would store the following on-site: LNG at atmospheric pressure and at a cryogenic temperature of approximately -260°F; liquid ethylene at -74°F and 100 psig; liquid propane at 60°F and 94 psig (similar to the conditions typically used in propane storage and domestic distribution), and isopentane at 60°F and 15 psig.

The mixed refrigerant (MR) process stream would consist of methane, ethylene, propane, and isopentane. Cryogenic temperatures as low as -248°F would occur within the MR process stream used to liquefy the feed gas. The temperature of natural gas liquids (NGL) in the heavy hydrocarbon removal process stream would be as low as -83°F. Loss of containment of LNG and MR liquid (MRL), and NGL could lead to the release of both liquid and vapor into the immediate area. Exposure to either cold liquid or vapor could cause freeze burns and, depending on the length of exposure, more serious injury or death. However, spills would be contained to on-site areas and the cold state of these releases would be greatly limited due to the continuous mixing with the warmer air. The cold temperatures from the release would not present a hazard to the public, which would not have access to on-site areas.

LNG and portions of the MRL stream are cryogenic liquids that would quickly cool any materials contacted by the liquid on release, causing extreme thermal stress in materials not specifically designed for such conditions. These thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These temperatures, however, would be accounted for in the design of equipment and structural supports, and would not be substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296ºF) or several other cryogenic liquids that have been routinely produced and transported in the United States.

A rapid phase transition (RPT) can occur when a cryogenic liquid is spilled onto water and changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction, an RPT is the result of heat transferred to the liquid inducing a change to the vapor state. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small and are not expected to cause significant damage. The average overpressures

recorded at the source of the RPTs during the Coyote tests have ranged from 0.2 pounds per square inch (psi) to 11 psi.[168] These events are typically limited to the area within the spill and are not expected to cause damage outside of the area engulfed by the LNG pool. However, a RPT may affect the rate of pool spreading and the rate of vaporization for a spill on water.

Vapor Dispersion

In the event of a loss of containment, LNG, ethylene, propane, and NGL would vaporize on release from any storage or process facilities. Depending on the size of the release, cryogenic liquids, such as LNG and MRL, may form a liquid pool and vaporize. Additional vaporization would result from exposure to ambient heat sources, such as water or soil. When released from a containment vessel or transfer system, LNG will generally produce 620 to 630 standard cubic feet (ft^3) of natural gas for each cubic foot of liquid. Ethylene will produce approximately 430 ft^3 of gas for each cubic foot of liquid. Propane will produce approximately 270 ft^3 of gas for each cubic foot of liquid. The extracted NGL would produce approximately 280 ft^3 of gas for each cubic foot of liquid. In the event of a loss of containment of isopentane, the isopentane would spill primarily as a liquid and form a pool, but would vaporize much more slowly than propane.

The vapor may form a toxic or flammable cloud depending on the material released. The dispersion of the vapor cloud will depend on the physical properties of the cloud, the ambient conditions, and the surrounding terrain and structures. Generally, a denser-than-air vapor cloud would sink to the ground due to the relative density of the vapor to the air and would travel with the prevailing wind, while a lighter-than-air vapor cloud would rise and travel with the prevailing wind. The density will depend on the material releases and the temperature of the material. For example, a LNG release would initially form a denser-than-air vapor cloud and transition to lighter-than-air vapor cloud as the vapor disperses downwind and mixes with the warm surrounding air; a liquid ethylene or NGL release would form a denser-than-air vapor cloud and transition to a neutrally buoyant vapor cloud as it mixes with the warm surrounding air; and a propane release would form a denser-than-air vapor cloud and would remain denser than the surrounding air, even after warming to ambient temperatures. However, experimental observations and vapor dispersion modeling indicate a LNG vapor cloud would not typically be warm, or buoyant, enough to lift off from the ground before the LNG vapor cloud disperses below its lower flammable limit (LFL).

The vapor cloud would continue to be hazardous until it dispersed below toxic levels and/or flammable limits. Toxicity is primarily dependent on the concentration of the vapor cloud in the air and the exposure duration, while flammability of the vapor cloud is primarily dependent just on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses downwind.

Toxicity is defined by a number of different agencies for different purposes. Acute Exposure Guideline Level (AEGLs) and Emergency Response Planning Guidelines (ERPGs) can be used for emergency planning, prevention, and response activities related to the accidental release of

[168] The Lawrence Livermore National Laboratory conducted seven tests (the Coyote series) on vapor cloud dispersion, vapor cloud ignition, and RPTs at the Naval Weapons Center in China Lake, California in 1981.

hazardous substances.[169] Other federal agencies, such as the Department of Energy, EPA, and NOAA, use AEGLs and ERPGs as the primary measure of toxicity.[170,171,172]

There are three AEGLs and ERPGs that are distinguished by varying degrees of severity of toxic effects with AEGL-1 and ERPG-1 (level 1) being the least severe to AEGL-3 and ERPG-3 (level 3) being the most severe. AEGL-1 is the airborne concentration of a substance that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, these effects are not disabling and are transient and reversible upon cessation of the exposure. AEGL-2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death. ERPG levels have similar definitions, but are based on the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing similar effects defined in each of the AEGLs. The EPA provides ERPGs (1 hour) and AEGLs at varying exposure times (10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours) for a list of chemicals. AEGLs are used preferentially as they are more inclusive and provide toxicity levels at various exposure times. The preferential use of AEGLs is also done by DOE and NOAA. The toxic properties for the various material components stored and processed on-site are tabulated in table 4.13.2.1-1.

TABLE 4.13.2.1-1

Toxicity Levels (in ppm) a/,b/

		10 min	30 min	60 min	4 hr	8 hr
Hydrogen Sulfide	AEGL 1	0.75	0.60	0.51	0.36	0.33
	AEGL 2	41	32	27	20	17
	AEGL 3	76	59	50	37	31
n-Hexane	AEGL 1	–	–	–	–	–
	AEGL 2	4,000*	2,900*	2,900*	2,900*	2,900*
	AEGL 3	12,000***	8,600**	8,600**	8,600**	8,600**
Mercaptans	AEGL 1	–	–	–	–	–
	AEGL 2	40	29	23	14	7.3
	AEGL 3	120	86	68	43	22
Benzene	AEGL 1	130	73	52	18	9
	AEGL 2	2,000*	1,100	800	400	200
	AEGL 3	9,700**	5,600*	4,000*	2,000*	990

[169] U.S. Environmental Protection Agency, *Dose-Response Assessment for Assessing Health Risks Associated with Exposure to Hazardous Air Pollutants*, http://www2.epa.gov/fera/dose-response-assessment-assessing-health-risks-associated-exposure-hazardous-air-pollutants, July 3, 2014.
[170] U.S. Department of Energy, *Temporary Emergency Exposure Limits for Chemicals: Methods and Practice*, DOE Handbook, DOE-HDBK-1046-2008, August 2008.
[171] U.S. Environmental Protection Agency, *40 CFR 68 Final Rule: Accidental Release Prevention Requirements: Risk Management Programs Under Clean Air Act Section 112(r)(7)*, 61 Federal Register 31667-31732, Vol. 61, No. 120, Thursday, June 20, 1996.
[172] U.S. National Oceanic and Atmospheric Administration, *Public Exposure Guidelines*, http://response.restoration.noaa.gov/oil-and-chemical-spills/chemical-spills/resources/public-exposure-guidelines.html, December 3, 2013.

TABLE 4.13.2.1-1

Toxicity Levels (in ppm) a/,b/

		10 min	30 min	60 min	4 hr	8 hr
Toluene	AEGL 1	200	200	200	200	200
	AEGL 2	3,100*	1,600	1,200	790	650
	AEGL 3	13,000**	6,100*	4,500*	3,000*	2,500*
EthylBenzene	AEGL 1	33	33	33	33	33
	AEGL 2	2,900	1,600	1,100	660	580
	AEGL 3	4,700	2,600	1,800	1,000	910
Xylenes	AEGL 1	130	130	130	130	130
	AEGL 2	2,500*	1,300*	920*	500	400
	AEGL 3	7,200**	3,600*	2,500*	1,300*	1,000*

a/ U.S. Environmental Protection Agency, Acute Exposure Guideline Levels, http://www.epa.gov/oppt/aegl/pubs/chemlist.htm, December 3, 2013.
b/ American Industrial Hygiene Association, 2013 ERPG/WEEL Handbook, http://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines, 2013.
*=≥10% LFL; **=≥50% LFL; ***=≥100%LFL.

In addition, methane and heavier hydrocarbons are classified as simple asphyxiants and may pose extreme health hazards, including death, if inhaled in significant quantities within a limited time. Very cold methane and heavier hydrocarbons vapors may also cause freeze burns. However, the locations of concentrations where cold temperatures and oxygen-deprivation effects could occur are greatly limited due to the continuous mixing with the warmer air surrounding the spill site. For that reason, exposure injuries from contact with releases of methane and heavier hydrocarbons normally represent negligible risks to the public.

Flammable vapors can develop when a flammable material is above its flash point and concentrations are between the LFL and the upper flammable limit (UFL). Concentrations between the LFL and UFL can be ignited, and concentrations above the UFL or below the LFL would not ignite. The flammable properties for the various material components stored and processed on-site are tabulated in table 4.13.2.1-2.

TABLE 4.13.2.1-2

Flammable Properties a/

Material Component	Flash Point	LFL (% vol)	UFL (% vol)
Methane	-283°F	5.0	15.0
Ethylene	-250°F	2.7	36
Ethane	-211°F	3.0	12.5
Propane	-155°F	2.1	9.5
n-Butane	-76°F	1.8	8.5
i-Butane	-105°F	1.8	8.4
n-Pentane	-56°F	1.4	7.8
i-Pentane	-60°F	1.4	7.6
n-Hexane	-7.6°F	1.2	7.5
Benzene	11°F	1.4	7.1
Toluene	45°F	1.2	7.1
EthylBenzene	75°F	1.0	6.7
m-Xylene	77°F	1.1	7.0

TABLE 4.13.2.1-2

Flammable Properties a/

Material Component	Flash Point	LFL (% vol)	UFL (% vol)
o-Xylene	75°F	1.1	6.0
p-Xylene	77°F	1.1	7.0
Hydrogen sulfide	-116°F	4.0	44

a/ Society of Fire Protection Engineers (2008)

The extent of the affected area and the severity of the impacts on objects within a vapor cloud would primarily be dependent on the material, quantity, and duration of the initial release, the surrounding terrain, and the environmental conditions present during the dispersion of the cloud. Jordan Cove has modeled the extent of the potential vapor dispersion hazards for the Project, which is discussed in section 4.13.5.

Flammable Vapor Ignition

If the flammable portion of a vapor cloud encounters an ignition source, a flame would propagate through the flammable portions of the cloud. In most circumstances, the flame would be driven by the heat it generates. This process is known as a deflagration, or a flash fire because of its relatively short duration. However, exposure to a deflagration, or flash fire, can cause severe burns and death, and can ignite combustible materials within the cloud. Jordan Cove has modeled the extent of the potential flammable vapor dispersion hazards for the Project, which is discussed in section 4.13.5.

If the deflagration in a flammable vapor cloud accelerates to a sufficiently high rate of speed, pressure waves that can cause damage would be generated. As a deflagration accelerates to super-sonic speeds, the large shock waves produced, rather than the heat, would begin to drive the flame, resulting in a detonation. The flame speeds are primarily dependent on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance. Jordan Cove has modeled the extent of the potential overpressure hazards for the Project, which is discussed in section 4.13.5.

Once a vapor cloud is ignited, the flame front may propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. When the flame reaches vapor concentrations above the UFL, the deflagration could transition to a fireball and result in a pool or jet fire back at the source. A fireball would occur near the source of the release and would be of a relatively short duration compared to an ensuing jet or pool fire. The extent of the affected area and the severity of the impacts on objects in the vicinity of a fire would primarily be dependent on the material, quantity, and duration of the fire, the surrounding terrain, and the environmental conditions present during the fire. Jordan Cove has modeled the extent of the potential radiant heat hazards for the Project, which is discussed in section 4.13.5.

Cascading Events

Fires and overpressures may also cause failures of nearby storage vessels, piping, and equipment if not properly mitigated. These failures are often termed cascading events or domino effects and can exceed the consequences of the initial hazard.

The failure of a pressurized vessel could cause fragments of material to fly through the air at high velocities, posing damage to surrounding structures and a hazard for operating staff, emergency personnel, or other individuals in proximity to the event. In addition, failure of a pressurized vessel when the liquid is at a temperature significantly above its normal boiling point could result in a boiling-liquid-expanding-vapor explosion (BLEVE). BLEVEs can produce overpressures when the superheated liquid rapidly changes from a liquid to a vapor upon the release from the vessel. BLEVEs of flammable fluids may also ignite upon its release and cause a subsequent fireball.

Failures of nearby storage vessels, piping, and equipment and the potential for cascading events are discussed in section 4.13.5. Jordan Cove has mitigated the risk for cascading event hazards for the Project, which is also discussed in section 4.13.5.

Overpressures

If the deflagration in a flammable vapor cloud accelerates to a sufficiently high rate of speed, pressure waves that can cause damage would be generated. As a deflagration accelerates to super-sonic speeds, large pressure waves are produced, and a shock wave is created. This shock wave, rather than the heat, would begin to drive the flame, resulting in a detonation. Deflagrations or detonations are generally characterized as "explosions" as the rapid movement of the flame and pressure waves associated with them cause additional damage beyond that from the heat. The amount of damage an explosion causes is dependent on the amount the produced pressure wave is above atmospheric pressure (i.e., an overpressure) and its duration (i.e., pulse). For example, a 1 psi overpressure, often cited as a safety limit in U.S. regulations, is associated with glass shattering and traveling with velocities high enough to lacerate skin.

Flame speeds and overpressures are primarily dependent on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance.

The potential for unconfined LNG vapor cloud detonations was investigated by the Coast Guard in the late 1970s at the Naval Weapons Center in China Lake, California. Using methane, the primary component of natural gas, several experiments were conducted to determine whether unconfined LNG vapor clouds would detonate. Unconfined methane vapor clouds ignited with low-energy ignition sources (13.5 joules), produced flame speeds ranging from 12 to 20 mph. These flame speeds are much lower than the flame speeds associated with a deflagration with damaging overpressures or a detonation. The tests indicated unconfined methane-air mixtures could be ignited, but no test produced unconfined detonation.

The Coast Guard conducted additional series of tests to quantify explosion hazards of LNG spills. Phase I included an analytical evaluation of the possible magnitude and damage potential of a spill of LNG. Phase II included tests igniting a range of methane concentrations using small and large boosters in a 1.8-meter-long, 0.6-meter-diameter shock tube and spark ignition sources in both 3.6-meter-long, 0.6-meter-diameter shock tube and thin film hemispheres. The intent was to evaluate potential from deflagration to detonation in unconfined flammable vapor clouds. Additional phases were conducted for spills of LNG and LPG and gasoline onto water for comparative reasons. These phases involved additional thin film hemisphere tests to evaluate whether a detonation initiated by a high explosive charge or a detonation exiting a tube could be sustained within an unconfined flammable vapor cloud.

In Phase II, spark ignition tests yielded velocities ranging from 45-63 m/s with overpressures of 0.2 to 0.4 psi. The Coast Guard also performed 5-meter and 10-meter radius hemisphere tests of unconfined stoichiometric methane-air mixtures ignited by spark igniters in the center of the hemisphere. During the 5-meter tests, flame speeds were approximately 5.2-7.3 m/s and a pressure wave was not recorded, indicating the pressure was less than the approximately 1.5 psi lower limit of the pressure sensing equipment. In one of the tests, simple obstacles were added and in another test, open tubes were added. Both of these failed to significantly alter the flame velocity.

Large explosive charge tests yielded velocities ranging from 910 m/s to 1,050 m/s with overpressures of 5.4 to 7.8 bar (78 to 113 psi). However, it is unclear whether the tube was long enough to obtain an accurate measure of the pressure induced by the methane versus the booster ignition source. Two attempts were also made to detonate a stoichiometric methane air mixture in 5-meter hemispheres using explosive boosters. During these tests, flame speeds were observed to propagate much more slowly than the initial detonation product expansion, measured at approximately 34 m/s.

In an additional phase (Phase III), tests were conducted to examine the level of sensitivity of an unconfined cloud to the presence of heavier hydrocarbons, such as ethane and propane. A series of tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined vapor cloud to detonate. Tests utilizing 57.6 percent, 76.8 percent, 81.6 percent, 86.4 percent, and 90 percent methane with the remainder of the fuel mixture made up of heavier hydrocarbons were examined. Methane concentrations above 81.6 percent failed to produce a vapor cloud detonation. Tests with 86-96 percent methane near stoichiometric proportions using exploding charges as the ignition source produced overpressures of 4 bar (58 psi), which was approximately the same overpressure produced during the calibration test involving the exploding charge ignition source alone. It remains unclear that the overpressure was attributable to the vapor deflagration.

In the last phase (Phase V) of the project, tests were conducted to determine whether methane could sustain a detonation initiated by an ignition source with high explosives or from an existing detonation emerging from a culvert. Tests indicated that 10-meter radius vapor clouds of nearly pure methane (99.9 percent) would not detonate from high explosives and the flame speeds and pressures rapidly decreased after initiation of the explosive charge. The second set of experiments used sheet explosive to create a detonation wave in a 6-meter-long culvert (1.8- and 2.4-meter-diameter) buried vertically in the ground filled with a flammable mixture of LNG with a 5- and 10-meter radius unconfined methane-propane and heavier hydrocarbon-air vapor cloud at the exit of the culvert. The experiments indicated that an unconfined vapor cloud with methane concentrations above 85 percent could not sustain a detonation from a 1.8-meter-diameter culvert. The experiment also indicated that an unconfined vapor cloud with a methane concentration of 99.9 percent could not sustain a detonation from a 2.4-meter-diameter diameter culvert. However, the experiments indicated that an unconfined vapor cloud with methane concentrations of up to 94 percent could sustain a detonation from a 2.4-meter-diameter culvert.

A separate study investigated the detonation sensitivity of methane-ethane-air stoichiometric mixtures from pure methane-air to pure ethane-air. The results of tests indicated that very strong

ignition sources were necessary to initiate a detonation with ethane concentrations greater than 10 percent in the fuel mixture (or approximately 1 percent of total fuel-air mixture).

Tests in the early 1970s also investigated the effects of ignition end location within a pipe. A 40-meter-long, 1.4-meter-diameter pipe with one open end and one closed end was filled with methane-air and ignited at the respective ends of the pipe to examine the difference in flame speeds. The highest flame speed was observed when the gas was ignited in the closed end and the other end was open. When ignition was at the open end, the flow velocity and the turbulence level ahead of the flame were very low and the flame propagated at low velocities through the pipe.

In the early 1980s, tests investigated the effects of repeated baffle plates inside a 10-meter-long, 2.5-meter-diameter pipe with one end open. Configurations using 1, 3, 5, and 6 equally spaced baffle plates with area blockage ratios of 16 percent, 30 percent, and 50 percent were examined. Using spark igniters, five equally spaced baffle plates with blockage ratios of 50 percent produced an average maximum overpressure of approximately 4 bar (58 psi) within the pipe, a maximum overpressure of 4.3 bar (62 psi) immediately outside of the pipe, and a maximum overpressure of 0.39 bar (6 psi) located 10 meters downstream of the pipe exit. Similar experiments were conducted using propane and found to produce an average maximum overpressure of approximately 7 bar (102 psi) within the pipe, a maximum overpressure of 13.9 bar (202 psi) immediately outside of the pipe, and a maximum overpressure of 0.61 bar (9 psi) located 10 meters downstream of the pipe exit.

Tests conducted in the late 1980s investigated whether flames propagating over and around repeated obstructions could generate high flame speeds. The tests ignited natural gas-air mixtures in a 45-meter-long open-sided rig, in which pipe arrays, obstructions, and grids were located to simulate obstacles found on most gas processing and storage sites. The first set of tests had 1.5-meter-spaced pipe arrays arranged with an area blockage ratio of approximately 40 percent over the first 18 meters of the test rig. Maximum flame speeds of approximately 50 m/s attained in the tests were up to 10 times higher than in unobstructed tests, but with peak overpressures in the range of only 0.4 to 1 psi.

Further tests were conducted with the same pipe array setup covering the first 22.5 meters of the test rig. Immediately after the flame emerged from the obstructed region into the unobstructed part of the cloud, the flame rapidly decelerated to a level that produced an overpressure less than 0.15 psi. Natural gas-air tests with the same pipe array setup spanning the full 45 meters of the test rig showed flame speeds of approximately 80 m/s with peak overpressure inside the test-rig of approximately 1.5 psi.

In an attempt to achieve a limiting flame speed for natural gas, the test-rig was modified to completely enclose the first 9 meters of the rig to study whether the flame speed would accelerate or decelerate from the flame emerging from the confined region. Pipe arrays were varied within the confined region to produce flame speeds emerging from the confined region between 100 and 1,000 m/s, but remained the same in the unconfined region. For experiments with initiating flame speeds from the confined area of less than approximately 500 m/s the flame rapidly decelerated to approximately 30 to 40 m/s. For experiments with initiating flame speeds from the confined area of 600 to 700 m/s, the flame sustained approximately 500 m/s over the

full length of the test-rig. In a further test with an initiating flame speed from the confined area of 1,000 m/s, the flame initially decelerated and then sustained at approximately 500 m/s.

To confirm that congestion was needed to sustain the high flame speeds, an experiment was conducted in which obstacles were located only over the first half of the test-rig. Similar to the unconfined tests, these tests also showed that immediately after the flame emerged from the congested region into the unobstructed part of the cloud, the flame rapidly decelerated to less than 10 m/s at the end of the test-rig. Additional tests showed that rapid deceleration occurred once the blockage ratio was reduced below 24 percent or the spacing between arrays exceeded 2.4 meters.

It was also shown that although more closely packed pipe arrays (down to 0.5 meter) could produce high flame speeds, there was not any evidence to suggest that in a longer region of more closely spaced pipe arrays (down to 0.5 meter) that higher flame speeds would have occurred compared to the previous tests.

Later tests of near stoichiometric proportions of methane-air were also conducted by the Explosion Research Cooperative to form the updated Baker-Strehlow-Tang (BST) blast wave curves for low reactivity substances. The tests ignited methane-air mixtures in an unconfined 12-foot-wide by 48-foot-long by 6-foot-high module test rig consisting of a 2x8 array of 6-foot cubical modules. Each 6-foot cubical module was outfitted with 2-inch-diameter schedule 40 pipe arrays of varying congestion. The low congestion set of tests had a 4x4 array of pipes with a pitch to diameter ratio of 7.6, an area blockage ratio of approximately 13 percent and volume blockage ratio of approximate 1.5 percent. The medium congestion set of tests had a 7x7 array of pipes with a pitch to diameter ratio of 4.3, an area blockage ratio of approximately 23 percent and volume blockage ratio of approximate 4.3 percent. The high congestion set of tests had alternating rows of 4 and 7 pipes with a pitch to diameter ratio of 3.1, an area blockage ratio of approximately 23 percent and volume blockage ratio of approximate 5.7 percent. According to those tests that form the BST blast wave curves, methane should not produce high flame speeds or associated large overpressures in areas of low congestion, even with partial confinement.

Numerous tests, reflective of offshore facilities, have also been conducted. These tests have shown similar trends of increased confinement and congestion resulting in larger overpressures. However, offshore facilities are not necessarily reflective of onshore, as offshore facilities are generally more congested and often contain multiple platform levels that can provide for confinement. This increase in congestion and confinement can be attributed to the smaller footprint associated with offshore facilities.

This history of natural gas explosion tests provides a frame of reference for informing our site specific evaluation on the potential for LNG facilities to produce damaging overpressures. To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the Coast Guard conducted further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. The tests indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined natural gas vapor cloud to detonate. Natural gas with greater amounts of heavier hydrocarbons would be more sensitive to detonation.

To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the Coast Guard conducted

further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. The tests indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined natural gas vapor cloud to detonate. Less processed natural gas with greater amounts of heavier hydrocarbons would be more sensitive to detonation.

Although it has been possible to produce damaging overpressures and detonations of unconfined LNG vapor clouds, the feed gas stream proposed for the Project would have lower ethane and propane concentrations than those that resulted in damaging overpressures and detonations. The substantial amount of initiating explosives needed to create the shock initiation during the limited range of vapor-air concentrations also renders the possibility of detonation of these vapors at an LNG plant as unrealistic. Ignition of a confined LNG vapor cloud could result in higher overpressures. In order to prevent such an occurrence, Jordan Cove would take measures to mitigate the vapor dispersion and ignition into confined areas, such as buildings. Jordan Cove would install hazard detection devices at all combustion and ventilation air intake equipment to enable isolation and deactivation of any combustion equipment whose continued operation could add to, or sustain, an emergency. In general, the primary hazards to the public from an LNG spill that disperses to an unconfined area, either on land or water, would be from dispersion of the flammable vapors or from radiant heat generated by a pool fire.

In comparison with LNG vapor clouds, there is a higher potential for unconfined propane clouds to produce damaging overpressures, and an even higher potential for unconfined ethylene vapor clouds to produce damaging overpressures. Unconfined ethylene vapor clouds also have the potential to transition to a detonation much more readily than propane. This has been shown by multiple experiments conducted by the Explosion Research Cooperative to develop predictive blast wave models for low, medium, and high reactivity fuels and varying degrees of congestion and confinement (Pierorazio et al. 2005). The experiments used methane, propane, and ethylene, as the respective low, medium, and high reactivity fuels. In addition, the tests showed that if methane, propane, or ethylene are ignited within a confined space, such as in a building, they all have the potential to produce damaging overpressures. The MRL and NGL process streams would contain a mixture of components such as the ones discussed above (i.e., ethylene and propane). Therefore, a potential exists for these process streams to produce unconfined vapor clouds that could produce damaging overpressures in the event of a release.

Discussion of these hazards and potential mitigation are in section 4.13.5 for the Project facilities.

4.13.3 Technical Review of the Facility Preliminary Engineering Design

Operation of the proposed facility poses a potential hazard that could affect the public safety if strict design and operational measures to control potential accidents are not applied. The primary concerns are those events that could lead to an LNG spill of sufficient magnitude to create an off-site hazard as discussed in section 4.13.2. However, it is important to recognize the stringent requirements in place for the design, construction, operation, and maintenance of the facility, as well as the extensive safety systems proposed to detect and control potential hazards.

In general, we consider an acceptable design to include various layers of protection or safeguards in the facility design to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public. These layers of protection are independent of one

another so that any one layer would perform its function regardless of the action or failure of any other protection layer or initiating event. Such design features and safeguards typically include:

- a facility design that prevents hazardous events through the use of suitable materials of construction; operating and design limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;
- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure the facility stays within the established operating and design limits;
- safety-instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;
- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and structural fire protection, to prevent escalation to a more severe event;
- site security measures for controlling access to the facility, including security inspections and patrols; response procedures to any breach of security and liaison with local law enforcement officials; and
- on-site and off-site emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

We believe the inclusion of such protection systems or safeguards in a facility design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. In addition, siting of the facility with regard to potential off-site consequences can be further used to minimize impacts to public safety. As discussed in Section 4.13.4, DOT's regulations in 49 CFR 193, Subpart B require a siting analysis be performed by Jordan Cove.

As part of the application, Jordan Cove provided a FEED for the Project. In developing the FEED, Jordan Cove conducted a hazard identification study of preliminary design to identify potential risk scenarios. This helped to establish the required safety control levels and identify whether additional process and safety instrumentation, mitigation, and/or administrative controls would be needed. We have analyzed the information filed by Jordan Cove to determine the extent that layers of protection or safeguards to enhance the safety, operability, and reliability of the facility are included in the FEED.

The objectives of our FEED review focused on the engineering design and safety concepts of the various protection layers, as well as the projected operational reliability of the proposed facilities. The design would use materials of construction suited to the pressure and temperature conditions of the process design. Piping would be designed in accordance with ASME B31.3. Pressure vessels would be designed in accordance with ASME Section VIII and the storage tanks would be designed in accordance with American Petroleum Institute (API) Standard 620, per 49 CFR 193 and the National Fire Protection Association's Standard 59A (NFPA 59A). All LNG storage tanks would also include boil-off gas compression to prevent the release of boil-off to the atmosphere in accordance with NFPA 59A for an inherently safer design. Valves and other equipment would be designed to recommended and generally accepted good engineering practices. Jordan Cove states that the LNG facility would be designed to withstand a sustained

wind of 150 miles per hour, and the South Dunes Power Plant site (i.e., gas pretreatment facilities and power generation) would be designed to comply with ASCE 7.[173]

The tsunami inundation map developed by the DOGAMI showed the inundation line at an elevation of +40 feet at the proposed site location. The top of the LNG loading platform would be set at an elevation of +30 feet NAVD88. The proposed elevation for the liquefaction area and gas pre-treatment area would be at a grade elevation of approximately +46 feet and 40 feet, respectively. The base of the LNG storage tanks would be at an elevation of +30 feet NAVD88 and would be surrounded by an earthen impoundment (storm surge barrier) that would have a proposed minimum elevation of +60 feet NAVD88.

The Jordan Cove site is located across the Coos Bay navigation channel from the Southwest Oregon Regional Airport. The LNG storage tanks have a proposed height of 255 feet above mean sea level (AMSL). The amine towers have a proposed height of 188 feet AMSL, and the LNG vessels were initially anticipated to have a height of 217 feet AMSL. Jordan Cove has coordinated with the Southwest Oregon Regional Airport and FAA on the height of structures at the facility to determine whether or not they interfere with the airport flight operations. The FAA conducted an aeronautical study under the provisions of 49 U.S.C. Section 44718 and 14 CFR Part 77 and on July 24, 2014 issued initial findings of five Notices of Presumed Hazards (NPH) for the two LNG storage tanks, the two amine towers, and the LNG vessels calling on the facility because these structures exceed the obstruction standards and/or would have an adverse physical or electromagnetic interference effect upon navigable airspace or air navigation facilities. Pending resolution of these issues, the structures are presumed to be hazards to air navigation. If the structures were reduced in height so as not to exceed 137 feet above ground level (167 feet AMSL), it would not exceed obstruction standards and a favorable determination could subsequently be issued. Any height exceeding 183 feet above ground level (213 feet above mean sea level), will result in a substantial adverse effect and would warrant a Determination of Hazard to Air Navigation.

On July 21, 2015, FERC staff issued a data request letter requiring Jordan Cove to file documentation of its consultations with the FAA and the Southwest Oregon Regional Airport pertaining to the five NPHs. On August 3, 2015, Jordan Cove provided responses to FERC data request and included a letter dated July 24, 2015 from the Southwest Oregon Regional Airport the FAA describing two possible mitigation measures, which include changing the approach direction for Runway 04 or adding lighting and marking to the storage tanks and amine towers. The August 3, 2015, responses also stated that the LNG vessel has been redefined to be below the 167-foot threshold that establishes the presumed hazard. The discussion of the vessel transit route can be found in section 4.13.6.5.

Since the FAA has not determined whether the proposed mitigation measures would be sufficient to alleviate the hazard or issued the final determinations, we have recommended in section

[173] A 150 mph sustained wind speed would correspond to a 183 mph three-second gust using the Durst Curve in ASCE 7-05 and a 185 mph three-second gust using a 1.23 gust factor for onshore winds at a coast line recommended in World Meteorological Organization, *Guidelines for Converting Between Various Wind Averaging Periods in Tropical Cyclone Conditions*. These wind speeds are equivalent to approximately a 14,000 year mean return interval or 0.36% probability of exceedance in a 50-year period for the site based on ASCE 7-05 wind speed return period conversions,

4.10.1.4 for Jordan Cove to file the final determinations from the FAA that indicate there would be no hazard to aircraft from the LNG terminal or related facilities.

Jordan Cove would install process control valves and instrumentation to safely operate and monitor the facility. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Operators would have the capability to take action from the control room to mitigate an upset.

Jordan Cove would develop facility operation procedures after completion of the final design; this timing is fully consistent with accepted industry practice. We have made recommendations for Jordan Cove to provide more information on the operating and maintenance procedures as they are developed, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training. In addition, we have recommended measures such as labeling of instrumentation and valves, piping, and equipment and car-seals/locks, to address human factor considerations and improve facility safety. An alarm management program would also be in place to ensure effectiveness of the alarms.

Safety valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. Safety instrumented systems would comply with International Society for Automation (ISA) Standard 84.01 and other recommended and generally accepted good engineering practices. We also made recommendations on the design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause and effect alarm or shutdown logic and enhanced representation of the emergency shutdown valves in the facility control system.

Safety relief valves and flares would be installed to protect the process equipment and piping. The safety relief valves would be designed to handle process upsets and thermal expansion within piping, per NFPA 59A and ASME Section VIII, and would be designed based on API 520, 521, 527, and other recommended and generally accepted good engineering practices. In addition, we made recommendations to ensure the design and installation of pressure and vacuum relief devices are adequate.

The security requirements for the liquefaction facility are governed by 49 CFR 193, Subpart J - Security. Subpart J specifies security requirements for the onshore component of LNG facilities. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. Security at the facility would be provided by both active and passive systems. The site would be surrounded by a protective enclosure (i.e., a fence or natural barrier). The enclosure would be illuminated with not less than 2.2 lux between sunset and sunrise.

Requirements for maintaining security can also be found in the Coast Guard's 33 CFR 127 regulations. Title 33 CFR 127 would require even higher intensity lighting at any loading flange and at each work area. Jordan Cove would install a camera monitoring system to provide remote surveillance and intrusion detection capability.

Requirements for maintaining security of the liquefaction facility can be found in 33 CFR 105. These security requirements were authorized by the Maritime Transportation Security Act (MTSA) of 2002, which requires all terminal owners and operators to submit a Facility Security

Assessment and a Facility Security Plan to the Coast Guard for review and approval. Some of the responsibilities of the applicant include, but are not limited to:

- designating an Facility Security Officer with a general knowledge of current security threats and patterns, risk assessment methodology, and the responsibility for implementing the Facility Security Assessment and Facility Security Plan and performing an annual audit for the life of the project;
- conducting a Facility Security Assessment to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures;
- developing a Facility Security Plan based on the Facility Security Assessment, with procedures for: responding to transportation security incidents; notification and coordination with local, state, and federal authorities; prevention of unauthorized access; measures and equipment to prevent or deter dangerous substances and devices; training; and evacuation;
- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, vessel stores and bunkers, and monitoring;
- ensuring the Transportation Worker Identification Credential program is properly implemented; and
- reporting all breaches of security and security incidents to the National Response Center.

Under 33 CFR 105, Jordan Cove would be required to submit a Facility Security Plan to the Coast Guard for review and approval before commencement of operations.

In the event of a release, drainage systems from LNG storage and liquefaction process facilities would direct a spill away from equipment in order to minimize flammable vapors from dispersing to confined, occupied, or public areas and to minimize heat from impacting adjacent equipment and public areas if ignition occurs. Spacing of vessels and equipment between each other, from ignition sources, and to the property line would meet the requirements of NFPA 59A (2001 edition), as referenced in 49 CFR 193.2401.

Jordan Cove performed a preliminary fire protection evaluation to ensure that adequate hazard detection, hazard control, and firewater coverage would be installed to detect and address any upset conditions. Structural fire protection, proposed to prevent failure of structural supports of equipment and pipe racks, would comply with NFPA 59A and other recommended and generally accepted good engineering practices. Jordan Cove would also install hazard detection systems to detect, alarm, and alert personnel in the area and control room to initiate an emergency shutdown and/or initiate appropriate procedures, and would meet NFPA 72, ISA 12.13, and other recommended and generally accepted good engineering practices. Hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A and NFPA 10, 12, 15, 17, and other recommended and generally accepted good engineering practices. Jordan Cove would provide automatic firewater systems and monitors for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire, and would meet NFPA 59A, 20, 22, and 24 requirements. We have made recommendations for Jordan Cove to provide more information on the design, installation, and

commissioning of hazard detection, hazard control, and firewater systems as Jordan Cove would further develop this information during the final design phase.

Jordan Cove would also have emergency procedures in accordance with 49 CFR 193 and 33 CFR 127. The emergency procedures would provide for protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the facility. Jordan Cove would also be required to develop an ERP in accordance with EPAct, as discussed further in section 4.13.7.

As a result of our technical review of the information provided by Jordan Cove in the submittal documents, we identified a number of concerns in an information data request letter issued on September 13, 2013 relating to the reliability, operability, and safety of the proposed design. Jordan Cove provided some, but not all, written responses to the information data request on October 3, 2013. Some of these responses indicated that Jordan Cove would correct or modify its design in order to address issues raised in the information request. As a result, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Jordan Cove should file with the Secretary, for review and approval by the Director of OEP, information/revisions pertaining to Jordan Cove's response numbers 17(b), 17(d), 27, 43, 46, 59, 61, 66, 91, 95, 103, 111, and 112 of its October 3, 2013 filing, which indicated features to be included or considered in the final design.**

The FEED and specifications submitted for the proposed facilities to date are preliminary, but would serve as the basis for any detailed design to follow. If authorization is granted by the Commission, the next phase of the Project would include development of the final design, including final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues. We do not expect that the detailed design information to be developed would result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs that were presented as part of the FEED.

A more detailed and thorough hazard and operability review (HAZOP) analysis would be performed by Jordan Cove during the final design phase to identify the major hazards that may be encountered during the operation of facilities. The HAZOP study would be intended to address hazards of the process, engineering and administrative controls, and would provide a qualitative evaluation of a range of possible safety, health, and environmental effects which may result from the design or operation of the facility. Recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review.

Once the design has been subjected to a HAZOP review, the design development team tracks changes in the facility design, operations, documentation, and personnel. Jordan Cove would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled. Resolutions of the recommendations generated by the HAZOP review would be monitored by the FERC staff. We have included a recommendation that Jordan Cove should file a HAZOP study on the completed final design.

Information regarding the development of the final design, as detailed below, would need to be filed with the Secretary for review and written approval by the Director of the Office of Energy Projects (OEP) before equipment construction at the site would be authorized. To ensure that the

concerns we've identified relating to the reliability, operability, and safety of the proposed design are addressed by Jordan Cove, and to ensure that the facility is subject to the Commission's construction and operational inspection program, **we recommend that the following measures should apply to the Jordan Cove Project. Information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; prior to introduction of hazardous fluids; or prior to commencement of service, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements, would be subject to public disclosure. All information should be filed a minimum of 30 days before approval to proceed is requested.**

- **Prior to initial site preparation, Jordan Cove should file an overall project schedule, which includes the proposed design stages of the commission plan.**
- **Prior to initial site preparation, Jordan Cove should provide procedures for controlling access during construction.**
- **Prior to initial site preparation, Jordan Cove should file the quality assurance and quality control procedures for construction activities.**
- **Prior to initial site preparation, Jordan Cove should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**
- **The final design should include an analysis of the structural integrity of the outer containment of the full containment storage tanks when exposed to a roof tank top fire or adjacent tank top fire.**
- **The final design should vent the seal gas from the pressure regulator and bursting disc to the flare, and the seal gas drum drain should be piped to a safe location for containment instead of draining to grade.**
- **The final design should specify the operating temperature of the hot gas injection nozzle to Refrigerant Suction Drum, 30-V-0101, consistent with the design temperature of the first stage refrigerant compressor discharge.**
- **The final design should provide provisions for the future installation of LNG transfer pumps for the BOG Compressor Suction Drums.**
- **The final design of the electrical seal interface between a flammable fluid and electrical cable should comply with the requirements of NFPA 59A (2001 edition), Section 7.**

- **The final design of the Marine Area and the Process Area Impoundment Basins should include low temperature detectors that shutdown and prevent the start-up of the storm water pumps.**
- **The final design should include procedures that require the equipment to be completely shut down and depressurized during maintenance.**
- **The final design should provide coarse mesh strainers in the bottom outlet piping of the adsorbers to prevent support material and molecular sieve migrating from the Mole Sieve Gas Dehydrators to the piping system and switching valves.**
- **The final design should provide drainage piping to the flare system from the Heavies Separator bottom outlet piping upstream of the shutoff valve.**
- **The final design should include a flow transmitter with low flow alarm in the cooling water inlet line to each refrigerant compressor motor cooling system.**
- **The final design should include a plant-wide shutdown initiated by low instrument air pressure. The setting should be above the minimum required to maintain stable operation.**
- **The final design should provide provisions for the future installation of transfer pumps for the Flare Knockout (KO) Drums.**
- **The final design should consider design features necessary to prevent liquid from the flare KO drums overflowing into the flare piping system in the event of releases into these drums when they are operating with high liquid levels, or when a plant shutdown has been initiated by high-high liquid level in a flare KO drum.**
- **The final design should include change logs that list and explain any changes made from the Front-End Engineering Design provided in Jordan Cove's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.**
- **The final design should provide up-to-date Process Flow Diagrams with heat and material balances and P&IDs, which include the following information:**

  a. equipment tag number, name, size, duty, capacity, and design conditions;
  b. equipment insulation type and thickness;
  c. storage tank pipe penetration size and nozzle schedule;
  d. valve high pressure side and internal and external vent locations;
  e. piping with line number, piping class specification, size, and insulation type and thickness;
  f. piping specification breaks and insulation limits;
  g. all control and manual valves numbered;
  h. relief valves with set points; and
  i. drawing revision number and date.

- **The final design should provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications.**

- **The final design should include three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**

- **The final design should provide complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.**

- **The final design should provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list should include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.**

- **The final design should provide facility plans and drawings that show the location of the firewater and foam systems. Drawings should clearly show: firewater and foam piping; post indicator valves; and the location, and area covered by, each monitor, hydrant, deluge system, foam system, water-mist system, and sprinkler. The drawings should also include piping and instrumentation diagrams of the firewater and foam system.**

- **The final design should include an updated fire protection evaluation of the facilities carried out in accordance with the requirements of NFPA 59A 2001, chapter 9.1.2 as required by 49 CFR Part 193. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.**

- **The final design should demonstrate that for hazardous fluids, piping and piping nipples 2 inches or less in diameter are to be no less than schedule 160 for carbon steel and no less than schedule 80 for stainless steel, and are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.**

- **The final design should include drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A.**

- **The final design should provide an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that: should continuously monitor for the presence of a flammable fluid; should alarm the hazardous condition; and should shutdown the appropriate systems.**

- **The final design should provide electrical area classification drawings.**
- **The final design should provide spill containment system drawings with dimensions and slopes of curbing, trenches, and impoundments.**
- **The final design of the hazard detectors should account for the calibration gas when determining the lower flammability limit set points for methane, propane, ethylene, and isopentane. Include a list of alarm and shutdown set points for each flammable gas detector.**
- **The final design of the hazard detectors should account for the calibration gas when determining the toxic concentration set points for hydrogen sulfide, benzene, toluene, ethylbenzene, and xylene. Include a list of alarm and shutdown set points for each toxic gas detector.**
- **The final design should provide an analysis of the localized hazards to operators from a potential liquid nitrogen release and should also provide consideration of any mitigation that may be prudent.**
- **The final design should include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations, should be filed.**
- **The final design should include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and setpoints.**
- **The final design should include a drawing showing the location of the emergency shutdown (ESD) buttons. ESD buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.**
- **The final design should specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System (DCS)/Safety Instrumented System (SIS).**
- **The final design should include a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193, and should provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing.**
- **The final design should include the sizing basis and capacity for the final design of pressure and vacuum relief valves for major process equipment, vessels, storage tanks, as well as vent stacks.**
- **The final design should provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3.**

- **<u>Prior to commissioning</u>, Jordan Cove should file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**

- **<u>Prior to commissioning</u>, Jordan Cove should provide a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids; and during commissioning and startup. Jordan Cove should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup would be issued.**

- **<u>Prior to commissioning</u>, Jordan Cove should provide results of the LNG storage tank hydrostatic test and foundation settlement results. At a minimum, foundation settlement results shall be provided thereafter annually.**

- **<u>Prior to commissioning</u>, Jordan Cove should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**

- **<u>Prior to commissioning</u>, Jordan Cove should file a tabulated list and drawings of the proposed hand-held fire extinguishers. The list should include the equipment tag number, extinguishing agent type, capacity, number, and location. The drawings should show the extinguishing agent type, capacity, and tag number of all hand-held fire extinguishers.**

- **<u>Prior to commissioning</u>, Jordan Cove should file the operation and maintenance procedures and manuals, as well as safety procedures.**

- **<u>Prior to commissioning</u>, Jordan Cove should maintain a detailed training log to demonstrate that operating staff has completed the required training.**

- **<u>Prior to introduction of hazardous fluids</u>, Jordan Cove should complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**

- **<u>Prior to introduction of hazardous fluids</u>, Jordan Cove should complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system.**

- **<u>Prior to commencement of service</u>, Jordan Cove should develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Jordan Cove staff.**

- **<u>Prior to commencement of service</u>, Jordan Cove should label piping with fluid service and direction of flow in the field in addition to the pipe labeling requirements of NFPA 59A.**

- **Prior to commencement of service, Jordan Cove should notify FERC staff of any proposed developments on the security plan of the facility.**

- **Prior to commencement of service, progress on the construction of the proposed systems should be reported in monthly reports filed with the Secretary. Details should include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project schedule. Problems of significant magnitude should be reported to the FERC within 24 hours.**

In addition, **we recommend the following measures should apply throughout the life of the Jordan Cove facilities:**

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Jordan Cove should respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**

- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also should be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.**

- **In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission should be notified within 24 hours and procedures for corrective action should be specified.**

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to FERC staff within 24 hours. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:**

  a. fire;

  b. explosion;

  c. estimated property damage of $50,000 or more;

  d. death or personal injury necessitating in-patient hospitalization;

  e. release of hazardous fluids for five minutes or more;

  f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

  g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

  h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

  i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

  j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

  k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

  l. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

  m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

In addition to the final design review, we would conduct inspections during construction and would review additional materials, including quality assurance and quality control plans, nonconformance reports, and cooldown and commissioning plans, to ensure that the installed design is consistent with the safety and operability characteristics of the FEED. We would also conduct inspections during operation to ensure that the facility is operated and maintained in accordance with the filed design throughout the life of the facility. Based on our analysis and recommendations presented above, we believe that the FEED presented by Jordan Cove would include acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

4.13.4 LNG Facility Siting Requirements

The principal hazards associated with the substances involved in the liquefaction, storage, and vaporization of LNG result from cryogenic and flashing liquid releases, flammable and toxic vapor dispersion, vapor cloud ignition, pool fires, BLEVEs, and overpressures. As discussed in section 4.13.3, our FEED review indicates that sufficient layers of protection would be incorporated into the facility design to mitigate the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. Siting of the facility with regard to potential off-site consequences is also required by DOT's regulations in 49 CFR 193, Subpart B as to ensure that impact to the public would be minimized. The Commission's regulations under 18 CFR 380.12(o)(14) require Jordan Cove to identify how the proposed design complies with the siting requirements of DOT's regulations in 49 CFR 193, Subpart B. As part of our review, we used Jordan Cove's information, developed to comply with DOT's regulations, to assess whether or not the facility would have a public safety impact. The Part 193 requirements state that an operator or government agency must exercise control over the activities that can occur within an "exclusion zone," defined as the area around an LNG facility that could be exposed to specified levels of thermal radiation or flammable vapor in the event of a release. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. The 2001 edition of NFPA 59A, an industry consensus safety standard for the siting, design, construction, operation, maintenance, and security of LNG facilities, is incorporated into Part 193 by reference, with regulatory preemption in the event of conflict. The following sections of Part 193 specifically address the siting requirements applicable to each LNG container and LNG transfer system:

- Part 193.2001 (b)(3), Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the marine vessel and the last manifold or valve immediately before a storage tank;
- Part 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in

accordance with Subpart B and NFPA 59A (2001). In the event of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail;

- Part 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with Section 2.2.3.2 of NFPA 59A (2001);
- Part 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with Sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001); and
- Part 193.2155(b), Structural requirements, specifies the minimum distance an LNG storage tank must be from the ends of an airport runway or from the nearest point on a runway, whichever is longer.

For the LNG facilities proposed for the Project, these Part 193 siting requirements would be applicable to the following equipment:

- two 42,267,500-gallon full containment LNG storage tanks and associated piping and appurtenances - Parts 193.2057 and 2059 require the establishment of thermal and flammable vapor exclusion zones for LNG tanks. NFPA 59A (2001), Section 2.2.3.2 specifies three thermal exclusion zones based on the volume of the storage tanks and one thermal exclusion zone based on a design spill. NFPA 59A (2001), Section 2.2.3.3 specifies a flammable vapor exclusion zone for the design spill which is determined by Section 2.2.3.5;
- a 36-inch-diameter LNG header used for ship loading - Parts 193.2001, 2057, and 2059 require thermal and flammable vapor exclusion zones for the marine cargo transfer system. NFPA 59A (2001) does not address LNG transfer systems;
- six 11,604 gpm in-tank pumps (three pumps per LNG storage tank) and associated piping and appurtenances; and one 484-gpm LNG-in-tank keep cool pump and associated piping and appurtenances for the proposed LNG storage tanks – Parts 193.2057 and 2059 require thermal and flammable vapor exclusion zones. NFPA 59A (2001) Section 2.2.3.2 specifies the thermal exclusion zone and Sections 2.2.3.3 and 2.2.3.4 specify the flammable vapor exclusion zone based on the design spills for containers and process areas; and
- four liquefaction heat exchangers (one per liquefaction train) and associated piping and appurtenances, including a 24-inch-diameter LNG rundown line – Parts 193.2057 and 2059 require thermal and flammable vapor exclusion zones. NFPA 59A (2001) Section 2.2.3.2 specifies the thermal exclusion zone and Sections 2.2.3.3 and 2.2.3.4 specify the flammable vapor exclusion zone based on the design spills for containers and process areas.

Previous FERC environmental assessments/impact statements for past projects have identified inconsistencies and areas of potential conflict between the requirements in Part 193 and NFPA 59A (2001). Sections 193.2057 and 193.2059 require exclusion zones for each LNG container and LNG transfer system, and an LNG transfer system is defined in Section 193.2007 to include cargo transfer system and transfer piping, and does not distinguish between permanent or temporary. However, NFPA 59A (2001) requires exclusion zones only for “transfer areas,”

which is defined as the part of the plant where the facility introduces or removes the liquids, such as truck loading or ship-unloading areas. The NFPA 59A (2001) definition does not include permanent plant piping, such as cargo transfer lines. Section 2.2.3.1 of NFPA 59A (2001) also states that transfer areas at the water edge of marine terminals are not subject to the siting requirements in that standard.

The DOT has addressed some of these issues in a March 2010 letter of interpretation.[174] In that letter, DOT stated that: (1) the requirements in the NFPA 59A (2001) for transfer areas for LNG apply to the marine cargo transfer system at a proposed waterfront LNG facility, except where preempted by the regulations in Part 193; (2) the regulations in Part 193 for LNG transfer systems conflict with NFPA 59A (2001) on whether an exclusion zone analysis is required for transfer piping or permanent plant piping; and (3) the regulations in Part 193 prevailed as a result of that conflict. The DOT has determined that an exclusion zone analysis of the marine cargo transfer system is required.

In FERC environmental assessments/impact statements for past projects, we have also noted that when the DOT incorporated NFPA 59A into its regulations, it removed the regulation that required impounding systems around transfer piping. As a result of that change, it is unclear whether Part 193 or the adopted sections of NFPA 59A (2001) require impoundments for LNG transfer systems. We note that Part 193 requires exclusion zones for LNG transfer systems, and that those zones were historically calculated based on impoundment systems. We also note that the omission of containment for transfer piping is not a sound engineering practice. For these reasons, we consider it prudent design practice to provide containment for all LNG transfer piping within a plant's property lines.

Federal regulations issued by OSHA under 29 CFR 1910.119 (Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents (PSM)), and the EPA under 40 CFR 68 (Risk Management Plans) cover hazardous substances, such as methane, propane, and ethylene at many facilities in the U.S. However, OSHA and EPA regulations are not applicable to facilities regulated under 49 CFR 193. On October 30, 1992, shortly after the promulgation of the OSHA Process Safety Management regulations, OSHA issued a letter of interpretation that precluded the enforcement of PSM regulations over gas transmission and distribution facilities. In a subsequent letter on December 9, 1998, OSHA further clarified that this letter of interpretation applies to LNG distribution and transmission facilities.

In addition, EPA's preamble to its final rule in Federal Register, Volume 63, Number 3, 639 645, clarified that exemption from the requirements in 40 CFR 68 for regulated substances in transportation, including storage incident to transportation, is not limited to pipelines. The preamble further clarified that the transportation exemption applies to LNG facilities subject to oversight or regulation under 49 CFR 193, including facilities used to liquefy natural gas or used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. Therefore, the above OSHA and EPA regulations are not applicable to facilities regulated under 49 CFR 193. As stated in Section 193.2051, LNG facilities must be provided with the siting requirements of

[174] PHMSA Interpretation #PI-10-0020 "Re: Application of the Siting Requirements in Subpart B of 49 CFR Part 193 to the Mount Hope Bay Liquefied Natural Gas Transfer System" (March 25, 2010). http://www.phmsa.dot.gov/portal/site/PHMSA/menuitem.6f23687cf7b00b0f22e4c6962d9c8789/?vgnextoid=1c1234025ed5b210VgnVCM1000001ecb7898RCRD&vgnextchannel=2b9b34d513f95410VgnVCM100000d2c97898RCRD&vgnextfmt=print.

NFPA 59A (2001 edition). The siting requirements for flammable liquids within an LNG facility are contained in NFPA 59A, Chapter 2:

- NFPA 59A (2001 edition) Section 2.1.1 requires consideration of clearances between flammable refrigerant storage tanks, flammable liquid storage tanks, structures and plant equipment, both with respect to plant property lines and each other. This section also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.
- NFPA 59A (2001 edition) Section 2.2.2.2 requires impoundments serving flammable refrigerants or flammable liquids to contain a 10-minute spill of a single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT. In addition, NFPA Section 2.2.2.5 requires impoundments and drainage channels for flammable liquid containment to conform to NFPA 30, Flammable and Combustible Liquids Code.
- NFPA 59A (2001 edition) Section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 Btu/ft^2-hr from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE3 or using models that have been validated by experimental test data appropriate for the hazard to be evaluated and that are acceptable to DOT.
- NFPA 59A (2001 edition) Section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or alternative models that take into account physical factors influencing LNG vapor dispersion. Alternative models must have been validated by experimental test data appropriate for the hazard to be evaluated and must be acceptable to DOT. NFPA 59A (2001 edition) Section 2.2.3.5 requires the design spill for impounding areas serving vaporization and process areas to be based on the flow from any single accidental leakage source.

For the following liquefaction facilities that are proposed for the Project, the refrigerant siting requirements from Part 193 and NFPA 59A (2001 edition) would be applicable to the following equipment:

- four liquefaction heat exchangers (one per liquefaction train) and associated piping and appurtenances;
- one 14,000-gallon ethylene storage bullet and associated piping;
- one 15,670-gallon propane storage bullet and associated piping;
- one 31,030-gallon isopentane storage bullet and associated piping;
- eight 2,052-gpm interstage refrigerant pumps (two pumps per train) and associated piping and appurtenances;
- eight 4,455-gpm refrigerant pumps (two pumps per train) and associated piping and appurtenances;
- one 75-gpm propane pump and associated piping and appurtenances; and

- one 75-gpm isopentane pump and associated piping and appurtenances.

4.13.5 LNG Facility Siting Analysis

4.13.5.1 Impoundment Sizing

Suitable sizing of impoundment systems and selection of design spills on which to base hazard analyses are critical for establishing an appropriate siting analysis. Although impoundment capacity and design spill scenarios for storage tank impoundments are well described by Part 193, a clear definition for other impoundments is not provided either directly by the regulations or by the adopted sections of NFPA 59A (2001). Under NFPA 59A (2001) Section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT.

We consider it prudent design practice to size impoundments based on the greatest flow capacity from a single pipe for 10 minutes, while recognizing that different spill scenarios may be used for the single accidental leakage sources for the hazard calculations required by Part 193. A similar approach is used with impoundments for process vessels. We recommend these to be able to contain the contents of the largest process vessel served, while recognizing that smaller design spills may be appropriate for Part 193 calculations.

Part 193.2181 references NFPA 59A (2001) for siting, which specifies each impounding system serving an LNG storage tank must have a minimum volumetric liquid capacity of 110 percent of the LNG tank's maximum design liquid capacity for an impoundment serving a single tank. We also consider it prudent design practice to provide a barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property) in the event that the full containment storage tank primary and secondary containers have a common cause failure. The purpose of the barrier is to prevent liquid from flowing off the plant property, and does not define containment or an impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements already met by sumps and impoundments throughout the site.

For the Project, Jordan Cove proposes two full-containment LNG storage tanks where the outer tank wall would serve as the impoundment system. The proposed LNG storage tanks would have a design maximum volume of 44,830,800 gallons. As shown in table 4.13.5.1-1, the outer tank would have a volumetric capacity of 56,169,100 gallons, which exceeds the 110 percent requirement by 6,855,220 gallons and complies with the Part 193 requirements. The Jordan Cove facility would have an earthen storm surge barrier around the perimeter of the two LNG storage tanks, which would serve to limit liquid from flowing off the plant property in the case of a common cause failure of the existing full containment storage tank primary and secondary containers. The earthen storm surge barrier would be constructed with a volume exceeding the volume of one full storage tank.

TABLE 4.13.5.1-1

Impoundment Area Sizing

Source	Spill Size (gallons)	Impoundment System	Impoundment Size (gallons)
LNG Storage Tank	44,830,800	Outer Tank Concrete Wall	56,169,100
36-inch Ship Loading Header (at dock)	784,600	Marine Area Impoundment Basin	785,170
36-inch Ship Loading Header (at LNG storage tanks)	827,740	Process Area Impoundment Basin	832,400
24-inch LNG Rundown Line	71,980	Process Area Impoundment Basin	833,400
6-inch MRL Process Line	61,060	Process Area Impoundment Basin	833,400
Ethylene Storage Tank	14,000	Refrigerant Spill Collection Area	43,935
Propane Storage Tank	15,670	Refrigerant Spill Collection Area	43,935
Isopentane Storage Tank	31,030	Refrigerant Spill Collection Area	43,935
Amine Make-up Tank	17,205	Secondary Containment Curbing	17,245

Jordan Cove proposes to install three concrete impoundment basins, including the process area impoundment basin, marine area impoundment basin, and the refrigerant spill collection area. The process area impoundment basin would be located west of the LNG storage tanks and within the storm surge barrier, while the marine area impoundment basin would be located between of the vessel berth and the liquefaction trains. Both impoundment basins would be sized for the maximum flow in the 36-inch-diameter LNG ship loading header, with six LNG in-tank pumps and one smaller keep-cool pump operating in parallel. The process area impoundment basin would be measured 85 feet long by 85 feet wide, with a usable depth under the trough of 15.42 feet and resulting usable volume of 833,400 gallons. Accounting for the pump runout flow rate due to pressure loss in the 36-inch-diameter LNG ship loading header at the LNG storage tank area, the largest spill to the process area impoundment basin would be a 10-minute spill volume of 827,740 gallons. The process area impoundment basin also serves any spills from the liquefaction area. The largest LNG spill from the liquefaction area would be from the 24-inch-diameter LNG rundown line, a 10-minute spill volume of 71,980 gallons. The largest refrigerant spill at the liquefaction heat exchanger area would be from a guillotine rupture of the 6-inch-diameter MRL process piping at the bottom of the liquefaction heat exchanger, which would result in a spill volume of 61,060 gallons. These spills would be contained in the process area impoundment basin.

The marine area impoundment basin would be measured 201 feet long by 35 feet wide, with a usable depth of 14.92 feet. The marine area impoundment basin would be a usable capacity of 785,170 gallons. Accounting for the pressure loss in the 36-inch-diameter LNG ship loading header at the marine area, Jordan Cove determined the 10-minute spill volume into the marine area impoundment basin would be 784,600 gallons. This spill would be contained in the marine area impoundment basin.

Jordan Cove proposes to construct a 95.5-foot-long by 9-foot-wide refrigerant spill collection area with an approximate capacity of 43,935 gallons. The refrigerant storage vessels and associated piping would be within a curbed area and would be sloped to direct any spills into the refrigerant spill collection area. The refrigerant storage area would be located approximately 350 feet to the north of the LNG storage tanks. The proposed refrigerant spill collection area would contain spills from the 14,000-gallon ethylene storage vessel, the 15,670-gallon propane storage

vessel, and the 31,030-gallon isopentane storage vessel. The refrigerant spill collection area and the refrigerant storage area would be separated by a 22-foot-height by 95-foot-long fire proof brick wall. Any spills from the refrigerant trucks would also be contained within the refrigerant spill collection area.

Jordan Cove proposes to install a 17,205-gallon amine make-up tank in the gas pre-treatment area. Any spills from the amine make-up tank would be contained within the 38-foot-long by 34.67-foot-wide by 1.75-foot-height secondary containment system.

4.13.5.2 Design Spills

Design spills are used in the determination of the hazard calculations required by Part 193. Prior to the incorporation of NFPA 59A in 2000, the design spill in Part 193 assumed the full rupture of "a single transfer pipe which has the greatest overall flow capacity" for not less than 10 minutes (old Part 193.2059(d)). With the adoption of NFPA 59A, the basis for the design spill for impounding areas serving only vaporization, process, or LNG transfer areas became the flow from any single accidental leakage source. Neither Part 193 nor NFPA 59A (2001) define "single accidental leakage source."

In a letter to FERC staff, dated August 6, 2013, DOT requested that LNG facility applicants contact the Office of Pipeline Safety's Engineering and Research Division regarding the Part 193 siting requirements.[175] Specifically, the letter stated that DOT required a technical review of the applicant's design spill criteria for single accidental leakage sources on a case-by-case basis to determine compliance with Part 193.

In response, Jordan Cove provided DOT with its design spill criteria and identified leakage scenarios for the proposed equipment. DOT reviewed the data and methodology Jordan Cove used to determine the single accidental leakage sources for the design spills based on the flow from various leakage sources including piping, containers, and equipment containing LNG, refrigerants, and other hazardous fluids. On June 18, 2014, DOT provided a letter to FERC staff stating that DOT had no objection to Jordan Cove's methodology for determining the single accidental leakage sources for candidate design spills to be used in establishing the Part 193 siting requirements for the proposed LNG liquefaction facilities.[176,177] The design spills produced by this method were identified in the documents reviewed by DOT and have been filed in the

[175] August 6, 2013 Letter from Kenneth Lee, Director of Engineering and Research Division, Office of Pipeline Safety to Terry Turpin, LNG Engineering and Compliance Branch, Office of Energy Projects. Filed in Docket Number CP13-25 on August 13, 2013. Accession Number 20130813-4019

[176] June 18, 2014 Letter "Re: Jordan Cove Energy Project, L.P., FERC Docket No. CP13-483-000, Design Spill Determination" from Kenneth Lee to Lauren H. O'Donnell. Filed in Docket Number CP13-483 on June 19, 2014. Accession Number 20140619-4001

[177] PHMSA based this decision on the following documents: (1) September 19, 2013 submission to PHMSA, FERC Accession Numbers 20130919-5087 and 20130919-5088; (2) April 11, 2014 submission to PHMSA containing Resource Report 1, 11, and 13, and detailed engineering information, FERC Accession Numbers 20130521-4008, -4010, -4013, -4014, and -4015; (3) April 15, 2014 submission to PHMSA containing release and dispersion data, FERC Accession Number 20140606-5028; (4) April 29, 2014 submission to PHMSA containing Design Spill Selection information, FERC Accession Number 20140606-5027; (5) May 15, 2014 response to PHMSA's follow-up questions, FERC Accession Numbers 20130521-4013, -4014, -4015, and 20140606-5028; (6) June 6, 2014 response to PHMSA's follow-up questions, FERC Accession Numbers 20140606-5027, -5029; (7) June 10, 2014 response to PHMSA's follow-up questions, FERC Accession Number 20140618-5027; (8) June 13, 2014 response to PHMSA's follow-up questions, FERC Accession Number 20140618-5026.

FERC docket for this project. These are the same design spills described in the following sections.

DOT's conclusions on the candidate design spills used in the siting calculations required by Part 193 was based on preliminary design information which may be revised as the engineering design progresses. If Jordan Cove's design or operation of the proposed facility differs from the details provided in the documents on which DOT based its review, then the facility may not comply with the siting requirements of Part 193. As a result, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Jordan Cove should file with the Secretary for review and approval by the Director of OEP, certification that the final design is consistent with the information provided to DOT as described in the design spill determination letter dated June 18, 2014 (Accession Number 20140619-4001). In the event that any modifications to the design alters the candidate design spills on which the Title 49 CFR Part 193 siting analysis was based, Jordan Cove should consult with DOT on any actions necessary to comply with Part 193.**

As design spill scenarios vary depending on the hazard (vapor dispersion, overpressure, or radiant heat), the specific design spills used for the Jordan Cove Liquefaction siting analysis are discussed under "Vapor Dispersion Analysis," "Overpressure Analysis," and "Thermal Radiation Analysis."

4.13.5.3 Vapor Dispersion Analysis

As discussed in section 4.13.2, a release may form a toxic or flammable cloud depending on the material released. A large quantity of flammable material released without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limit or encountered an ignition source. In order to address these hazards, 49 CFR §193.2051 and 193.2059 require vapor dispersion evaluation of potential incidents and exclusion zones in accordance with applicable sections of NFPA 59A (2001). NFPA 59A, Section 2.1.1 requires consideration of clearances between flammable refrigerant storage tanks, flammable liquid storage tanks, structures and plant equipment, both with respect to plant property lines and each other. This section also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility. NFPA 59A Section 2.2.3.4 also requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Taken together, Part 193 and NFPA 59A (2001) require that flammable vapors either from an LNG tank impoundment or a single accidental leakage source do not extend beyond areas in which the operator or a government agency legally controls all activities. Other potential incidents (e.g., toxic releases) must also be considered.

Title 49 CFR §193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the LFL of LNG vapor) under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature. Similar factors to account for model uncertainty (i.e., one half the LFL of other flammable materials and one half the AEGL of toxic

materials) and parameters (i.e., Class F stability, 2 m/s wind speed, 50 percent relative humidity, average regional temperature, and 0.03m surface roughness) have also been specified for other hazardous fluids.

The regulations in Part 193 specifically approve the use of two models for performing these dispersion calculations, DEGADIS and FEM3A. The use of alternative models is also allowed, but must be specifically approved by the DOT. Although Part 193 does not require the use of a particular source term model, modeling of the spill and resulting vapor production is necessary prior to the use of vapor dispersion models. In August 2010, the DOT issued Advisory Bulletin ADB-10-07 to provide guidance on obtaining approval of alternative vapor-gas dispersion models under Subpart B of 49 CFR 193. The guidance included requirements for scientific assessment, verification, and validation against experimental data. Draft decisions were issued for public comment on July 12, 2011, for PHAST and on August 15, 2011, for FLACS. On October 7, 2011, PHAST-UDM Version 6.6 and Version 6.7 (submitted by Det Norske Veritas) and FLACS Version 9.1 Release 2 (submitted by GexCon) were approved by DOT for use in vapor dispersion exclusion zone calculations. PHAST 6.7 and FLACS 9.1, with their built-in source term models, were used to calculate dispersion distances.

As discussed under "Design Spills" in section 4.13.5.2, failure scenarios must be selected as the basis for the Part 193 dispersion analyses. Process conditions at the failure location would affect the resulting vapor dispersion distances. In determining the spill conditions for these leakage sources, process flow diagrams for the proposed design, used in conjunction with the heat and material balance information (i.e., flow, temperature, and pressure), can be used to estimate the flow rates and process conditions at the location of the spill. In general, higher flow rates would result in larger spills and longer dispersion distances; higher temperatures would result in higher rates of flashing; and higher pressures would result in higher rates of jetting and aerosol formation. Therefore, two scenarios may be considered for each design spill:

1. The pressure in the line is assumed to be maintained by pumps and/or hydrostatic head to produce the highest rate of flashing and jetting (i.e., flashing and jetting scenario); and
2. The pressure in the line is assumed to be depressurized by the breach and/or emergency shutdowns to produce the highest rate of liquid flow within a curbed, trenched, or impounded area (i.e., liquid scenario).

Alternatively, a single scenario for each design spill could be selected if adequately supported with an assessment of the depressurization calculations and/or an analysis of process instrumentation and shutdown logic acceptable to DOT.

In addition, the location and orientation of the leakage source must be considered. The closer a leakage source is to the property line, the higher the likelihood that the vapor cloud would extend off-site. As most flashing and jetting scenarios would not have appreciable liquid rainout and accumulation, the siting of impoundment systems would be driven by liquid scenarios, while siting of piping and other remaining portions of the plant would be driven by flashing and jetting scenarios.

Jordan Cove reviewed multiple releases for the liquid scenarios and for the flashing and jetting scenarios. Jordan Cove used the following conditions, corresponding to 49 CFR §193.2059, for the vapor dispersion calculations: ambient temperature of 53.3°F, relative humidity of 50

percent, wind speeds of 1-2 m/s in various directions, atmospheric stability class of F and a ground surface roughness of 0.03 m. In addition, a sensitivity analysis to the wind speed and direction was provided to demonstrate the longest predicted downwind dispersion distance in accordance with the PHAST and FLACS Final Decisions.

Jordan Cove accounted for the facility geometry, including the impoundment and trench geometry details as established by available plant layout drawings. The plant geometry accounts for any on-site wind channeling that could occur. The releases were initiated after sufficient time had passed in the model simulations to allow the wind profile to stabilize from effects due to the presence of buildings and other on-site obstructions.

Vapor Dispersion Design Spill Analyses for LNG

As required by 49 CFR 193, design spills from containers with over the top withdrawal lines and no bottom penetrations should be the largest flow from the container (i.e., storage tank) withdrawal pumps for a 10-minute duration at full-rated capacity[178]. With three in-tank pumps running in parallel at their maximum pump runout, the maximum flow rate from the LNG storage tank withdrawal line would be 41,800 gpm. However, Jordan Cove selected the design spill as the guillotine rupture of the 36-inch-diameter LNG loading line to address the highest rate of LNG flow (i.e., liquid scenario) into the process area impoundment basin, the marine area impoundment basin, and the trench system. This liquid spill would result in a maximum flow rate of 44,000 gpm for a 10-minute duration and would exceed the maximum flow rate from the LNG storage tank withdrawal line with all 3 pumps running at their maximum pump runout.

Jordan Cove used PHAST Version 6.7 to perform diameter sensitivity studies in order to address the highest rate of LNG vapor flow (i.e., flashing and jetting scenario). The sensitivity analysis led Jordan Cove to evaluate the releases at various locations along the 36-inch-diameter ship loading line between the LNG storage tanks and the loading arms, the 24-inch-diameter LNG rundown lines from the liquefaction trains to the LNG storage tanks, and the 18-inch-diameter in-tank pump header at various elevations. Table 4.13.5.3-1 shows LNG release scenarios from the LNG storage tanks area, liquefaction area, and marine area.

TABLE 4.13.5.3-1

LNG Design Spills

Scenario	Location	Hole Diameter	Pressure (psig)	Temperature (°F)	Flow Rate (lb/hr)
1	Ship Loading Line (liquid scenario)	36-inch	1.1	-258.1	9.12E6
2	Ship Loading Line at LNG Storage Tank Area (jetting and flashing scenario)	12-inch	38.3	-257.7	5.45E6
3	Ship Loading Line at Marine Area (jetting and flashing scenario)	14-inch	21.3	-257.7	5.54E6
4	LNG Rundown Line (jetting and flashing scenario)	8-inch	15.0	-245	1.4E6
5	In-Tank Pump Header (jetting and flashing scenario)	2-inch	63	-258	1.94E5

Jordan Cove proposes to install a series of 8-foot-, 12-foot-, 20-foot-, and 40-foot-high vapor barriers along the east property line as well as at various locations adjacent to the liquefaction

[178] Title 49 § 193.2059 incorporates by reference Table 2.2.3.5 of NFPA 59A (2001 edition).

trains, LNG storage tanks, and refrigerant storage tanks, as shown in figure 4.13-1, to confine the vapor clouds and limit the extent of the vapor dispersion zones. In subsequent figures for the vapor dispersion analysis, the green dotted lines indicate the Jordan Cove property lines. All of the vapor barriers would be impermeable except for the 12-foot vapor barrier to the south of the process area near the ship berth would be permeable. The permeable vapor fence segment would consist of a 12-foot chain link fence with slats installed in the fence. Impermeable vapor fences (i.e., 8 foot, 12 foot, 20 foot, and 40 foot) would consist of precast lightweight concrete panels similar to noise barrier walls along highways. Parallel vapor barrier segments would be spaced at least 60 feet apart and therefore does not represent significant confinement. Both impermeable and permeable vapor fences would be designed for 150 mph sustained wind load (183 mph, three-second gust) and classified as seismic category II.

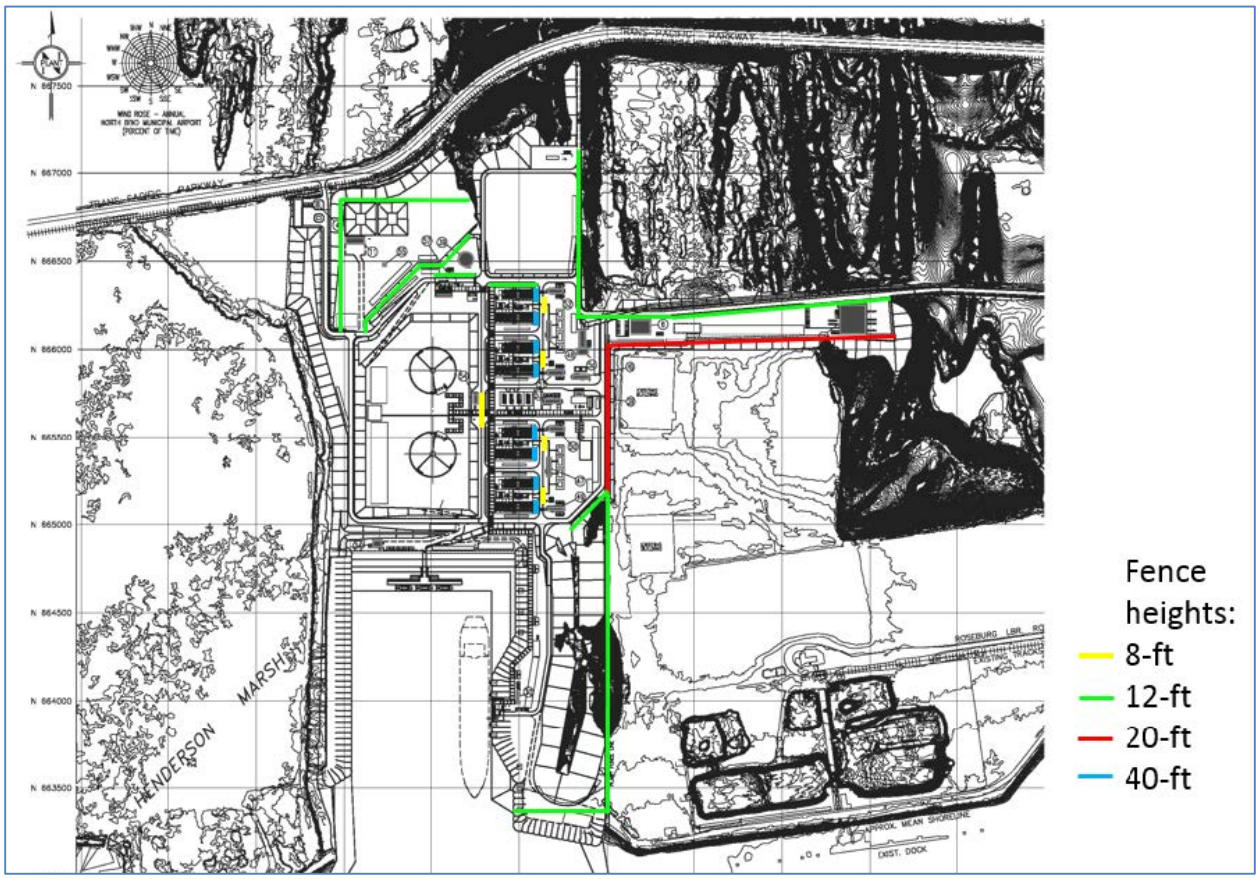


Figure 4.13-1. Vapor Fences at Jordan Cove Facility

Jordan Cove stated that the permeable vapor fences would be inspected regularly for broken or damaged slats, and the impermeable walls would be on a bi-annual inspection program. Proper maintenance would be performed by Jordan Cove personnel as required. Jordan Cove would also perform additional unscheduled inspections following an unusual wind or seismic event. In order to ensure that the vapor barriers are maintained throughout the life of the facility, **we recommend that:**

- **<u>Prior to construction of the final design,</u> Jordan Cove should file with the Secretary, for review and written approval by the Director of OEP, the details of the vapor barriers as well as procedures to maintain and inspect the vapor barriers provided**

to meet the siting provisions of 49 CFR § 193.2059. This information should be filed <u>a minimum of 30 days before approval to proceed is requested.</u>

Jordan Cove used FLACS to simulate different release directions, wind speeds, and wind directions. Figures 4.13-2 to 4.13-9 show the FLACS results of the longest ½-LFL vapor clouds for LNG liquid release scenarios and jetting and flashing scenarios from the LNG storage tanks area, liquefaction area, and marine area.

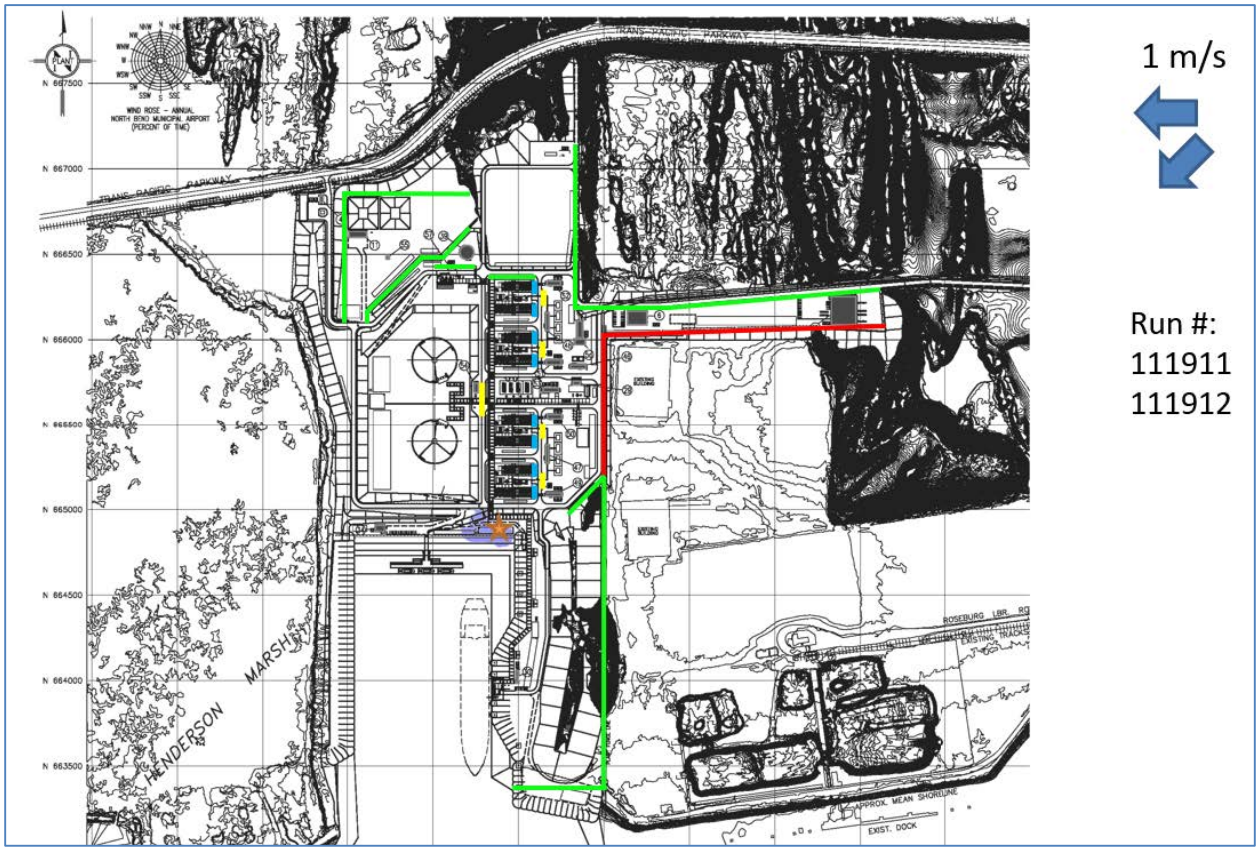


Figure 4.13-2. LNG Spill (i.e., liquid release scenario) from a Guillotine Rupture of the Ship Loading Header into the Marine Area Impoundment Basin (1 m/s)

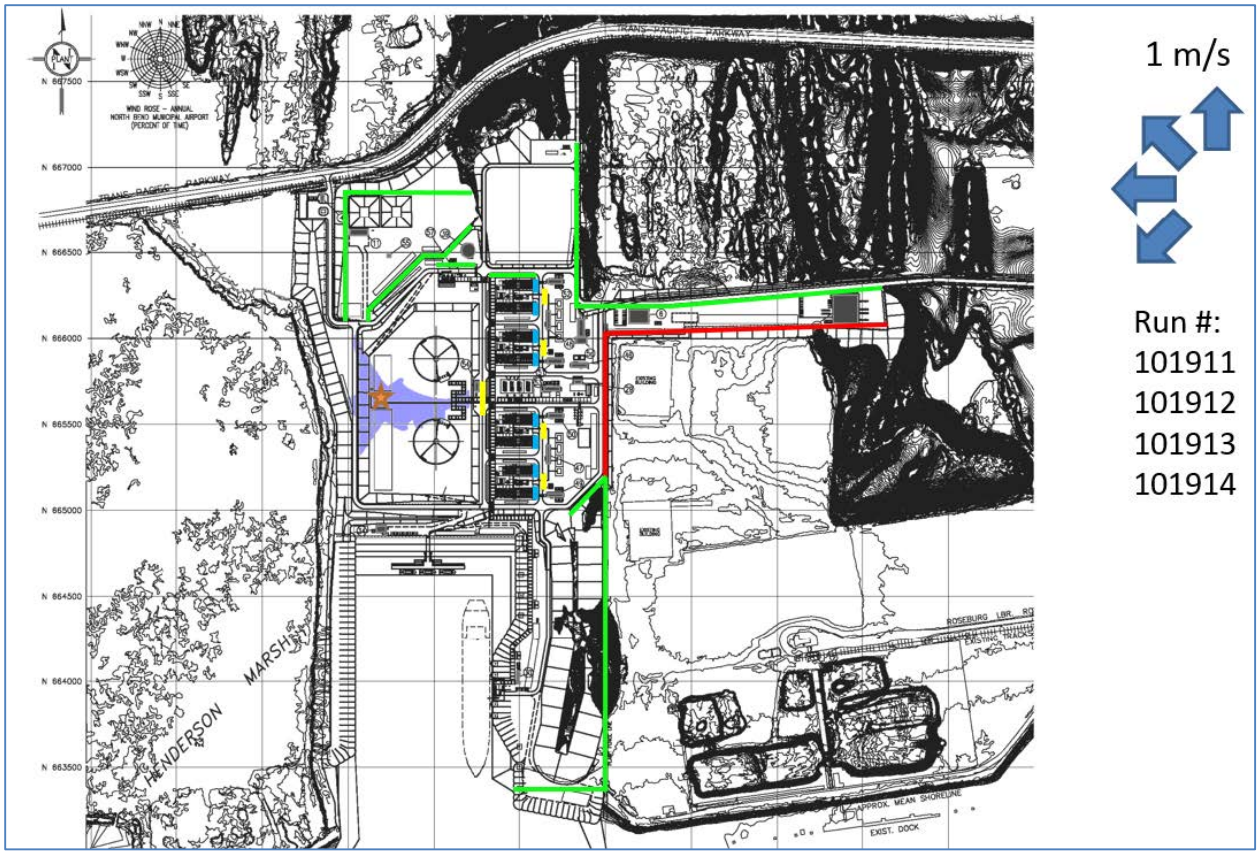


Figure 4.13-3. LNG Spill (i.e., Liquid Release Scenario) from a Guillotine Rupture of the Ship Loading Header into the Process Area Impoundment Basin (1 m/s)

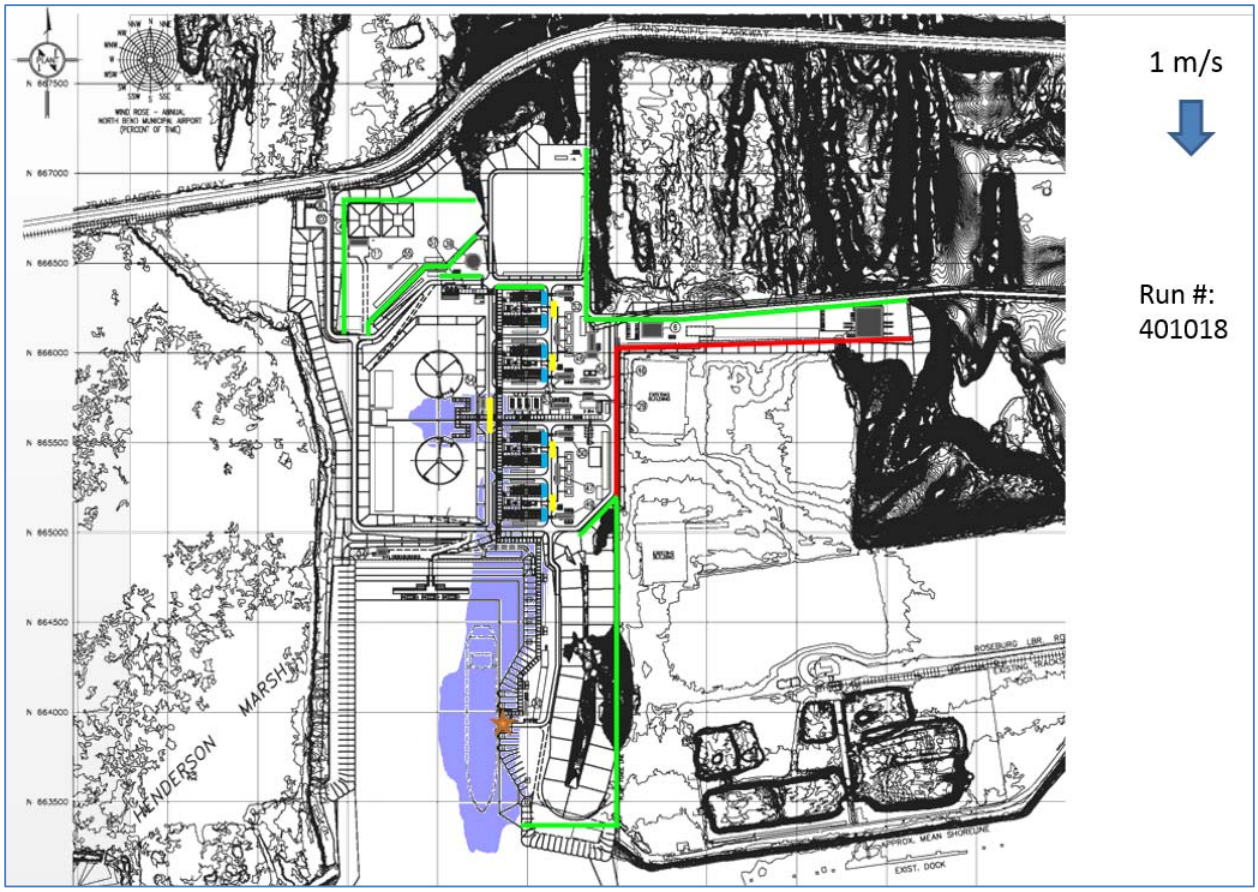


Figure 4.13-4. LNG Spill (i.e., Liquid Release Scenario) from a Guillotine Rupture of the Ship Loading Header into the Marine Berth Trench System (1 m/s)

Figure 4.13-5. LNG Spill (i.e., Liquid Release Scenario) from a Guillotine Rupture of the Ship Loading Header into the Liquefaction Trench System (1 m/s)

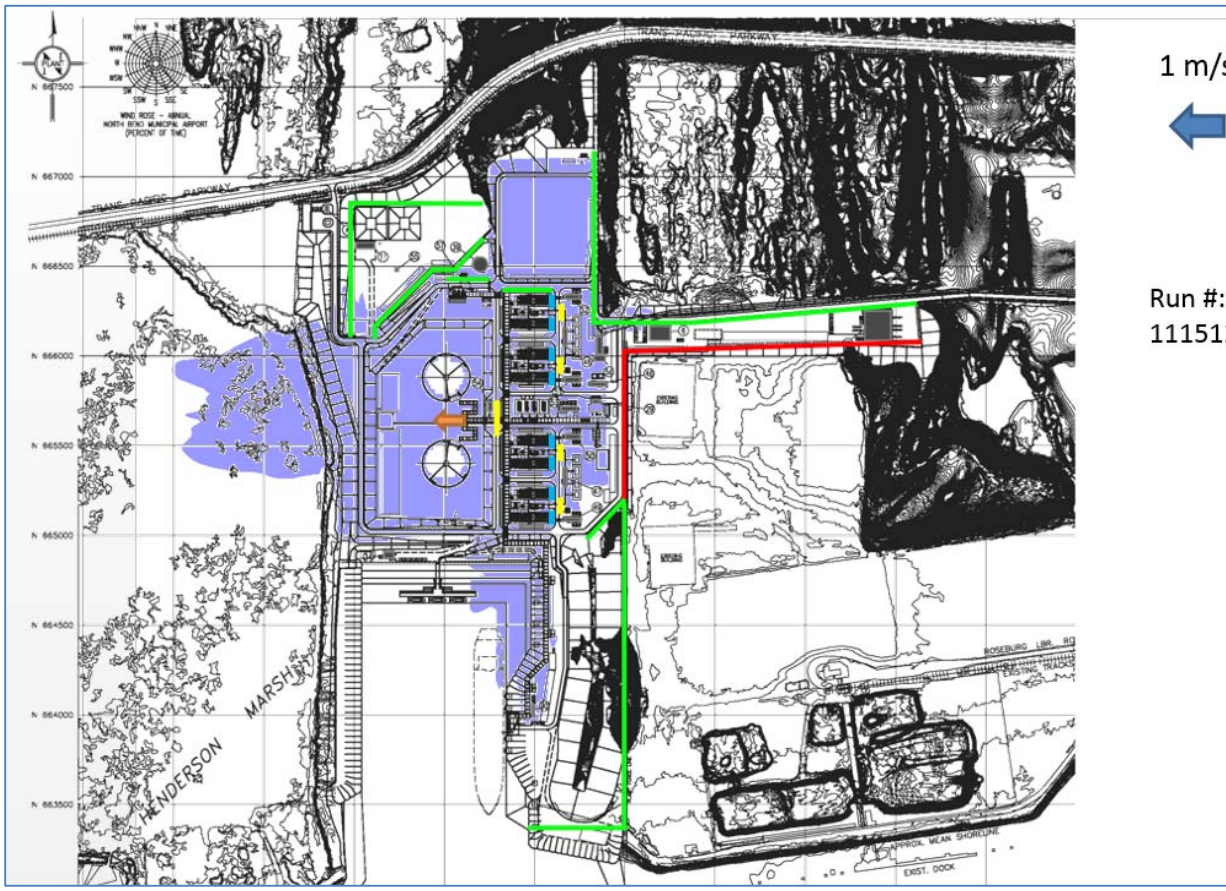


Figure 4.13-6. LNG Jetting and Flashing Scenario from a Rupture of the Ship Loading Header at the LNG Storage Tank pg 4-955Area (1 m/s). The ½-LFL vapor cloud extends across Jordan Cove property into the Henderson Marsh.

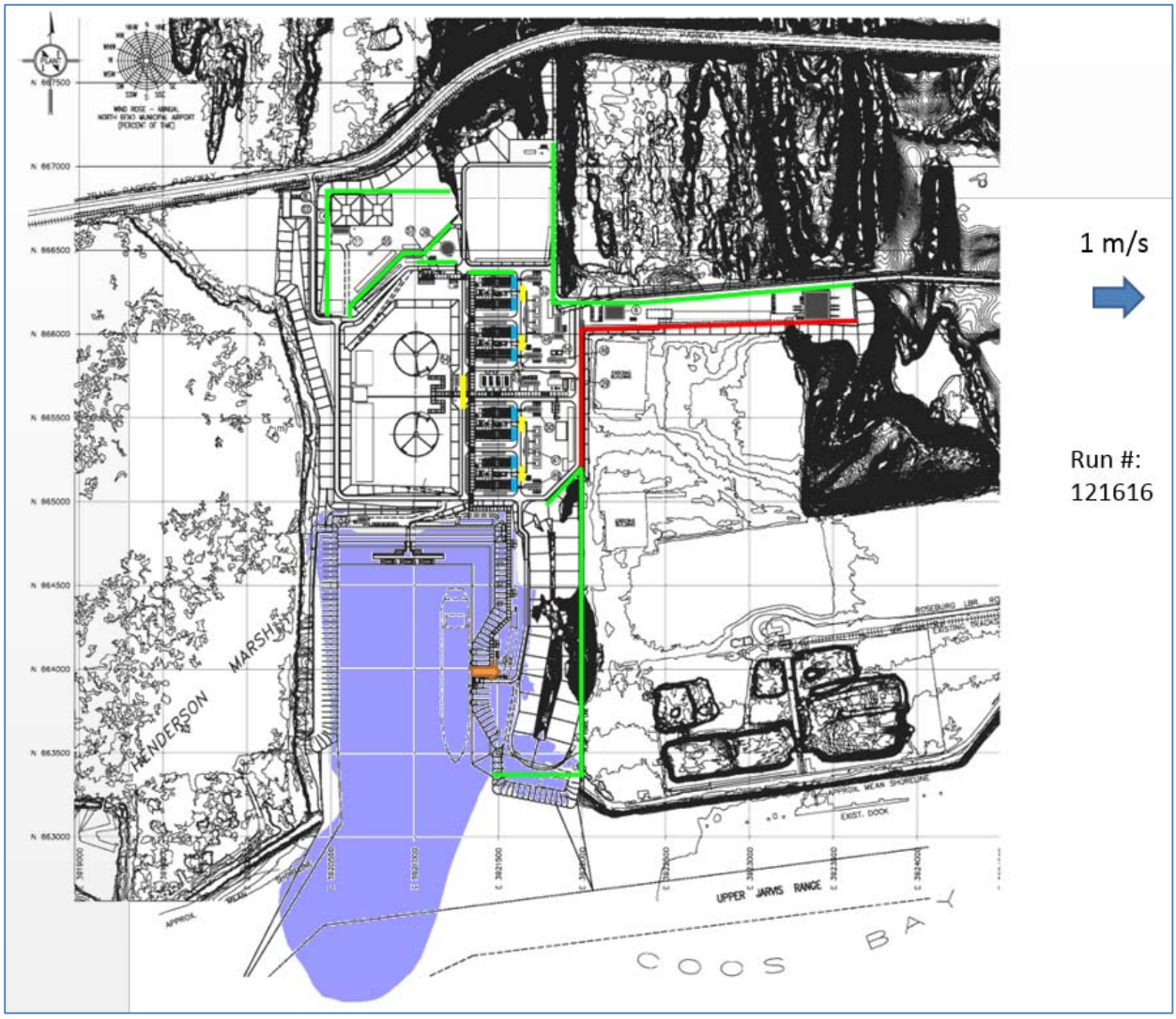


Figure 4.13-7. LNG Jetting and Flashing Scenario from a Rupture of the Ship Loading Header at the Marine Area (1 m/s)

Figure 4.13-8. LNG Jetting and Flashing from a Rupture of the Ship Loading Header between the LNG Storage Tank Area and the Marine Area (1 m/s)

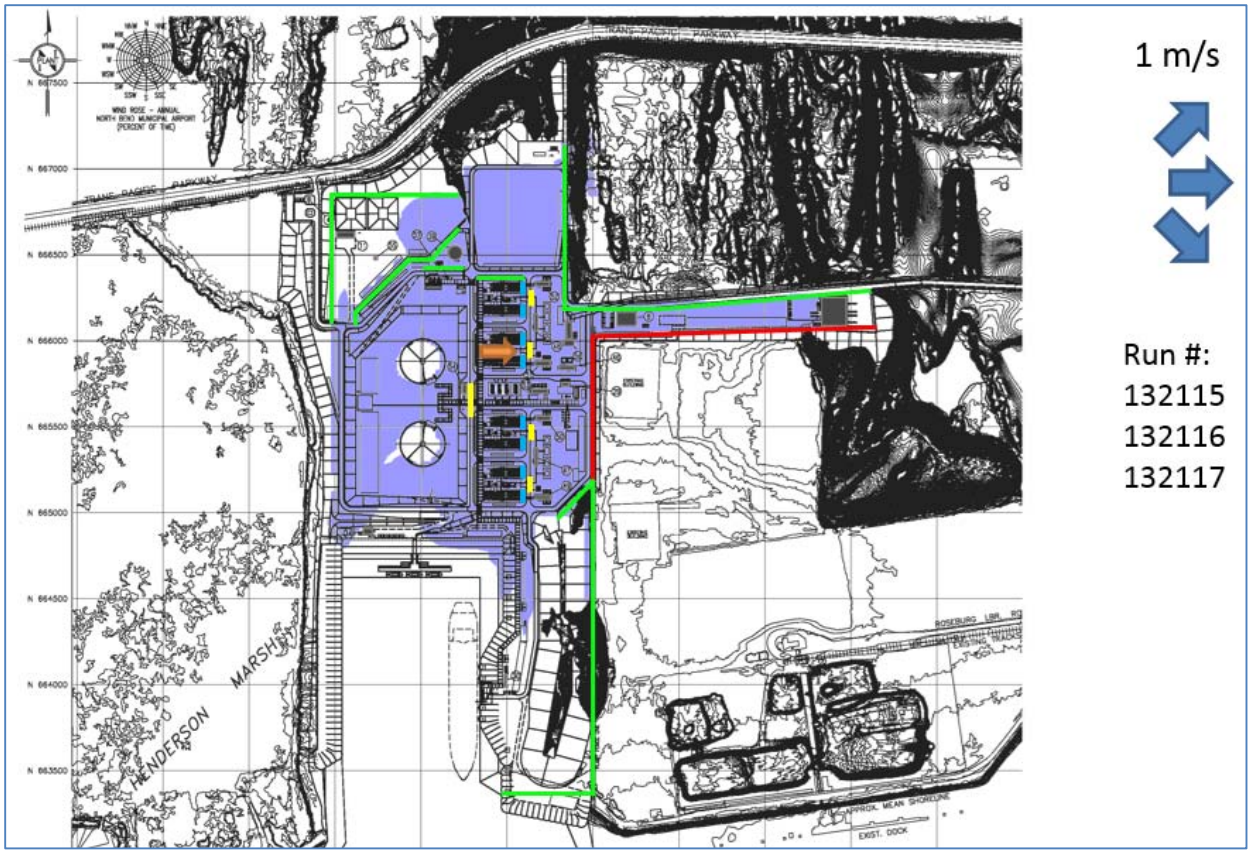


Figure 4.13-9. LNG Jetting and Flashing Scenario from a Rupture of the LNG Rundown Line at the Liquefaction Area (1 m/s)

As shown on figure 4.13-6, the FLACS results indicate that the ½-LFL vapor clouds from jetting and flashing scenario at the LNG storage tank area would extend beyond the Jordan Cove property line onto the Henderson Marsh to the west and southwest. According to Frequently Asked Question #15 on PHMSA's website "LNG Facility Siting Application Requirements," [179] it is possible for the applicant to show compliance with exclusion zone requirements by securing a legal agreement with the property owner affected by the exclusion zone. On April 25, 2014, Jordan Cove submitted to PHMSA the final language for a Safety Zone Easement Option between the Port and Jordan Cove to restrict the land use within the thermal radiation zones from the LNG storage tanks. By email dated April 28, 2014, PHMSA provided its statement of no objection to the final Safety Zone Easement Option language. However, the Safety Zone Easement Option does not address the compliance with 49 CFR 193.2059 (i.e., vapor dispersion exclusion zones) for the ½-LFL vapor clouds from LNG releases. We believe the Safety Zone Easement Option should also satisfy compliance with the vapor dispersion requirements of 49 CFR 193.2059 for the vapor dispersion clouds that extend onto Henderson Marsh. Therefore, **we recommend that:**

- **<u>Prior to initial site preparation</u>, Jordan Cove should file with the Secretary concurrence from PHMSA that the Safety Zone Easement Option language satisfies the exclusion zone requirements of 49 CFR 193.2059. This information should be filed <u>a minimum of 30 days before approval to proceed is requested</u>.**

The FLACS results shown in figures 4.13-2 through 4.13-5 and figures 4.13-7 through 4.13-9 indicated the ½-LFL vapor clouds for LNG release scenarios would remain within Jordan Cove's property or extend over a navigable body of water. Jordan Cove also used PHAST to assess LNG jetting and flashing releases from the 18-inch-diameter in-tank pump header at various elevations. A release from the top of the LNG storage tank would result in the maximum distance to the ½-LFL of 340 feet and would remain within Jordan Cove property. Therefore as a result of our technical review of the preliminary engineering design and our recommended mitigation, we conclude that the siting of the proposed Project would not have a significant impact on public safety with respect to LNG vapor dispersion. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

Vapor Dispersion Analyses for Other Hazardous Fluids

In addition to the LNG releases evaluated above, Jordan Cove considered other release scenarios for the MR, ethylene, propane, and isopentane. The MR scenarios included releases from the interstage refrigerant pump 10-inch-diameter discharge piping, the refrigerant pump 16-inch-diameter discharge piping, and the 6-inch-diameter MR process line at the bottom of the liquefaction heat exchanger. The refrigerant (i.e., ethylene, propane, and isopentane) release scenarios included releases from the refrigerant storage tanks and refrigerant trucking hoses. Jordan Cove provided a screening analysis that demonstrated a release from the ethylene trucking hose would be the bounding scenario at the refrigerant storage and trucking area. We agree with this assessment. PHAST Version 6.7 was used to perform diameter sensitivity studies for each release scenario. Table 4.13.5.3-2 shows the hole diameters that result in the highest

[179] http://primis.phmsa.dot.gov/lng/faqs.htm.

rate of vapor flow for refrigerant release scenarios from the liquefaction area, refrigerant storage area, and refrigerant truck loading area.

Table 4.13.5.3-2

Other Hazardous Fluid Design Spills

Scenario	Location	Hole Diameter	Pressure (psig)	Temperature (°F)	Flow Rate (lb/hr)
1	Interstage Refrigerant Pump Discharge	2.5-inch	565.3	100.4	5.31E5
2	Refrigerant Pump Discharge	3.5-inch	580.0	97.3	1.03E6
3	MR Process Piping at the bottom of Liquefaction Heat Exchanger	5-inch	552.3	-243.9	2.07E6
4	Ethylene Trucking Hose	2-inch	100	-74	2.6E5

Jordan Cove used FLACS to simulate different release directions, wind speeds, and wind directions. Figures 4.13-10 to 4.13-13 show the FLACS results of the ½-LFL vapor clouds for refrigerant release scenarios from the liquefaction area, refrigerant storage area, and refrigerant truck loading area.

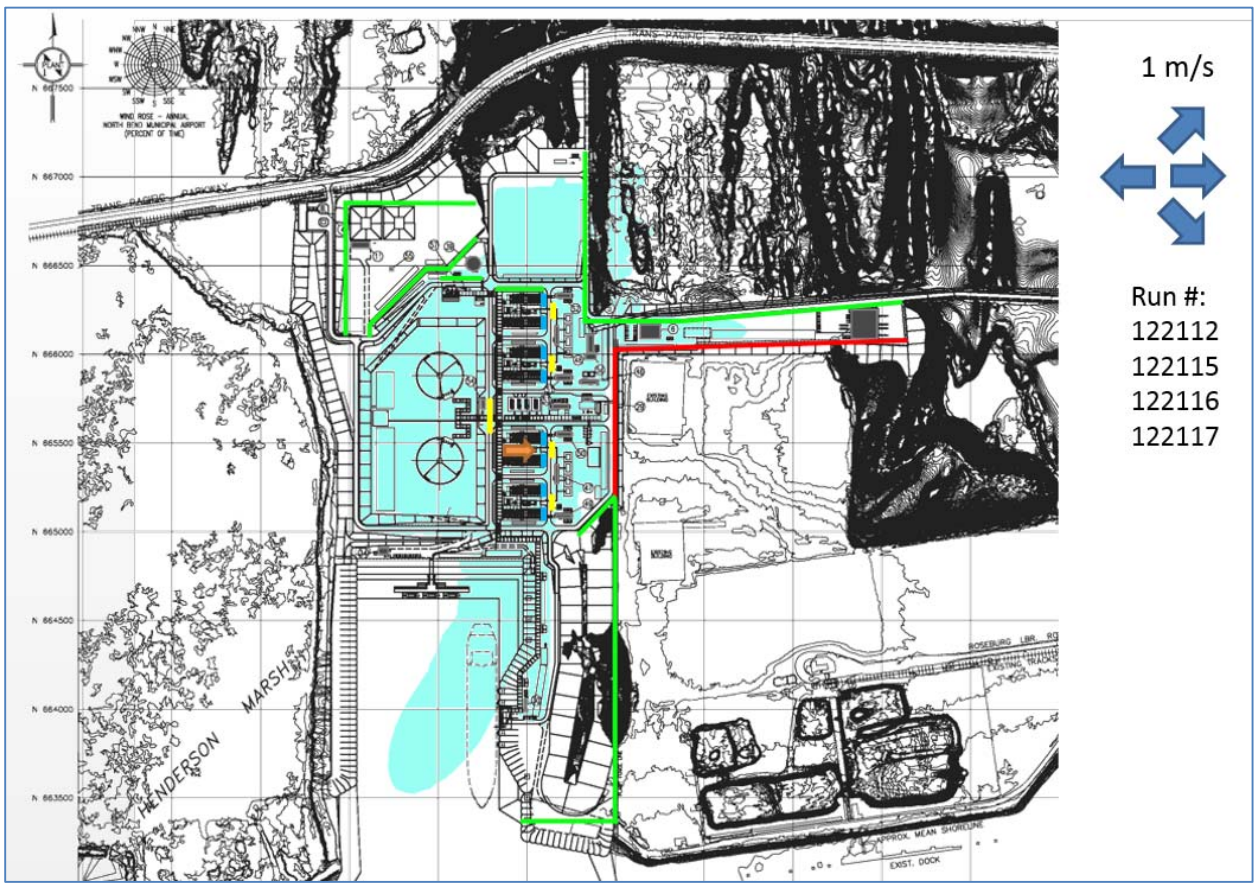


Figure 4.13-10. MR Release from Rupture of the Interstage Refrigerant Pump Discharge Piping (1 m/s)

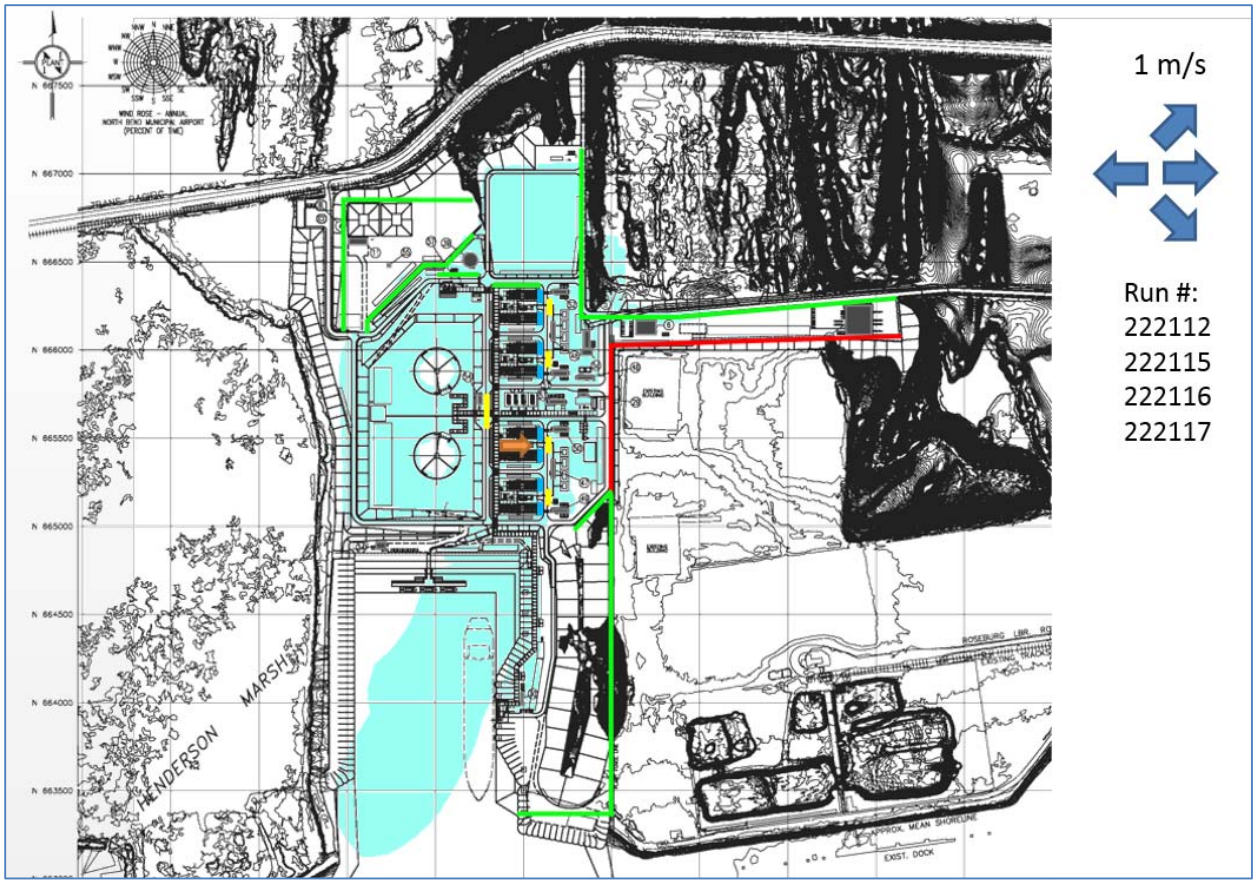


Figure 4.13-11. MR Release from Rupture of the Refrigerant Pump Discharge Piping (1 m/s)

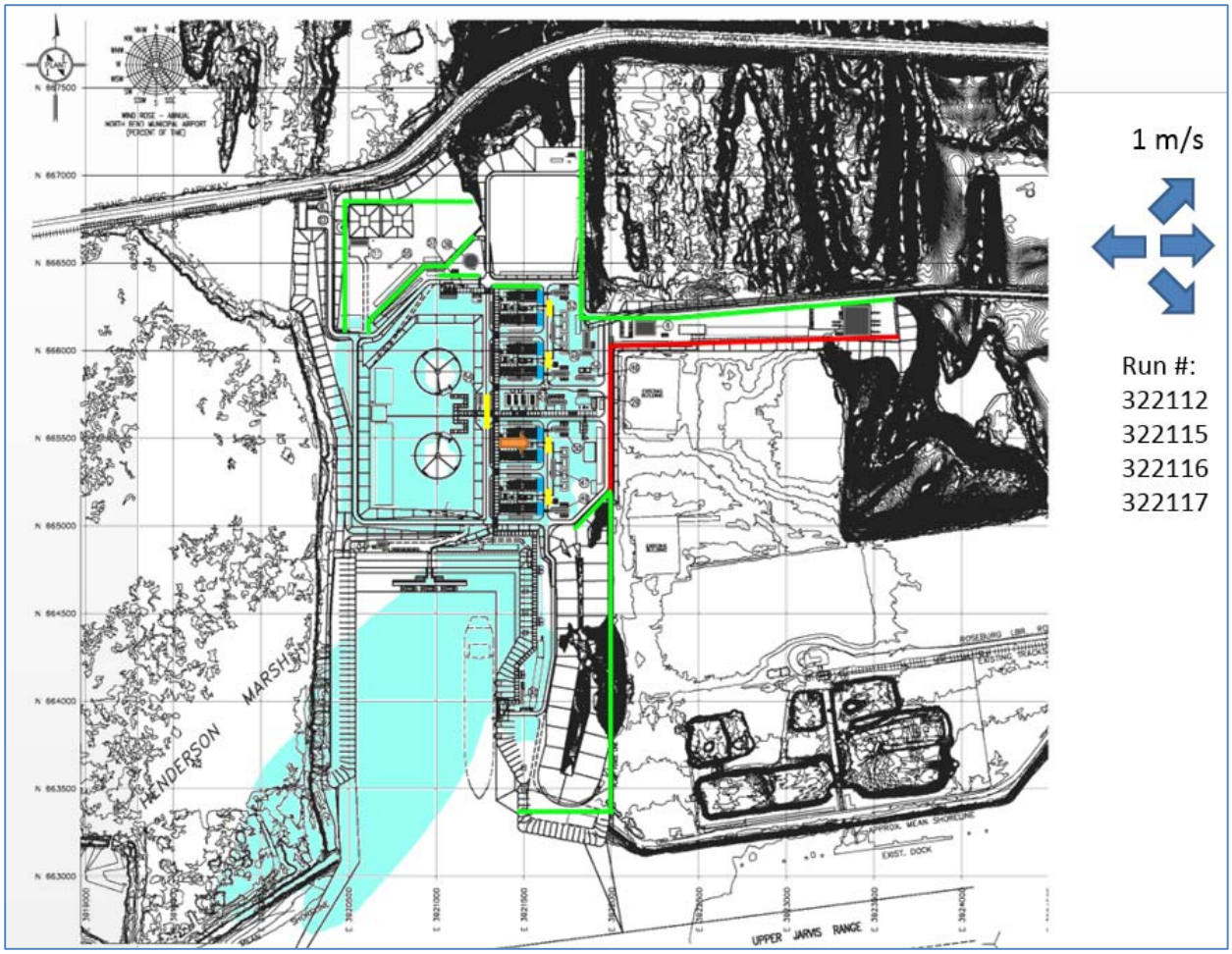


Figure 4.13-12. MR Release from Rupture of the 6-Inch-Diameter MR Process Piping (1 m/s). Note that the ½-LFL vapor cloud extends beyond Jordan Cove property to the southwest.

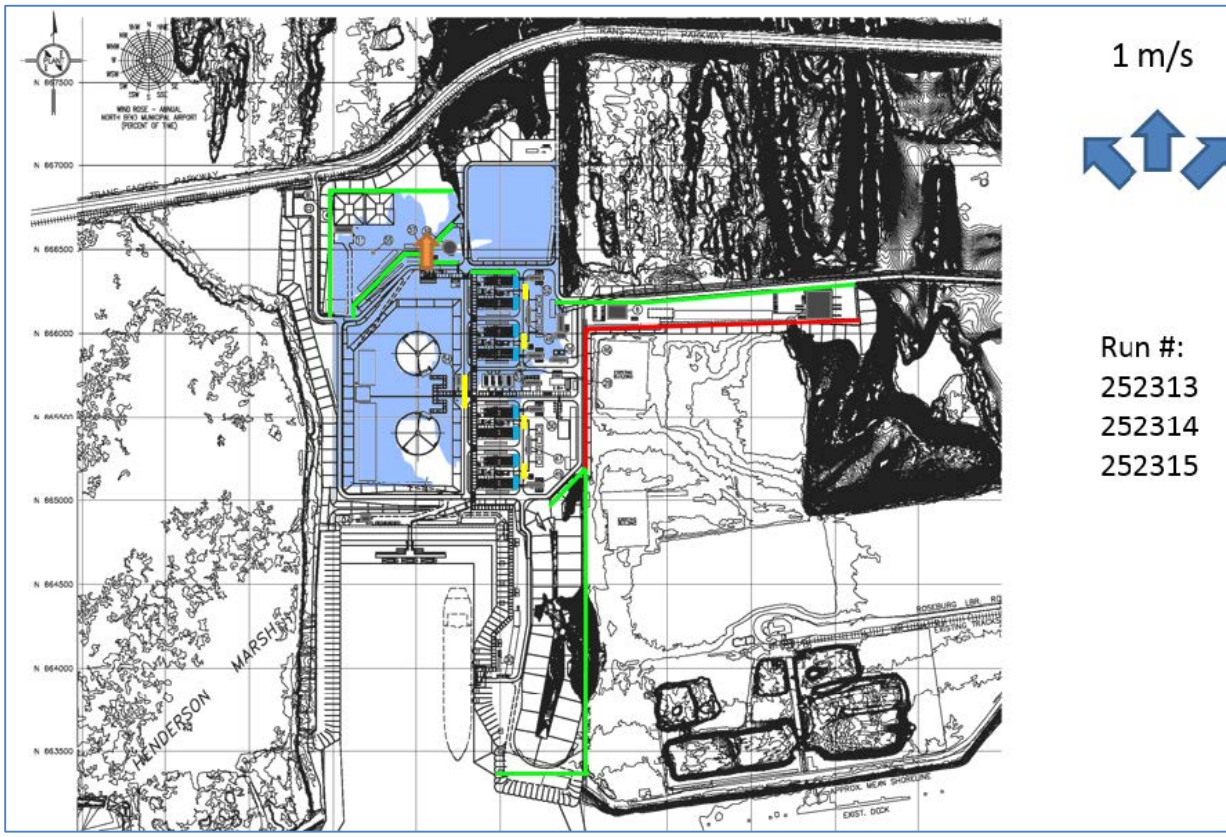


Figure 4.13-13. Ethylene Release from Rupture of the Ethylene Trucking Hose (1 m/s)

The FLACS results shown in figures 4.13-10, 4.13-11, and 4.13-13 indicated the ½-LFL vapor clouds for the MR release scenarios from the liquefaction area and the ethylene release scenario at the refrigerant trucking area would remain within Jordan Cove's property or extend over a navigable body of water. As shown on figure 4.13-12, the FLACS results indicate that the ½-LFL vapor cloud from a rupture of the 6-inch-diameter MR process piping at the liquefaction area would extend beyond Jordan Cove property line onto the Henderson Marsh to the southwest. Jordan Cove has entered into an agreement with the Port to restrict land use within the portion of the land that is covered by the vapor cloud from the MR release in the liquefaction area. Therefore as a result of our technical review of the preliminary engineering design and our recommended mitigation, we conclude that the siting of the proposed Project would not have a significant impact on public safety with respect to other flammable vapor dispersion. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

4.13.5.4 Overpressure Analysis

As discussed in section 4.13.2, the propensity of a vapor cloud to detonate or produce damaging overpressures is influenced by the reactivity of the material, the level of confinement and congestion surrounding and within the vapor cloud, and the flame travel distance. It is possible that the prevailing wind direction may cause the vapor cloud to travel into a partially confined or congested area.

LNG Vapor Clouds

As adopted by Part 193, section 2.1.1 of NFPA 59A (2001) requires an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility be considered. As discussed under "Flammable Vapor Ignition" in section 4.13.2.1, unconfined LNG vapor clouds would not be expected to produce damaging overpressures.

The potential for unconfined LNG vapor cloud detonations was investigated by the Coast Guard in the late 1970s at the Naval Weapons Center in China Lake, California. Using methane, the primary component of natural gas, several experiments were conducted to determine whether unconfined LNG vapor clouds would detonate. Unconfined methane vapor clouds ignited with low-energy ignition sources (13.5 joules), produced flame speeds ranging from 12 to 20 mph. These flame speeds are much lower than the flame speeds associated with a deflagration with damaging overpressures or a detonation.

To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the Coast Guard conducted further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. The tests indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined natural gas vapor cloud to detonate. Less processed natural gas with greater amounts of heavier hydrocarbons would be more sensitive to detonation.

The Coast Guard indicated overpressures of 4 bar and flame speeds of 78 mph were produced from vapor clouds of 86 percent to 96 percent methane in near stoichiometric proportions using exploding charges as the ignition source. The 4 bar overpressure was the same overpressure produced during the calibration test involving exploding the charge ignition source alone, so it remains unclear that the overpressure was attributable to the vapor deflagration.

Additional tests were conducted to study the influence of confinement and congestion on the propensity of a vapor cloud to detonate or produce damaging overpressures. The tests used obstacles to create a partially confined and turbulent scenario, but found that flame speeds developed for methane were not significantly higher than the unconfined case and were not in the range associated with detonations.

Although it has been possible to produce damaging overpressures and detonations of unconfined LNG vapor clouds, the Jordan Cove Project would be designed to receive feed gas with methane concentrations as low as 94 percent, which are not in the range shown to exhibit overpressures and flame speeds associated with high-order explosions and detonations.

Ignition of a confined LNG vapor cloud could result in higher overpressures. In order to prevent such an occurrence, Jordan Cove would take measures to mitigate the vapor dispersion and ignition into confined areas, such as buildings. Buildings would be located away from process areas, and combustion and ventilation air intake equipment would be required to have hazard detection devices that enable isolation of the air dampers. Hazard detection with shutdown capability would also be installed at air intakes of combustion equipment whose continued operation could add to, or sustain, an emergency.

Vapor Clouds from Other Hazardous Fluids

In comparison with LNG vapor clouds, there is a higher potential for unconfined propane clouds to produce damaging overpressures, and an even higher potential for unconfined ethylene vapor clouds to produce damaging overpressures. Unconfined ethylene vapor clouds also have the potential to transition to a detonation much more readily than propane. This has been shown by multiple experiments conducted by the Explosion Research Cooperative to develop predictive blast wave models for low, medium, and high reactivity fuels and varying degrees of congestion and confinement (Pierorazio et al. 2005). The experiments used methane, propane, and ethylene, as the respective low, medium, and high reactivity fuels. In addition, the tests showed that if methane, propane, or ethylene is ignited within a confined space, such as in a building, they all have the potential to produce damaging overpressures. The refrigerant streams would contain all three of these components (i.e., methane, propane, and ethylene). Therefore, a potential exists for unconfined vapor clouds that could produce damaging overpressures in the event of a release of refrigerant.

In order to evaluate this hazard, Jordan Cove used FLACS to perform an overpressure analysis. Jordan Cove used the vapor dispersion results, previously discussed in section 4.13.5.3, Vapor Dispersion Analysis. Releases of the MR stream, which contains nitrogen, methane, propane, and ethylene, from the liquefaction process area dispersing to the most confined and congested regions of the plant were evaluated in the overpressure analyses. Various ignition locations and times were evaluated to predict the worst case overpressure distances. Jordan Cove considered 40 overpressure scenarios, 10 from each of the four liquefaction trains, with various wind directions and ignition locations within the flammable vapor cloud.

Figures 4.13-14 to 4.13-17 show the FLACS results of 1 psi overpressures with a safety factor of 2 (i.e., ½ psi overpressure) for MR vapor cloud explosions at the liquefaction area.

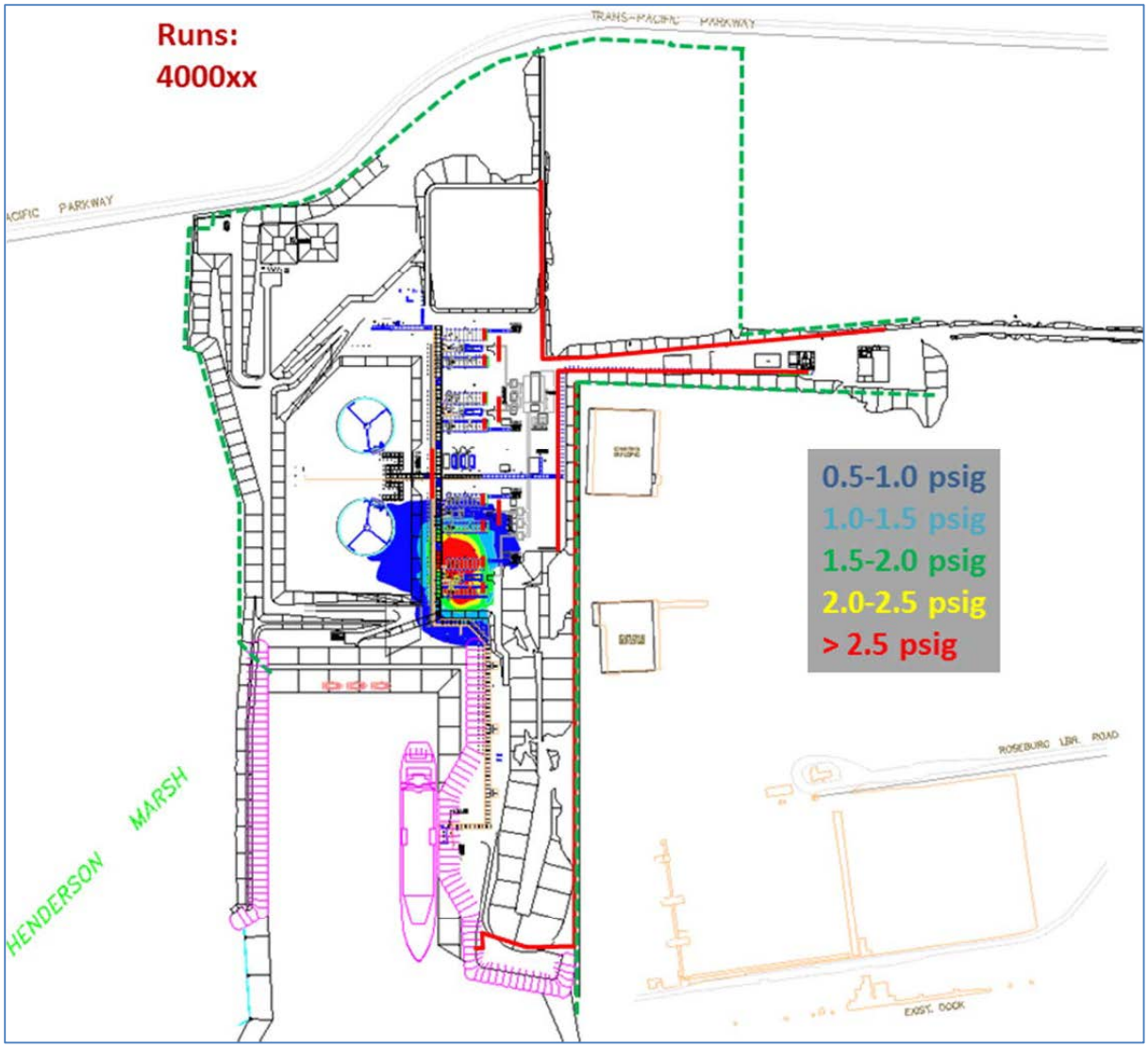


Figure 4.13-14. MR Overpressure Scenario at Train 1

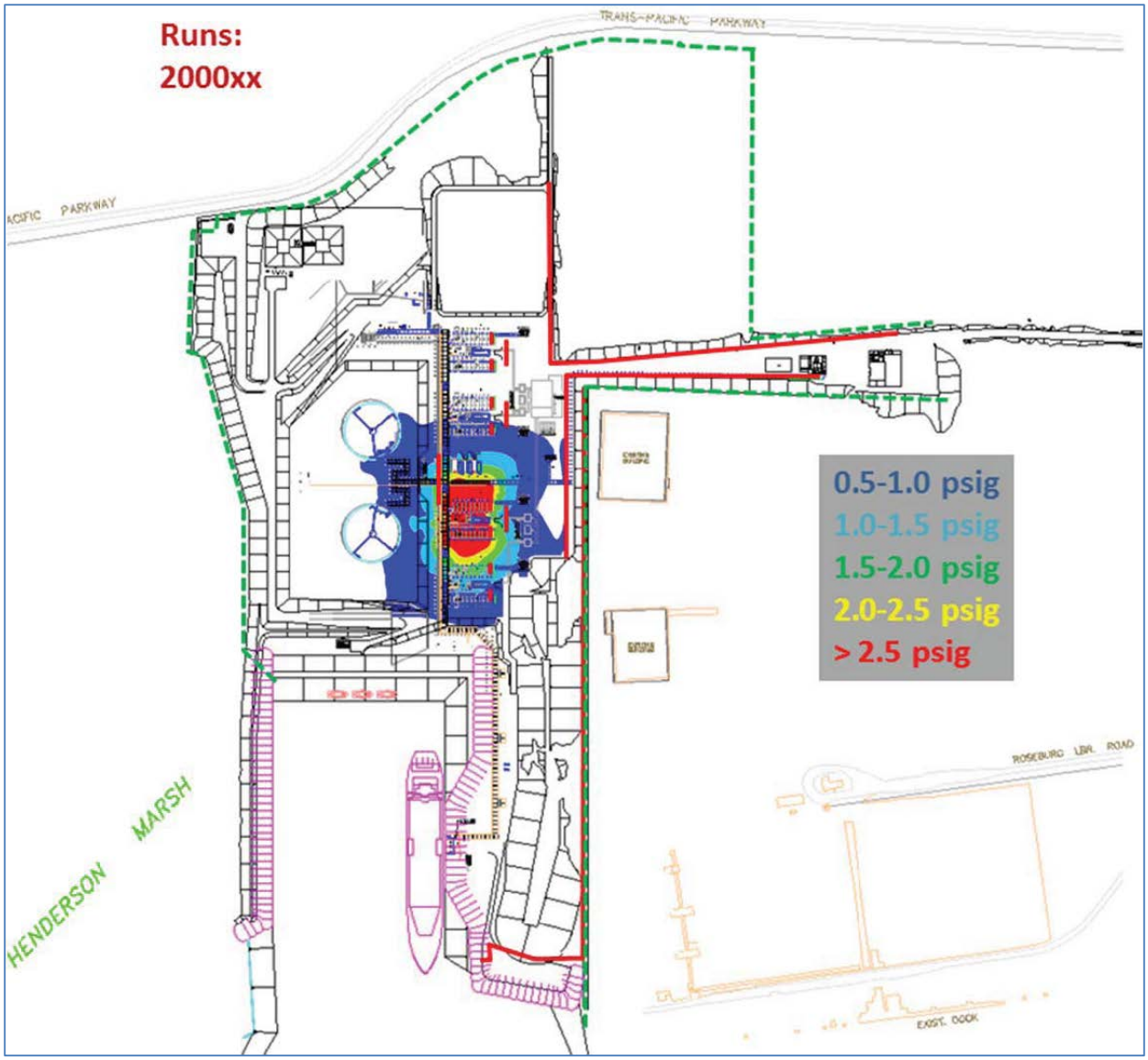


Figure 4.13-15. MR Overpressure Scenario at Train 2

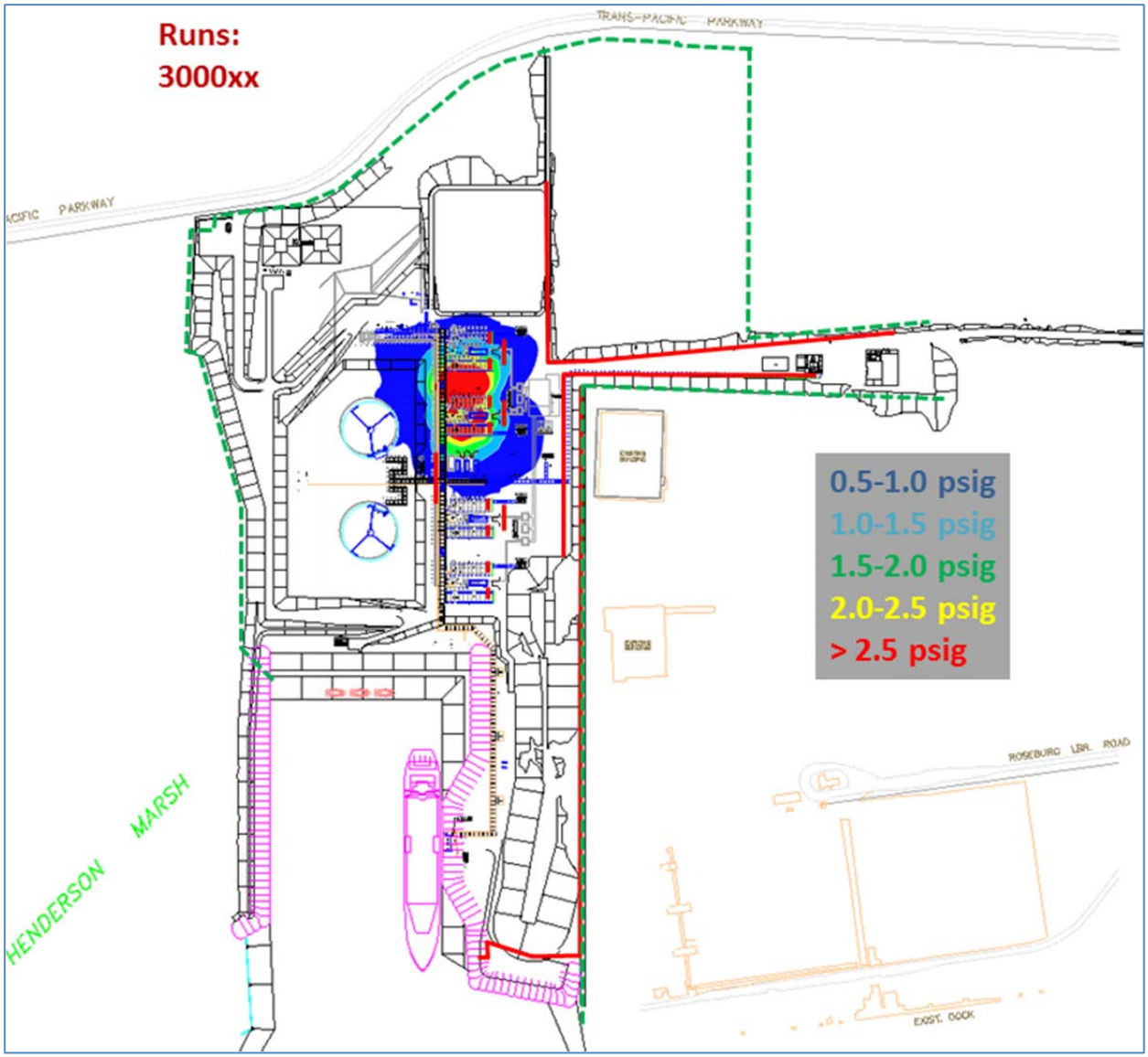


Figure 4.13-16 MR Overpressure Scenario at Train 3

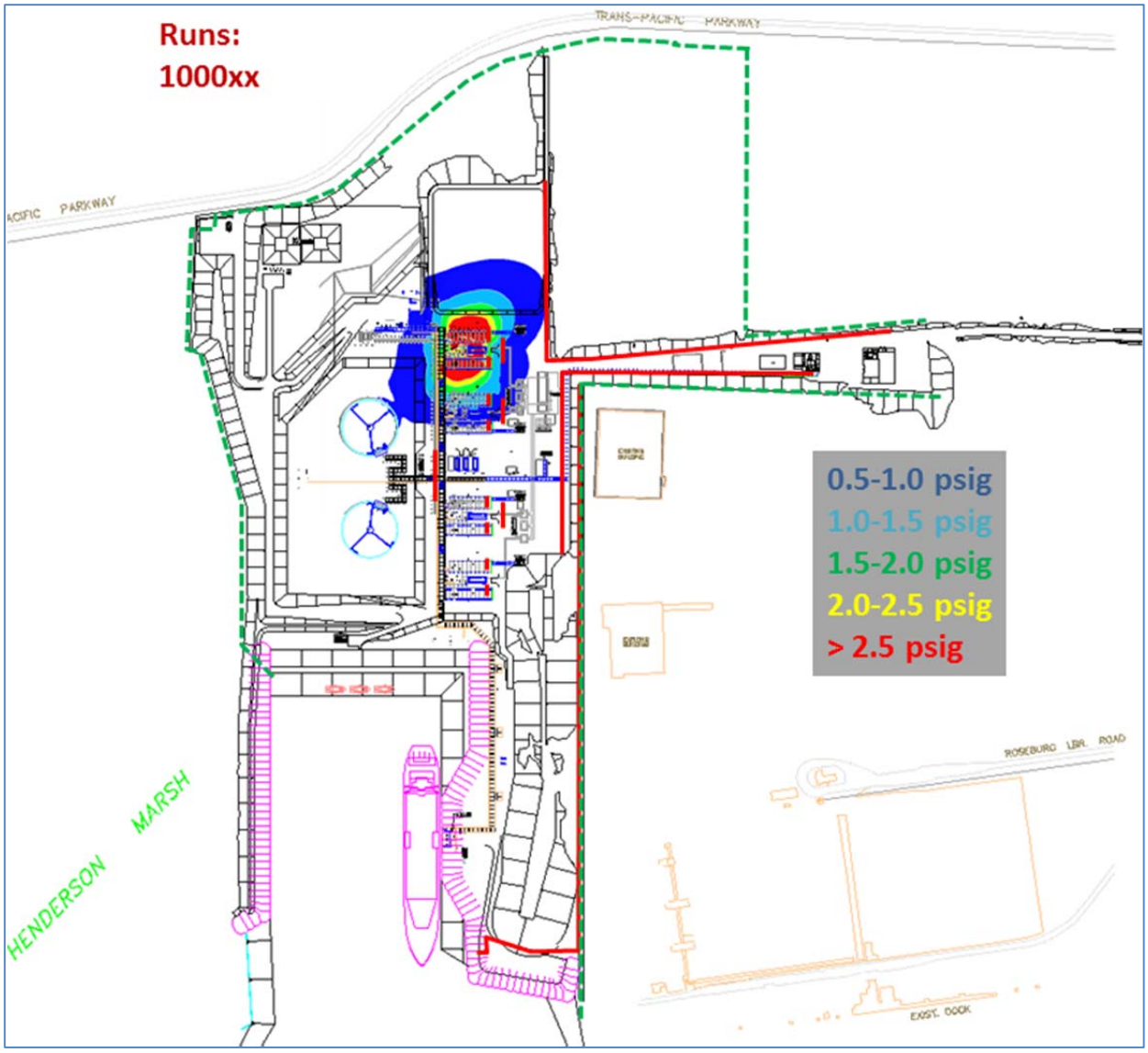


Figure 4.13-17. MR Overpressure Scenario at Train 4

FLACS results indicate that the ½ psi overpressure distances from the liquefaction area would remain within Jordan Cove property. However, Jordan Cove did not evaluate the potential ethylene vapor cloud explosions due to releases from design spills. In order to evaluate the impacts from ethylene vapor cloud explosions, FERC staff conservatively modeled ethylene vapor cloud explosions using the BST methodology and found that the overpressures to 1 psi may extend beyond the property line, but would not have a significant impact to public safety. The overpressures would likely be less when considering the actual size and concentrations from ethylene vapor clouds formed from the design spills. In addition, the impacts could be further mitigated by accounting for barriers and actual elevations of the site. However, it is not clear whether this would meet the federal regulations under 49 CFR Part 193. Therefore, **we recommend that:**

- **<u>Prior to initial site preparation,</u> Jordan Cove should file with the Secretary for review and approval by the Director of OEP, concurrence with the PHMSA that the**

ethylene vapor cloud explosions due to releases from design spills comply with 49 CFR Part 193.

Overpressures were also evaluated at the proposed LNG Storage Tanks, which would be approximately 2.3 psig. Jordan Cove stated the LNG storage tanks would be designed to withstand an overpressure of 2.3 psig.

We received a comment on the DEIS about the effects of overpressures at the storage tanks and their ability to withstand the 2.3 psig overpressure. However, Jordan Cove did not evaluate the potential ethylene vapor cloud explosions due to releases from design spills. In order to evaluate the impacts from ethylene vapor cloud explosions, FERC staff conservatively modeled ethylene vapor cloud explosions using the BST methodology and found that the overpressures at the tanks would be in excess of 10 psi. The overpressures would likely be less when considering the actual size and concentrations from ethylene vapor clouds formed from the design spills. In addition, the overpressures could likely be mitigated by accounting for more realistic congestion and mitigation measures at the site. In order to ensure that the LNG storage tanks can withstand this overpressure, **we recommend that:**

- **<u>Prior to construction of the final design,</u> Jordan Cove should file with the Secretary, for review and approval by the Director of OEP, the details of the LNG storage tank structural design that demonstrate the tanks can withstand overpressures from ignition of design spills. This information should be filed a minimum of 30 days before approval to proceed is requested.**

In addition, there appears to be a potential for flammable vapor to disperse under the elevated LNG storage tanks. In order to evaluate the impacts from vapor cloud explosions under the elevated LNG storage tanks, FERC staff conservatively modeled various scenarios using the BST methodology and FLACS, and found that depending on the size and concentration of the vapor clouds there is potential for a deflagration to detonation transition. The overpressures would likely be less when considering the actual size and concentrations from flammable vapor clouds formed from the design spills. In addition, the impacts could be further mitigated by accounting for barriers and actual elevations of the site. In order to ensure that the overpressures generated from ignition of flammable vapor clouds under the elevated LNG storage tanks would not impact the structural integrity of the LNG storage tanks, **we recommend that:**

- **<u>Prior to construction of the final design,</u> Jordan Cove should file with the Secretary for review and approval by the Director of OEP, an evaluation that demonstrate flammable vapor clouds would be prevented from dispersing under the elevated LNG storage tanks or the LNG storage tanks would be able to withstand the overpressure due to ignition of design spills. This information should be filed a minimum of 30 days before approval to proceed is requested.**

As a result of our technical review of the preliminary engineering design and our recommended mitigation, we conclude that the siting of the proposed Project would not have a significant impact on public safety with respect to vapor cloud explosions. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

Since the acid gas stream would contain the toxic component of hydrogen sulfide, and the heavy hydrocarbon stream would contain toxic components of benzene, toluene, ethylbenzene, and xylene, Jordan Cove used PHAST to calculate the dispersion distances to toxic threshold exposure limits based on the toxicity levels that were at or below ½-AEGLs. Table 4.13.5.4-1 shows the distances to the ½-AEGLs for releases of the acid gas stream from the gas pre-treatment area and the heavy hydrocarbon stream from the liquefaction area. Jordan Cove considered exposure durations of 1 hour for the heavy hydrocarbon release and 10 minutes for the acid gas release since the heavy hydrocarbon release would form a pool while the acid vapor cloud would dissipate once the release ends.

TABLE 4.13.5.4-1

Distance (in feet) to the ½-AEGL 1

Substance	Exposure Time (minutes)	½-AEGL 1 (feet)
Hydrogen Sulfide	10	110
Benzene	60	230
Ethylbenzene	60	23
Toluene	60	24
Xylenes	60	3

The distances to the ½-AEGL 1 for the substances listed in table 4.13.5.4-1 would remain within the facility boundary. However, Jordan Cove did not include an analysis of the all components, including hexane or mercaptans, in its toxic vapor dispersion analyses. In order to evaluate this hazard FERC staff modeled the total concentration of hexane, benzene, ethylbenzene, toluenes, xylenes, and mercaptans using PHAST and found that the distances to the ½-AEGL-1 60 minute concentration would extend beyond the property line, but would not be a significant impact to the public. The ½-AEGL-2 60 minute concentration would not extend beyond the property line, and vapor concentrations would not reach the ½-AEGL-3 60 minute concentration. The concentrations would likely be even less when considering the actual geometry of the facility.

As a result of our technical review of the preliminary engineering design and our recommended mitigation, we conclude that the siting of the Project would not have a significant impact on public safety with respect to the presence of the toxic components (i.e., hydrogen sulfide, benzene, ethylbenzene, toluene, and xylene). If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

4.13.5.5 Thermal Radiation Analysis

As discussed in section 4.12.2, if flammable vapors are ignited, the deflagration could propagate back to the spill source and result in a pool fire causing high levels of thermal radiation (i.e., heat from a fire). In order to address this, 49 CFR 193.2057 requires each LNG container and LNG transfer system to have a thermal exclusion zone in accordance with Section 2.2.3.2 of NFPA 59A (2001). Together, Part 193 and NFPA 59A (2001) specify different hazard endpoints for spills into LNG storage tank containment and spills into impoundments for process or transfer

areas. For LNG storage tank spills, there are three radiant heat flux levels which must be considered:

- 1,600 Btu/ft^2-hr – This level can extend beyond the facility's property line that can be built upon but cannot include areas that, at the time of facility siting, are used for outdoor assembly by groups of 50 or more persons;
- 3,000 Btu/ft^2-hr – This level can extend beyond the facility's property line that can be built upon but cannot include areas that, at the time of facility siting, contain assembly, educational, health care, detention or residential buildings or structures; and
- 10,000 Btu/ft^2-hr – This level cannot extend beyond the facility's property line that can be built upon.

The requirements for spills from process or transfer areas are more stringent. For these impoundments, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the facility's property line that can be built upon.

Part 193 requires the use of the LNGFIRE3 computer program model developed by the Gas Research Institute to determine the extent of the thermal radiation distances. Part 193 stipulates that the wind speed, ambient temperature, and relative humidity that produce the maximum exclusion distances must be used, except for conditions that occur less than 5 percent of the time based on recorded data for the area. Jordan Cove selected the following ambient conditions to produce the maximum exclusion distances: wind speeds of 20.5 mph (9.2 m/s), ambient temperature of 25.7°F, and 20 percent relative humidity. We agree with Jordan Cove's selection of atmospheric conditions.

For its analysis, Jordan Cove calculated thermal radiation distances for the 1,600-, 3,000-, and 10,000-Btu/ft^2-hr incident radiant heat levels for the LNG storage tanks using the outer tank's concrete wall diameter (260 feet) as the pool diameter. The flame base was set equal to 122 feet above grade. Target heights were set at the ground level. In addition, Jordan Cove calculated thermal radiation distances using LNGFIRE3 for the 1,600-Btu/ft^2-hr incident radiant heat level centered on the Marine Area and Process Area Impoundment Basins.

Jordan Cove also used LNGFIRE3 to predict the thermal radiation distance at the level of 1,600-Btu/ft^2-hr for fires from the Refrigerant Spill Collection Area. Although LNGFIRE3 is specifically designed to calculate thermal radiation flux levels for LNG pool fires, LNGFIRE3 could also be used to conservatively calculate the thermal radiation flux levels for flammable hydrocarbons such as ethylene, propane, and isopentane. Two of the parameters used by LNGFIRE3 to calculate the thermal radiation flux is the mass burning rate of the fuel and the surface emissive power (SEP) of the flame, which is an average value of the thermal radiation flux emitted by the fire. The mass burning rate and SEP of an ethylene, propane, or isopentane fire would be less than an equally sized LNG fire. Since the thermal radiation from a pool fire is dependent on the mass burning rate and SEP, the thermal radiation distances required for ethylene, propane, and isopentane fires would not extend as far as the exclusion zone distances previously calculated for an LNG fire in the same sump.

The resulting maximum thermal radiation distances are shown in table 4.13.5.5-1 and figure 4.13-18. The 10,000- and 3,000-Btu/ft^2-hr heat fluxes from the LNG storage tanks and the 1,600-Btu/ft^2-hr heat flux from the Marine Area and Process Area Impoundment Basins, and the

Refrigerant Spill Collection Area would remain within the facility property lines. Thermal radiation from a potential fire in the trench system leading to the spill impoundments would be less significant than the thermal radiation from the impoundment fires. However, Jordan Cove did not evaluate jet fires due to releases from design spills, which have the potential to emit higher radiant heats. In order to evaluate the impacts from jet fires, FERC staff evaluated jet fires from the design spills using PHAST and found that the jet fires radiant heat to 1,600 Btu/ft^2-hr may extend beyond the property line, but would not have a significant impact to public safety. In addition, the impacts could be further mitigated by accounting for barriers and actual elevations of the site. However, it is not clear as to whether this would meet the federal regulations under 49 CFR Part 193. Therefore, **we recommend that:**

- **<u>Prior to initial site preparation,</u> Jordan Cove should file with the Secretary for review and approval by the Director of OEP, concurrence with the PHMSA that the jet fires due to releases from design spills comply with 49 CFR Part 193.**

As a result of our technical review of the preliminary engineering design and our recommended mitigation, we conclude that the siting of the proposed Project would not have a significant impact on public safety with respect to radiant heat from the impoundment fires or jet fires. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

TABLE 4.13.5.5-1

Thermal Radiation Exclusion Zone for Impoundment Basins

	Thermal Flux Level (Btu/ft2-hr)		
	10,000	**3,000**	**1,600**
Distance from LNG Storage Tanks (ft)	450	770	985
Distance from Process Area Impoundment Basin (ft)	N/A	N/A	435
Distance from Marine Area Impoundment Basin (ft)	N/A	N/A	330 (front) 305 (side)
Distance from Refrigerant Spill Collection Area (ft)	N/A	N/A	180 (front) 175 (side)

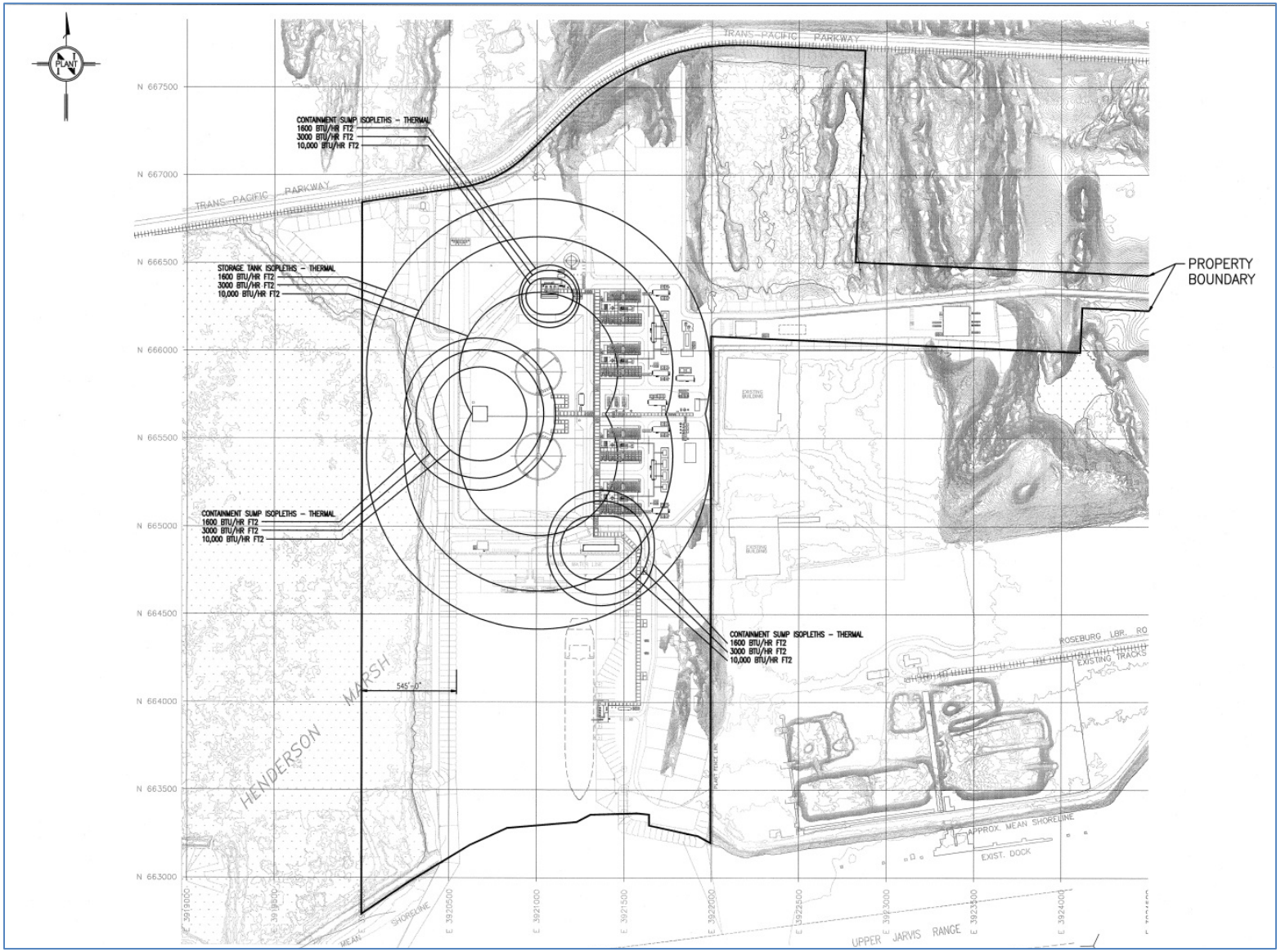


Figure 4.13-18. Thermal Radiation Zones at the Jordan Cove Facility

The 1,600-Btu/ft^2-hr heat flux from the southern LNG storage tank crosses the property line to the southwest onto the Henderson Marsh. In its October 3, 2013 response to FERC staff's data request, Jordan Cove stated it was amending its existing Option Agreement with the Port to include a restriction of use in regards to the land west of the LNG storage tanks to satisfy the requirements of 49 CFR 193.2057. On April 25, 2014, Jordan Cove submitted to the DOT the final language of the Safety Zone Easement Option between the Port and Jordan Cove to restrict the land use within the thermal radiation zones from the LNG storage in order to comply with 49 CFR 193.2057. By email dated April 28, 2014, PHMSA provided its statement of no objection to the final Safety Zone Easement Option language. The correspondence between Jordan Cove and PHMSA can be found on FERC's eLibrary site under the accession no. 20140703-5042. Since the Safety Zone Easement Option would restrict the activities in these areas to those allowed by Part 193, we conclude that the siting of the proposed Project would not have a significant impact on public safety. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

4.13.5.6 Cascading Events

The refrigerant storage tank area would be located approximately 300 feet to the north of the LNG storage tanks. Jordan Cove proposes to install a 22-foot-high and 95-foot-long fire proof brick wall between the refrigerant storage tanks and the refrigerant storage area sump to protect the refrigerant storage tanks from thermal radiation exposure as a result of a fire at the refrigerant storage sump. Jordan Cove used Fire Dynamics Simulator (FDS), a computational fluid dynamics (CFD) model of fire-driven fluid flow, to account for the shielding effect of the fire resistant wall. The results of the FDS analysis show the 22-foot-height wall would prevent the refrigerant storage tanks from being exposed to a heat flux greater than approximately 640-Btu/ft^2-hr from a fire at the refrigerant storage area sump. Therefore, the risk of a BLEVE at the refrigerant storage tanks would be negligible. In addition, Jordan Cove would install fire detection equipment, emergency isolation and depressurization valves, passive fire protection measures, fire suppression units, and firewater monitors to mitigate the potential of a BLEVE from an adjacent jet fire. Recommendations for an updated fire protection evaluation is included to assess the adequacy of these measures. As a result of our technical review of the preliminary engineering design and our recommended mitigation, we conclude that the siting of the proposed Project would not have a significant impact on public safety with respect to cascading events.

4.13.6 LNG Vessel Hazards

Since 1959, ships have transported LNG without a major release of cargo or a major accident involving an LNG vessel. There are more than 370 LNG vessels in operation routinely transporting LNG between more than 100 import/export terminals currently in operation worldwide. Since U.S. LNG terminals first began operating under FERC jurisdiction in the 1970s, there have been more than 2,600 individual LNG ship arrivals at terminals in the U.S. For more than 40 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

Jordan Cove has not identified specific source(s) for LNG export destinations for the proposed project. LNG from the terminal may be exported to any country throughout the world for which Jordan Cove has authority to export. There are 29 countries which have facilities to receive LNG: Argentina, Belgium, Brazil, Canada, Chile, China, Dominican Republic, England, France,

Greece, India, Indonesia, Italy, Japan, Kuwait, Malaysia, Mexico, Netherlands, Portugal, Singapore, South Korea, Spain, Sweden, Taiwan, Thailand, Turkey, United Arab Emirates, United States, and Wales with another 9 planned or under construction: Albania, Croatia, Cyprus, Germany, Ireland, Lithuania, Pakistan, Philippines, and Poland. Although LNG could be sent to any of these countries, Jordan Cove has stated that its export would be to markets primarily in Asia and domestic markets in Alaska and Hawaii.

4.13.6.1 Past LNG Vessel Incidents

A review of the history of LNG maritime transportation indicates that there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG vessels, including minor collisions with other vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant occurrences, representing the range of incidents experienced by the worldwide LNG vessel fleet, are described below:

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, the cargo tanks were not damaged, and no cargo was released. The complete cargo of LNG was subsequently transferred to another LNG vessel and delivered to its United States destination.
- **LNG Taurus** grounded in December 1980 near the entrance to Taboata Harbor, Japan. The grounding resulted in extensive bottom damage, but the cargo tanks were not affected. The vessel was refloated and the cargo unloaded.
- **Tellier** was blown by severe winds from its docking berth at Skikda, Algeria, in February 1989 causing damage to the loading arms and the ship and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck causing fracture of some plating.
- **Mostefa Ben Boulaid** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The vessel was required to discharge its cargo, after which it proceeded to dock for repair.
- **Khannur** had a cargo tank overfill into the ship's vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After re-inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.
- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000-m^3 LNG vessel, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.
- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 feet by 80 feet, and internal breaches allowed

water to enter the insulation space between the primary and secondary membranes. The vessel was refloated, repaired, and returned to service.

- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.
- **Catalunya Spirit** lost propulsion and became adrift 35 miles east of Chatham, Massachusetts, on February 11, 2008. Four tugs towed the vessel to a safe anchorage for repairs. The vessel was repaired and taken to port to discharge its cargo.
- **Suez Matthew** grounded on the reef off Cayo Maria Langa, near Guayanilla, Puerto Rico on December 19, 2009. The ship was refloated and no damage was found to the hull.
- **Al Gharrafa** collided with a container ship, Hanjin Italy, in the Malacca Strait off Singapore on December 19, 2013. The bow of the Al Gharrafa and the middle of the starboard side of the Hanjin were damaged. Both ships were safely anchored after the incident. No losses of LNG, fatalities, or injuries were reported.

4.13.6.2 LNG Carrier Hazards Resulting from Accidents

Although the history of LNG shipping has been free of major incidents, and no incidents have resulted in significant quantities of cargo being released, the possibility of an LNG spill from a vessel over the duration of the proposed project must be considered. If an LNG spill were to occur, the primary hazard to the public would be from radiant heat from a pool fire. If an LNG release were to occur without ignition, an ignitable gas cloud could form and also present a hazard. Historically, the events most likely to cause a significant release of LNG were a vessel casualty such as:

- a grounding sufficiently severe to puncture an LNG cargo tank;
- a vessel colliding with an LNG vessel in transit;
- an LNG vessel alliding[180] with the terminal or a structure in the waterway; or
- a vessel alliding with an LNG vessel while moored at the terminal.

The potential for an LNG vessel breach was analyzed by Sandia for DOE in December 2004. The report entitled, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water* (2004 Sandia Report) included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for both credible accidental and intentional LNG spill events. Accidental breaching evaluations were based on finite element modeling of collisions of double-hulled oil tankers similar in size and design to LNG ships. The analysis of accidental events found that breach areas would be from 0.5 to 1.5 m^2.

The possibility of a LNG release due to an accident, such as a collision or grounding, is considered minimal. In addition, current operational procedures in use by the Coast Guard, such as managing ship traffic, coordinating ship speeds, and active ship control in inner and outer harbors, would also further reduce the potential of LNG spill from accidental causes.

[180] "Allision" is the action of dashing against or striking upon a stationary object (for example, the running of one ship upon another ship that is docked) – distinguished from "collision," which is used to refer to two moving ships striking one another.

4.13.6.3 LNG Carrier Hazards Resulting from Intentional Acts

The 2004 Sandia Report also analyzed credible intentional breaches on LNG carriers up to 145,000 m^3 in capacity using modern finite element modeling and explosive shock physics modeling. The events considered for credible intentional acts were based on intelligence and historical data.

For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 m^2. In most cases, an intentional breaching scenario would not result in a nominal hole area of more than 5 to 7 m^2, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 meters.

The 2004 Sandia Report also evaluated cascading damage due to brittle fracture from exposure to cryogenic liquid or fire-induced damage to foam insulation. While possible under certain conditions, the cascading damage was found to not likely involve more than two or three cargo tanks. Cascading events were expected to increase the fire duration but not to significantly increase the overall fire hazard.

Based on the potential cargo breaches, the 2004 Sandia Report determined that the most significant impacts to public safety and property would exist within approximately 500 meters (1,640 feet) of a spill due to thermal hazards from a fire, with lower public health and safety impacts beyond 1,600 meters (approximately 1 mile). Large unignited LNG vapor releases were found to be unlikely, but could extend from nominally 2,500 meters (8,200 feet) to a conservative maximum distance of 3,500 meters (2.2 miles) for an intentional spill.

In 2008, the DOE released another study prepared by Sandia, entitled *Breach and Safety Analysis of Spills Over Water from Large Liquefied Natural Gas Carriers, May 2008* (2008 Sandia Report). The 2008 Sandia Report assessed the scale of possible hazards for newer LNG vessels with capacities up to 265,000 m^3. Using the same methodology as the 2004 Sandia Report, the 2008 Sandia Report concluded thermal hazard distances would be 7 to 8 percent greater than those from vessels carrying 145,000 m^3 of LNG, due primarily to the slightly greater height of LNG above the waterline. The 2008 Sandia Report also noted the general design of the larger vessels was similar to the previously analyzed ship designs and, for near-shore facilities; the calculated breach size for intentional scenarios would remain the same. Overall, the 2008 Sandia Report maintained the same impact zones as with the smaller vessels that were analyzed in the 2004 Sandia Report.

In February 2007, the U.S. Government Accountability Office (GAO) published a report assessing several studies, including the 2004 Sandia Report that had been conducted on the consequences of an LNG spill resulting from a terrorist attack on an LNG vessel (GAO 2007). The GAO's panel of experts agreed that the most likely public safety impact of an LNG spill would be the radiant heat from a pool fire and suggested that further study was needed to eliminate uncertainties in the assumptions used in modeling large LNG spills on water. After the GAO report, Congress requested the DOE to further address these research needs. DOE contracted Sandia to conduct a series of large-scale LNG fire and cryogenic damage tests to investigate the larger classes of LNG carriers with capacities up to 260,000 m^3, representative of the largest LNG vessels in operation. Sandia conducted the largest LNG pool fire tests done to

date and performed advanced computational modeling and ship simulations between 2008 and 2011.

As in the earlier studies, Sandia worked with marine safety, law enforcement, and intelligence agencies to assess threats and credible intentional acts. Scenarios included attacks with shoulder-fired weapons, explosives, and attacks by aircraft and other boats. Sandia identified several ranges of possible hull breaches ranging from 0.005 m^2 (Very Small) to 15 m^2 (Very Large). Based on the collected pool fire test data and the ship simulations, Sandia concluded that thermal hazard distances to the public from a large LNG pool fire was smaller, by at least 2 to 7 percent, than the results listed in the 2004 and 2008 Sandia Reports.

In order to more robustly analyze the potential for cascading failure of LNG carrier cargo tanks, Sandia use detailed vessel structural and thermal damage models to simulate the effects to a LNG carrier from a spill. For the large breaches considered, Sandia predicts that as much as 40 percent of the LNG released from the cargo tank would remain within the ship's structure. Due to both the cold temperature of the LNG and the heat from a pool fire, the LNG carrier's structural steel would be degraded. The effects could be significant enough to cause the ship to be disabled, severely damaged, and at risk of sinking.

Although LNG ship design and construction practices render simultaneous, multiple tank failures as extremely unlikely, Sandia concluded that sequential multi-tank spills may be possible. If sequential failures were to occur, they would not increase the size of the area impacted by the pool fire but could increase the duration of the fire hazards. Based on this research, Sandia concluded that use of a nominal one-tank spill, with a maximum of a three-tank spill, as was recommended in the 2004 Sandia report, is still appropriate for estimating hazard distances.

The possibility of a LNG release due to an intentional act is considered minimal. In addition, current security procedures in use by the Coast Guard would reduce the potential of a LNG spill from intentional causes.

4.13.6.4 LNG Vessel Regulatory Oversight

The Coast Guard exercises regulatory authority over LNG vessels under 46 CFR 154, which contains the United States safety standards for vessels carrying liquefied natural gas in bulk. The LNG vessels visiting the proposed facility would also be constructed and operated in accordance with the IMO's *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and the *International Convention for the Safety of Life at Sea* (SOLAS). All LNG vessels entering U.S. waters are required to possess a valid IMO Certificate of Fitness and either a Coast Guard Certificate of Inspection (for U.S. flag vessels) or a Coast Guard Certificate of Compliance (for foreign flag vessels). These documents certify that the vessel is designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG vessels under 46 CFR Part 154.

The LNG vessels which would deliver or receive LNG to or from the proposed facility would also need to comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code* (ISPS Code) in 2003. The ISPS Code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to passengers, crew, and port personnel on

board ships and in port areas. All LNG vessels, as well as other cargo vessels 500 gross tons and larger, and ports servicing those regulated vessels, must adhere to the IMO standards. Some of the IMO requirements for ships are as follows:

- ships must develop security plans and have a Vessel Security Officer;
- ships must have a ship security alert system. These alarms transmit ship-to-shore security alerts identifying the ship, its location, and indication that the security of the ship is under threat or has been compromised;
- ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- ships may have equipment onboard to help maintain or enhance the physical security of the ship.

In 2002, the MTSA was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the ISPS Code and SOLAS. The resulting Coast Guard regulations, contained in 33 CFR 104, require vessels to conduct vulnerability assessments and develop corresponding security plans. All LNG vessels servicing the facility would have to comply with the MTSA requirements and associated regulations while in U.S. waters.

The Coast Guard also exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 U.S.C. Section 191); the Ports and Waterways Safety Act of 1972, as amended (33 U.S.C. Section 1221, et seq.); and the MTSA of 2002 (46 U.S.C. Section 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in 33 CFR Part 105.

The Coast Guard regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between where the vessel moors, and the last manifold or valve immediately before the tanks 33 CFR 127 regulates the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Pursuant to 33 CFR 127.019, Jordan Cove would be required to submit two copies of its Operations and Emergency Manuals to the Coast Guard COTP for examination.

Both the Coast Guard regulations under 33 CFR 127 and FERC regulations under 18 CFR 157.21, require an applicant who intends to build an LNG import and/or export facility to submit an LOI to the Coast Guard at the same time the pre-filing process is initiated with the Commission.

In addition to the LOI, 33 CFR 127 and FERC regulations require each LNG project applicant to submit a WSA to the cognizant COTP no later than the start of the FERC pre-filing process. Until a facility begins operation, applicants must annually review their WSAs and submit a report to the COTP as to whether changes are required. The WSA must include the following information:

- port characterization;
- risk assessment for maritime safety and security;
- risk management strategies; and
- resource needs for maritime safety, security, and response.

In order to provide the Coast Guard COTPs/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic, the Coast Guard has published a Navigation and Vessel Inspection Circular – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 01-11).

As described in 33 CFR 127 and in NVIC 01-11, the applicant develops the WSA in two phases. The first phase is the submittal of the Preliminary WSA, which begins the Coast Guard's review process to determine the suitability of the waterway for LNG marine traffic. The second phase is the submittal of the Follow-On WSA. This document is reviewed and validated by the Coast Guard and forms the basis for the agency's recommendation to the FERC.

The Preliminary WSA provides an outline which characterizes the port community and the proposed facility and transit routes. It provides an overview of the expected major impacts LNG operations may have on the port, but does not contain detailed studies or conclusions. This document is used to start the Coast Guard's evaluation of the suitability of the waterway for LNG marine traffic.

The Follow-On WSA must provide a detailed and accurate characterization of the LNG facility, the LNG tanker route, and the port area. The assessment should identify appropriate risk mitigation measures for credible security threats and safety hazards. The Follow-on WSA provides a complete analysis of the topics outlined in the Preliminary WSA. It should identify credible security threats and navigational safety hazards for the LNG marine traffic, along with appropriate risk management measures and the resources (federal, state, local, and private sector) needed to carry out those measures.

NVIC 01-11 directs the use of the three concentric Zones of Concern, based on LNG vessels with a cargo carrying capacity up to 265,000 m^3, used to assess the maritime safety and security risks of LNG marine traffic. The Zones of Concern are:

- Zone 1 – impacts on structures and organisms are expected to be significant within 500 meters (1,640 feet). The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kilowatts per square meter (kW/m^2) (12,000 Btu/ft^2-hr) from a pool fire.
- Zone 2 – impacts would be significant but reduced, and damage from radiant heat levels are expected to transition from severe to minimal between 500 and 1,600 meters (1,640 and 5,250 feet). The outer perimeter of Zone 2 is approximately the distance to thermal hazards of 5 kW/m^2 (1,600 Btu/ft^2-hr) from a pool fire.
- Zone 3 – impacts on people and property from a pool fire or an un-ignited LNG spill are expected to be minimal between 1,600 meters (5,250 feet) and a conservative maximum distance of 3,500 meters (11,500 feet, or 2.2 miles). The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the LFL from a worst-case

un-ignited release. Impacts to people and property could be significant if the vapor cloud reaches an ignition source and burns back to the source of the discharge.

Once the applicant submits a complete Follow-On WSA, the Coast Guard reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic in the port.

As required by its regulations (33 CFR 127.009), the Coast Guard is responsible for issuing a LOR to the FERC regarding the suitability of the waterway for LNG marine traffic with respect to the following items:

- physical location and description of the facility;
- the LNG vessel's characteristics and the frequency of LNG shipments to or from the facility;
- waterway channels and commercial, industrial, environmentally sensitive, and residential areas in and adjacent to the waterway used by LNG vessels en route to the facility, within 25 kilometers (15.5 miles) of the facility;
- density and character of marine traffic in the waterway;
- locks, bridges, or other manmade obstructions in the waterway;
- depth of water;
- tidal range;
- protection from high seas;
- natural hazards, including reefs, rocks, and sandbars;
- underwater pipes and cables;
- distance of berthed vessels from the channel and the width of the channel; and
- any other issues affecting the safety and security of the waterway and considered relevant by the COTP.

The Coast Guard may also prepare an LOR Analysis, which serves as a record of review of the LOR and contains detailed information along with the rationale used in assessing the suitability of the waterway for LNG marine traffic.

4.13.6.5 Jordan Cove's Waterway Suitability Assessment

On April 10, 2006, Jordan Cove submitted the Preliminary WSA to the COTP Sector Portland for review as part of the previous import project proposal. Jordan Cove submitted the Follow-On WSA to the Coast Guard on March 1, 2007.

In its application to FERC for the export project, Jordan Cove stated it notified the Coast Guard of its intent to build an export facility and proposed that any changes due to a change from import to export facility equipment and operations would be addressed in the annual WSA update. The COTP affirmed Jordan Cove's approach and asked that the WSA and the LOI be updated as needed. The 2012 annual update to the WSA included changes to reflect the export facility. At that time, Jordan Cove also changed the LOI to reflect the export facility.

Further, Jordan Cove contacted the Coast Guard about the direction of LNG marine traffic for the export project. The Coast Guard stated that the WSR[181] and LOR for the import project would remain the Coast Guard's position, and that the direction of movement of the LNG on vessels in the waterway does not alter the analysis of the original WSR and LOR.

LNG Vessel Routes

Approximately 90 LNG vessels per year would be required to transport the LNG from the Project to its delivery points. The 90 LNG vessels is the number calculated for the proposed six MMTPA output of the liquefaction facilities for the 148,000 m^3 sized LNG vessel reviewed by the Coast Guard for the Project. The LNG marine traffic study conducted by Moffat & Nichol (2006c) concluded that the additional LNG marine traffic associated with the import project could be accommodated in the Port and the Coos Bay navigation channel. The ship traffic conditions in the Port when the LNG marine traffic study was conducted have not changed.

The Moffat & Nichol (2006c) study[182] included an LNG vessel maneuvering simulation study to evaluate the transit of an LNG vessel through the Coos Bay navigation channel to the terminal, evaluate the feasibility of the berthing configuration at the terminal, and evaluate the tractor tug requirements for the proposed project. Moffat & Nichol contracted Marine Safety International in Rhode Island to develop the transit model and perform the simulations under direction from marine consultants. The study included the transit of a 71,500 m^3, 87,600 m^3, 137,000 m^3, and a 165,000 m^3 LNG vessel. The study indicated that LNG vessels could safely maneuver the approach to the LNG terminal and ship berth with the assistance of three tugs. The transit of the 137,000 m^3 and 165,000 m^3 LNG vessels would be possible with the benefit of the Port's plan to widen and deepen the channel. Based on the simulation study, Moffat & Nichol made several recommendations including: adding buoys at different points to define the turning basin originally contemplated in the design; the arrival time of LNG vessels to coincide with high slack water; and support for a series of simulations to familiarize Coos Bay pilots, tractor tug operators, and vessel masters with the transit of an LNG vessel.

In March 2008, Moffat & Nichol conducted another LNG vessel maneuvering simulation study that evaluated the transit of the Coos Bay navigation channel by an LNG vessel with a capacity of 148,000 m^3 without a turning basin. Jordan Cove contracted a pilot from the Coos Bay Pilots Association to provide local waterway expertise. Jordan Cove also contracted a pilot from Lake Charles Pilots, Inc. (who routinely operate LNG vessels in the Calcasieu ship channel) to provide insight on LNG vessel behavior to the Coos Bay pilot and perform as the helmsman during the simulations. The simulations supported the conclusion that LNG vessels with a capacity of 148,000 m^3 could safely navigate to and from the terminal in the current Coos Bay navigation channel in high water conditions and without a turning basin.

A pilot would board the outgoing LNG vessel at the facility. LNG vessels would be under the pilot's control until at least five nmi outside of the sea buoy. Before departing the facility, three 80 metric ton bollard pull tractor tugs would be secured to the LNG vessel at the direction of the pilot. The three tugs would assist the LNG vessel to transit from the pier into the Coos Bay

[181] Under current Coast Guard policy, the conclusions and recommendations contained in the Waterway Suitability Report are now issued as the "Letter of Recommendation Analysis."
[182] Included as Appendix B.11 to Jordan Cove's Resource Report 11, attached to their June 2013 application to the FERC.

navigation channel. At this point, one tug would drop lines, and the remaining two tugs would assist the LNG vessel throughout its transit of the Coos Bay navigation channel through the breakwater and offshore. If conditions are deemed not appropriate to leave the facility, the LNG vessel would remain at the pier. For most deep draft vessels, a speed of 4 to 6 knots is maintained while they transit the Coos Bay navigation channel. The total distance an LNG vessel would travel from the entrance of the ship channel to the end of the jetties is approximately 1.7 nmi. LNG vessels would require a minimum depth and width in the Coos Bay navigation channel. The present channel depth and width would be acceptable for the safe transit of a nominal size/capacity 148,000 m^3 LNG vessel with the aid of high tides.

During its approximately eight-mile transit, the LNG vessel would pass by the Southwest Oregon Regional Airport and the neighborhoods of Empire, Barview, and Charleston to the east and the uninhabited North Spit to the west. The LNG vessel would cross Southwest Oregon Regional Airport's main runway designed for instrument landings. The issue of an LNG vessel passing through the flight path of the airport's main runway was discussed between Jordan Cove and the FAA airport authority during the development of the WSA. The current height limitation imposed on marine traffic in the Coos Bay navigation channel by the FAA is 137 above ground level. This equates to a height of 167 feet AMSL. The FAA indicated that as long as vessels did not exceed the maximum height of 167 feet AMSL, they would not have any objections to vessels passing through the flight path of the main runway. In its development of the WSA, Jordan Cove verified the highest height to the mast of existing LNG vessels with a capacity of 148,000 m^3 is 139 feet above mean sea level. Since the development of the WSA, newly constructed LNG vessels could exceed the 167 feet AMSL. In response to a FERC data request on July 21, 2015, Jordan Cove reviewed the global inventory of the LNG vessels that could call on the LNG terminal and all of the LNG vessels would have a maximum height of 167 AMSL or less. Jordan Cove has agreed to amend the FAA's Form 7460 to reflect the change in LNG vessel height. If the FAA agrees with this change to the height of the LNG vessels, there would no longer be a NPH pertaining to the height of LNG vessels.

Hazard Zones Associated with the Proposed Route

The only area of land that would be overlapped by Zone 1 in the LNG vessel's transit to the proposed terminal would be a small portion of the western side of Empire and a small portion of the eastern side of the uninhabited North Spit. During transit, Zone 2 would overlap portions of the neighborhoods of Charleston, Barview, and Empire to the east and most of the North Spit to the west. Near the proposed terminal, Zone 2 would overlap the Roseburg Forest Products site and a portion of the Southwest Oregon Regional Airport's main runway. During transit, Zone 3 would overlap portions of the cities of Coos Bay and North Bend.

Estimates for the number of structures and the population within the Zones of Concern were provided in sections 4.7.1.2 and 4.8.1.1 of the FEIS the FERC issued in May 2009 for the previously proposed Jordan Cove LNG import terminal in Docket No. CP07-444-000. No residential structures, hotels, or motels were identified within Zone 1 (within 1,640 feet of the waterway). There are about 11 hotels or motels, and about 5,457 residential structures, including single family homes, apartments, and mobile homes, within Zones 2 and 3 combined, between 0.3 and 2.2 miles outside of the waterway. We estimated that there are approximately 16,922 people total residing within the Zones of Concern.

4.13.6.6 Coast Guard Letter of Recommendation

The COTP Sector Portland provided the FERC with a WSR and LOR (provided on July 1, 2008 and April 24, 2009, respectively) which summarized the required safety and security measures, as well as the port community's capabilities to implement these measures.

Based on its review of the WSA and its own independent risk assessment, the Coast Guard stated its opinion that the Coos Bay navigation channel was not currently suitable, but could be made suitable, for the type and frequency of LNG marine traffic associated with the Jordan Cove LNG terminal. This opinion was contingent upon the availability of additional measures necessary to responsibly manage the maritime safety and security risks. These measures are further detailed in the WSR and LOR, and include the following recommendations:

- development of a TMP in consultation with the Coast Guard and participating agencies that would define the roles, responsibilities, and specific procedures for the LNG vessel, the LNG terminal, and the various agencies that would be responsible for managing the risks of LNG marine traffic;
- establishment of a moving safety/security zone around the LNG vessel extending 500 yards around the vessel but ending at the shoreline;
- establishment of a fixed safety/security zone of 150 yards around the LNG vessel while moored at the terminal to include the entire terminal slip. When there is no LNG vessel moored, the recommended security zone would cover the entire terminal slip and extend 25 yards into the waterway;
- restriction on the size of LNG vessels transiting to the proposed terminal to a capacity of 148,000 m^3 and restriction on the physical dimensions of a vessel to a length of 950 feet, beam of 150 feet, and a loaded draft of 40 feet until additional simulator studies are conducted to assure the sufficiency of the channel;
- restriction of LNG vessels to daylight transit for at least the first six months, unless approved in advance by the COTP Portland;
- boarding of pilots onto an inbound LNG vessel at least five miles outside the sea buoy;
- coordination of inbound and outbound transit details with the Coast Guard, FBI, Coos Bay Pilot Association, Escort Tug Masters, and other escort assets at least 24 hours prior to an LNG vessel's arrival;
- establishment of an automatic identification system that can be monitored by appropriate agencies, port authorities, and vessel companies;
- presence of two tractor tugs with at least 80-ton bollard pull to assist in the transit of LNG marine traffic to the terminal;
- presence of one tractor tug with at least 80-ton bollard pull to assist with turning and mooring of LNG vessels at the terminal;
- addition of four aids to navigation and the relocation of eight current aids to navigation in the Coos Bay navigational channel;
- installation of a Physical Oceanographic Real-Time System contracted with NOAA to supply real time river levels, currents, and wind data;
- simulator training for pilots and tug operators identified as having responsibility for LNG marine traffic prior to the arrival of the first LNG vessel;
- augmentation of emergency response planning resources to develop procedures and protocols as well as continuously update the plans as conditions change;

- pre-arrival inspection and transfer monitoring of the LNG vessels and facility;
- annual Coast Guard inspections of the LNG vessels and the facility;
- augmentation of firefighting capabilities at the facility and along the transit route;
- adequate means to notify the public along the transit route, including on-going public education, emergency notification systems, and drills and training. Education programs should meet the needs of all users of the waterway, including commercial and recreational boaters, local businesses, local residents, and tourists;
- adequate means of gas detection along the transit route and at the facility; and
- restriction on the size of LNG vessels transiting to the Project site to a capacity of 148,000 m^3 until a completed site-specific risk analysis for larger vessels is approved by the COTP Portland.

On February 21, 2012, in response to Jordan Cove's annual update to the WSA for the import project, the Coast Guard issued a letter stating that examination of the proposed export facility operations could be handled through future annual WSA updates. The current Letter of Intent, the Emergency Response Plan, the Operations Manual, and the Facility Security Plan would need to be amended to include export operations. In addition, the Coast Guard recommended that waterway impacts associated with the export project should not change from those set forth in the original import project EIS and WSA. In the 2012 annual update to the WSA, Jordan Cove included changes to reflect the export facility. At that time, Jordan Cove also changed the LOI to reflect the export facility.

Under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA, and the Safety and Accountability For Every Port Act, the COTP has the authority to prohibit LNG transfer or LNG vessel movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port, or marine environment. If this Project is approved and if appropriate resources are not in place prior to LNG vessel movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations. Therefore, **we recommend that:**

- **<u>Prior to commencement of service</u>, Jordan Cove should receive written authorization from the Director of OEP. Prior to issuing such authorization, the Director of OEP would consult with the Coast Guard COTP to confirm that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Jordan Cove or other appropriate parties.**

4.13.7 Emergency Response

Prior to commencing service, Jordan Cove would be required to prepare final emergency procedure manuals, as required by 49 CFR 193.2509, that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, section 193.2509(b)(3) requires, "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…"

While the worst-case scenarios evaluated for the onshore facility in section 4.13.5.3 and for marine spills in section 4.13.6.5 provide guidance on the maximum extent of potential hazards, they should not be assumed to represent the evacuation zone for every potential incident. As with any other fuel or hazardous material, the actual severity of the incident would determine what area needs to be evacuated, if any, rather than a worst-case maximum zone. It is anticipated that the emergency evacuation plans would identify evacuation distances based upon increasing severity of events. The Emergency Response Plan would include provisions for a tsunami event.

The U.S.C.[183] stipulates that in any Order authorizing an LNG terminal, the Commission shall require the LNG terminal operator to develop an Emergency Response Plan in consultation with the Coast Guard and state and local agencies. The FERC must approve the Emergency Response Plan prior to any final approval to begin construction. Therefore, **we recommend that:**

- **<u>Prior to initial site preparation</u>, Jordan Cove should file with the Secretary, for review and written approval by the Director of OEP, an Emergency Response Plan. The Emergency Response Plan should include evacuation procedures. Jordan Cove should coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state, county, and local law enforcement; and appropriate federal agencies. This plan should include at a minimum:**

  a. designated contacts with state and local emergency response agencies;

  b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

  c. procedures for notifying residents and recreational users within areas of potential hazard;

  d. evacuation routes/methods for residents and other public use areas that are within any transient hazard areas along the route of the LNG marine traffic;

  e. locations of permanent sirens and other warning devices; and

  f. an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.

  The Emergency Response Plan should include consideration of a tsunami event. Jordan Cove should notify the FERC staff of all planning meetings in advance and should report progress on the development of its Emergency Response Plan at <u>3-month intervals</u>.

On several LNG terminal proposals, a number of organizations and individuals have expressed concern that the local community would have to bear some of the cost of ensuring the security and emergency management of the LNG facility and the LNG vessels while in transit and loading at the facility. To that end, Section 3A(e) of the NGA (as amended by EPAct) specifies that the Emergency Response Plan shall include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicants agree to provide to any state and local agencies

[183] 5 U.S.C. § 717b-1 (2013), amended by Energy Policy Act of 2005, Pub. L. No. 109-58.

with responsibility for security and safety at the LNG terminal and in proximity to LNG vessels that serve the facility. Therefore, **we recommend that:**

- **<u>Prior to initial site preparation</u>, Jordan Cove should file with the Secretary, for review by the Director of OEP, a Cost-Sharing Plan to be included in its Emergency Response Plan. The Cost-Sharing Plan should identify the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Jordan Cove should notify FERC staff of all planning meetings in advance and should report progress on the development of its Cost-Sharing Plan at <u>3-month intervals</u>.**

The cost-sharing plan must specify what the LNG terminal operator would provide to cover the cost of the state and local resources required to manage the security of the LNG terminal and LNG vessel, and the state and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example patrol boats, fire-fighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The Cost-Sharing Plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each state and local agency designated to receive resources.

In 2008, the State of Oregon established the requirements for all LNG projects in Oregon. Jordan Cove signed a MOU with the State which outlines the actions, resources, and training to be provided by Jordan Cove for the Project. On March 31, 2009, Jordan Cove filed with FERC the MOU between Jordan Cove and the State of Oregon. The MOU establishes a framework for cooperation between the State of Oregon and Jordan Cove, as well as collaboration with the ODOE, the Coast Guard, the Coos County Sheriff's Department, the Coos Bay and North Bend Police and Fire Departments, and the North Bay and Charleston Fire Departments. The document outlines the responsibilities of Jordan Cove and the State of Oregon with respect to the safety and security of the terminal, including the resources and financing that Jordan Cove would provide to other entities for safety and security services. In the MOU, Jordan Cove has agreed to provide personnel, training, and money to ensure that the necessary safety and security resources would be available and operational prior to operation of the terminal. The 2009 agreement was replaced and superseded by a revised MOU on LNG emergency preparedness for the export terminal signed on June 10, 2014 between ODE and Jordan Cove.[184] Also on June 10, 2014, ODE entered into a MOU with Jordan Cove regarding adherence to the state's CO_2 standards and retirement of the facilities.

[184] The new MOU was filed by Jordan Cove with the FERC on July 1, 2014 in Docket No. CP13-483-000.

4.13.8 Conclusions on Facility Reliability and Safety

As part of the NEPA review, Commission staff must assess whether the proposed facilities would be able to operate safely and securely. As a result of our technical review of the preliminary engineering design, we have made a number of recommendations to be implemented prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the facility to enhance the reliability and safety of the facility and to mitigate the risk of impact to the public. Based on our analysis and recommended mitigation, we believe that the facility design proposed by Jordan Cove includes acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

As a cooperating agency, DOT assisted FERC staff in evaluating whether Jordan Cove's proposed design would meet the DOT siting requirements. DOT reviewed the data and methodology Jordan Cove used to determine the design spills from various leakage sources, including piping, containers, and equipment containing hazardous liquids. Jordan Cove used those design spills to model hazardous releases. On June 18, 2014, DOT provided a letter to the FERC staff stating that DOT had no objection to Jordan Cove's methodology for determining the single accidental leakage sources for candidate design spills to be used in establishing the Part 193 siting requirements for the proposed LNG liquefaction facilities. Based on the hazardous area calculations we reviewed, we conclude that potential hazards from the siting of the facility at this location would not have a significant impact on public safety. The areas impacted by these design spills also appear to meet the DOT's exclusion zone requirements by either being within the facility property boundary, within land controlled by Jordan Cove, or over a navigable body of water. If the facility is constructed and becomes operational, the facility would be subject to DOT's inspection and enforcement program. Final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by DOT staff.

As a cooperating agency, the Coast Guard analyzed the suitability of the waterway for LNG marine traffic. Based on its review and its own independent risk assessment, the Coast Guard has determined that the waterway could be made suitable for the type and frequency of LNG marine traffic associated with the proposed Jordan Cove LNG facility. This opinion was contingent upon the availability of additional measures necessary to responsibly manage the maritime safety and security risks. However, the strategies and risk mitigation measures referenced in the LOR should not be perceived as being prescribed conditions by the Coast Guard. Under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act of 2002, and the Safety and Accountability For Every Port Act, the COTP has the authority to prohibit LNG transfer or LNG vessel movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port or marine environment. If appropriate resources are not in place prior to LNG vessel movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

4.13.9 Pipeline Facilities

The transportation of natural gas by pipeline involves some risk to the public in the event of an accident and subsequent release of gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiate, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death.

Methane has an ignition temperature of 1,000ºF and is flammable at concentrations between 5 and 15 percent in air. Unconfined mixtures of methane in air are not explosive. However, a flammable concentration within an enclosed space in the presence of an ignition source can explode. Methane is buoyant at atmospheric temperatures and disperses rapidly in air.

4.13.9.1 Safety Standards

The DOT is mandated to provide pipeline safety under 49 U.S.C. § 601. The PHMSA Office of Pipeline Safety (OPS) administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. The PHMSA ensures that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level. Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and monitoring functions. A state may also act as the DOT's agent to inspect interstate facilities within its boundaries; however, the DOT is responsible for enforcement action. The majority of the states have either 5(a) certifications or 5(b) agreements, while nine states act as interstate agents.

The DOT pipeline standards are published in 49 CFR Parts 190-199. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues.

Under an MOU on natural gas transportation facilities dated January 15, 1993, between the DOT and the FERC, the DOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or shall certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards other than the DOT standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the MOU to promptly alert the DOT. The MOU also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipeline under the Commission's jurisdiction.

The FERC also participates as a member of the DOT's Technical Pipeline Safety Standards Committee, which determines if proposed safety regulations are reasonable, feasible, and practicable.

The Pacific Connector pipeline and aboveground facilities must be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards in 49 CFR Part 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. Part 192 specifies material selection and qualification, minimum design requirements, and protection from internal, external, and atmospheric corrosion.

We received comments requesting that unified safety standards be applied across the entire pipeline route. However, Part 192 defines area classifications, based on population density in the vicinity of the pipeline, and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are defined as follows:

- Class 1 – Location with 10 or fewer buildings intended for human occupancy;
- Class 2 – Location with more than 10 but less than 46 buildings intended for human occupancy;
- Class 3 – Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days per week for 10 weeks in any 12-month period; and
- Class 4 – Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated (solid) rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock.

Class locations also specify the maximum distance to a sectionalizing block valve. Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure, inspection and testing of welds and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. Class locations by MP are listed in table 4.13.9.1-1.

TABLE 4.13.9.1-1

DOT Class Locations for the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Class Location
1.5R	9.9	1
9.9	11.1	2
11.1	55.7	1
55.7	57.8	2
57.8	65.6	1
65.6	66.6	2

TABLE 4.13.9.1-1

DOT Class Locations for the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Class Location
66.6	94.6	1
94.6	95.0	2
95.0	121.9	1
121.9	123.1	2
123.1	132.3	1
132.3	133.5	2
133.5	190.3	1
190.3	191.3	2
191.3	197.5	1
197.5	197.9	3
197.9	198.2	1
198.2	198.6	3
198.6	210.5	1
210.5	210.8	3
210.8	228.1	1

If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, Pacific Connector would be required to reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if applicable, to comply with the DOT code of regulations for the new class location.

In 2002, Congress passed an act to strengthen the nation's pipeline safety laws. The Pipeline Safety Improvement Act of 2002 (HR 3609) was passed by Congress on November 15, 2002, and signed into law by the President in December 2002. As of December 17, 2004, gas transmission operators must develop and follow a written integrity management program that contains all the elements described in §192.911 and addresses the risks on each covered transmission pipeline segment. Specifically, the law establishes an integrity management program which applies to all high consequence areas (HCAs). The DOT (68 FR 69778, 69 FR 18228, and 69 FR 29903) defines HCAs as they relate to the different class zones, potential impact circles, or areas containing an identified site as defined in §192.903 of the DOT regulations.

The OPS published a series of rules from August 6, 2002 to May 26, 2004 (69 Federal Register 29903), that defines HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate in 49 USC 60109 for the OPS to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area.

The HCAs may be defined in one of two ways. In the first method, an HCA includes:

- current Class 3 and 4 locations,

- any area in Class 1 or 2 where the potential impact radius[185] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle,[186] or
- any area in Class 1 or 2 where the potential impact circle includes an identified site.[187]

In the second method, an HCA includes any area within a potential impact circle which contains:

- 20 or more buildings intended for human occupancy, or
- an identified site.

Once a pipeline operator has determined the HCAs on its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. The DOT regulations specify the requirements for the integrity management plan at § 192.911. Pacific Connector has identified three Class 3 locations or HCAs that are crossed by or adjacent to the proposed pipeline route (see table 4.13.9.1-2). The pipeline integrity management rule for HCAs requires inspection of the entire pipeline in HCAs every 7 years.

TABLE 4.13.9.1-2

DOT Class 3 Locations and High Consequence Areas Crossed by and Adjacent to the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Criteria
122.3	123.0	Vicinity to Oregon Trail
197.2	198.9	Vicinity to Collins Lumber Mill
210.3	211.0	Vicinity to Wong Potatoes

Part 192 prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under section 192.615, each pipeline operator must also establish an ERP that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;
- emergency shutdown of system and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property, and making them safe from actual or potential hazards.

[185] The potential impact radius is calculated as the product of 0.69 and the square root of the MAOP of the pipeline in psi multiplied by the pipeline diameter in inches.
[186] The potential impact circle is a circle of radius equal to the potential impact radius.
[187] An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days per week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Pacific Connector would provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment would be required to handle pipeline emergencies.

Pipeline system emergencies can include gas leaks, fire or explosion, and/or damage to the pipeline and aboveground facilities. Pacific Connector would maintain 24-hour emergency response capabilities, including an emergency-only phone number, which accepts collect charges. The number would be included in informational mail-outs, posted on all pipeline markers (installed at public road crossings), and provided to local emergency agencies in the vicinity of the pipeline and compressor station.

As part of Pacific Connector's ERP, operations personnel would attend training for emergency response procedures and plans prior to commencing pipeline operations. Pacific Connector would meet with local emergency responder groups (fire departments, police departments, land-managing agencies including the BLM, Forest Service, and Reclamation, and other public officials) to review plans and would work with these groups to communicate the specifics about the pipeline facilities in the area and the need for emergency response. Pacific Connector would also meet periodically with the groups to review the plans and revise them when necessary. If requested by local public emergency response personnel, Pacific Connector would participate in any operator-simulated emergency exercises and post-exercise critiques. Pacific Connector would use adequate local or contract resources to support the pipeline and facilities if an emergency occurs.

All of the information that Pacific Connector gathers about its system would be used to tailor its safety and integrity management activities, so that parts of the system in the greatest need of attention receive greater scrutiny, such as residential areas or areas subject to growth and development. For example, Pacific Connector would decide where and when to internally inspect the pipeline based on this information. Risk assessment of the pipeline system determines what inspection criteria are required. This may include many different types of assessment tools that provide specific types of information about the condition of the pipeline.

The Klamath Compressor Station would also be equipped with automatic emergency detection and shut down systems. For example, the station would have hazardous gas and fire detection systems, and an emergency shutdown system. These safety and emergency systems would be tested routinely to ensure they are operating properly. The emergency shutdown system would be designed to shut down and isolate elements of the compressor station in the event of a fire, before the development of a flammable mixture of gas could occur. The system would include sensors for detecting natural gas concentrations as well as ultraviolet sensors for detecting flames. Additionally, the compressor station equipment would be designed to shut down automatically if a mechanical failure poses risk to the equipment or otherwise constitutes a hazard. The compressor station would be equipped with relief valves to protect the piping from over pressurization.

Personnel would be able to respond to a compressor station emergency in 60 minutes or less during non-scheduled work hours and within a few minutes if they are at the compressor station. Personnel would be on call at all times, 24 hours a day, 365 days a year to respond to emergencies. Emergencies while the compressor station is unattended would be monitored remotely via Williams Pacific Operator's Gas Control Facility in Salt Lake City, Utah. Personnel living within a 30 minute travel time of the compressor station would be dispatched by the gas control facility in the event of an emergency at the compressor station.

Personnel would be Operator Qualified per DOT PHMSA requirements for operational and emergency situations at the station. Fire protection, first aid, and safety equipment would be maintained at the compressor station and Williams Pacific Operator personnel would be trained in first aid and proper equipment use.

The Pacific Connector pipeline would cross areas subject to ongoing and future land management activities on federal lands managed by BLM, Forest Service, and Reclamation. Pacific Connector would be required to prepare a POD for activities on these federal lands that also addresses other safety and reliability measures requested by the BLM, Forest Service, and Reclamation. The BLM, Forest Service, and Reclamation would review and approve draft plans to ensure all safety concerns associated with construction and operation of the proposed Pacific Connector pipeline on federally managed lands are addressed.

Pipeline Standards to Minimize Fire Risk to Forest Lands

The Pacific Connector pipeline would be in areas where forest fires could occur. Pacific Connector proposes to meet or exceed DOT pipeline burial depth requirements (found in 49 CFR Part 192), and would install the Pacific Connector pipeline with at least 36 inches of cover in Class I locations with normal soils and at least 24 inches of cover in consolidated rock areas.

Pursuant to 49 CFR 192.615, each pipeline operator must also develop an ERP that includes procedures to minimize the hazards in the event of a natural gas pipeline emergency. The key elements of the required plan include establishing and maintaining communications with local fire officials and coordinating emergency response, emergency shutdown of the system and safe restoration of service, making personnel, equipment, tools, and materials available at the scene of an emergency, and protecting people and property from hazards. Part 192 specifically requires that each pipeline operator establish and maintain liaison with appropriate fire officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and must coordinate mutual assistance. The previous discussion in section 4.13.9.1 describes the specific emergency response capabilities of the Project, including maintenance by Pacific Connector of 24-hour emergency response capabilities.

In addition, in compliance with the federal requirements discussed above, Pacific Connector must develop an ERP for the entire system. A draft ERP was included as Appendix G to the POD. The ERP requires operations personnel to attend training for emergency response procedures and requires the pipeline operators to meet with local emergency responder groups, including fire departments, to review plans and educate the responder groups on the specific of the pipeline facilities within the relevant service area. After the initial coordination with local responders, Pacific Connector would also meet periodically with the groups to review plans and revise them when necessary. Finally, if requested by local response personnel, Pacific Connector would participate in any simulated emergency exercises and post-exercise critiques. Through

these coordination activities, the fire response personnel would become familiar with the location and specific safety and fire issues associated with the pipeline. This information would significantly reduce risks to the fire response personnel responding to a fire either caused by or in the vicinity of the pipeline alignment. The majority of the training costs would be borne by Pacific Connector; therefore, the coordination requirements would not significantly increase fire suppression costs.

In the event a fire was to occur on the surface in the vicinity of the pipeline, the presence of the pipeline would not increase fire hazards. Fires on the surface are not a direct threat to underground natural gas pipelines because of the insulating effects of soil cover over the pipeline. Soil is a poor conductor of heat with thermal conductivity values ranging from 0.44 to 1.44 Btu/ft-hr-°F. The heat capacity of most soils is 0.20 to 0.25 Btu/lb-°F. In one study, soil temperature from intense slash pile burns reached a maximum of only about 50°C (122°F) at a depth of about 24 inches directly under the burn piles (Massman et al. 2008). Based on the proposed burial depth of 24 to 36 inches, and the insulating effects of soil cover over the pipeline, we do not believe that forest fires would affect pipeline integrity. In addition, we do not believe that additional burial depth beyond what is proposed by Pacific Connector would be necessary to protect against damage by forest fires.

In the event that a fire were to occur in forest lands in the vicinity of, or including the pipeline easement, Pacific Connector would take an active role in the emergency response in coordination with the local fire response personnel. Within forested areas, the local fire personnel would take on fire suppression and control duties similar to conventional forest fire situations. Local fire departments within forested areas are already trained and equipped to fight forest fires using conventional techniques and equipment. Pacific Connector would provide personnel knowledgeable with the pipeline to cooperatively work with fire responders to confirm the location of the pipeline easement, depth of ground cover and any precautionary measures to be undertaken if crossing the pipeline with heavy load bearing equipment or vehicles. Therefore, the presence of the pipeline would not interfere with fire suppression efforts, or require the local fire departments to purchase any new or specialized equipment. The presence of the pipeline would also not require local fire departments to hire additional personnel.

Pacific Connector has also developed a *Fire Prevention and Suppression Plan*, which is provided as Appendix K to the POD. This plan is consistent with Forest Service and BLM policies and current practices. Although designed for federal lands, it would be applicable to the entire pipeline route; regardless of landownership. The intent of the plan is to identify measures to minimize the chances of a fire starting and spreading from project facilities and to reduce the risk of wildland and structural fire.

4.13.9.2 Pipeline Accident Data

The DOT requires all operators of natural gas transmission pipelines to notify the DOT of any significant incident and to submit a report within 20 days. Significant incidents are defined as any leaks that:

- caused a death or personal injury requiring hospitalization; or

- involve property damage of more than $50,000 (1984 dollars[188]).

During the 20-year period from 1993 through 2012, a total of 1,217 significant incidents were reported on the more than 300,000 total miles of natural gas transmission pipelines nationwide.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.13.9.2-1 provides a distribution of the causal factors as well as the number of each incident by cause.

TABLE 4.13.9.2-1

Natural Gas Transmission Pipeline Serious Incidents by Cause (1994–2013) a/

Cause	No. of Incidents	Percentage
Corrosion	292	23.6
Excavation b/	211	17.0
Pipeline material, weld or equipment failure	304	24.6
Natural force damage	142	11.5
Outside force c/	74	6.0
Incorrect operation	33	2.7
All other causes d/	81	14.6
Total	**1,237**	**100**

a/ All data gathered from PHMSA Serious incident files, February 28, 2013. http://primis.phmsa.dot.gov/comm/reports/safety/
b/ Includes third party damage
c/ Fire, explosion, vehicle damage, previous damage, intentional damage
d/ Miscellaneous causes or unknown causes

The dominant causes of pipeline incidents are corrosion and pipeline material, weld or equipment failure constituting 48.2 percent of all significant incidents. The pipelines included in the data set in table 4.13.9.2-1 vary widely in terms of age, diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

The frequency of significant incidents is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents, since corrosion is a time-dependent process. The use of both an external protective coating and a cathodic protection system[189], required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe.

Outside forces are the cause in 34.5 percent of significant pipeline incidents. These result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipelines contain a disproportionate number of smaller-diameter pipelines; which have a greater rate of outside forces incidents. Small diameter pipelines are more easily crushed or broken by

[188] $50,000 in 1984 dollars is approximately $115,000 based on the September 2014 Consumer Price Index.
[189] Cathodic protection is a technique to reduce corrosion (rust) of the natural gas pipeline through the use of an induced current or a sacrificial anode (like zinc) that corrodes at faster rate to reduce corrosion.

mechanical equipment or earth movement. Table 4.13.9.2-2 shows the various causes of outside force incidents.

TABLE 4.13.9.2-2

Outside Forces Incidents by Cause (1994-2013) a/

Cause	No. of Incidents	Percent of all Incidents
Third-party excavation damage	176	14.2
Operator excavation damage	25	2.0
Unspecified excavation damage/previous damage	10	0.8
Heavy rain/floods	72	5.8
Earth movement	35	2.8
Lightning/temperature/high winds	21	1.7
Natural force (other)	14	1.1
Vehicle (not engaged with excavation)	45	3.6
Fire/explosion	8	0.6
Previous mechanical damage	5	0.4
Fishing or maritime activity	7	0.6
Intentional damage	1	0.1
Electrical arcing from other equipment/facility	1	0.1
Unspecified/other outside force	7	0.6
Total	**427**	**–**

a/ Excavation, Outside Force, and Natural Force.

Since 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies (e.g., oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts.

4.13.9.3 Impact on Public Safety

Pipeline Construction

The Forest Service has expressed concern about public safety during construction of the Pacific Connector pipeline. Active pipeline construction can increase safety risks to the public generally in two ways, from an increase of traffic on roadways in the vicinity of the pipeline, and from potential exposure to construction activity itself within the construction right-of-way.

During periods of active construction, roadways in the vicinity of the pipeline project would experience an increase in small vehicle traffic from the construction work force, as well as large vehicle traffic transporting construction equipment and materials. Where the pipeline would cross roadways, access to and from the right-of-way by construction vehicles and construction activity itself at the roadway crossing could disrupt traffic and create potential safety hazards to the public. Pacific Connector has developed Transportation Plans for both private and federal lands that describe measures that it would implement to minimize public access and safety concerns as a result of construction vehicle traffic and construction activity at roadway crossings (see additional discussion in section 4.10). In addition, Pacific Connector would obtain all necessary permits for public roadway crossings and roadway use, and would comply with traffic control and public safety mitigation measures that are conditions of these permits.

During pipeline construction, the general public could be exposed to safety hazards within the pipeline construction right-of-way itself. Hazards would be typical of a construction site involving clearing, grading, and excavation, and could include timber felling, heavy equipment operation including on steep slopes, open trench, falling or rolling rock on steep slopes, and fly rock from blasting. During active construction the contractor and company personnel present on the job would limit access to the public to potentially hazardous situations such as operation of heavy equipment, or blasting for trench excavation. During construction off hours, the public could be exposed to hazards such open trench or loose rock. Locating the pipeline in non-populated areas helps to minimize the chance for unauthorized public access to the right-of-way.

Where the pipeline would be placed within residential areas, Pacific Connector would minimize impacts and potential safety hazards by ensuring that the construction proceeds quickly through such areas. Where the construction work area would be within 50 feet of a residence, Pacific Connector would install safety fence along the edge of the work area for a distance of 100 feet on either side of the residence. Fencing would be maintained, at a minimum, throughout the open trench phases of pipeline installation. Where feasible, Pacific Connector has reduced the width of the construction right-of-way near residences and placed TEWAs as far as practicable from the residences. In residential areas Pacific Connector would also limit the period of time the trench remains open prior to backfilling. For the residences within 50 feet of the proposed right-of-way, Pacific Connector has developed site-specific plans showing the temporary and permanent rights-of-way and noting special construction techniques and mitigation measures.

The BLM, Forest Service, and Reclamation can require Pacific Connector to incorporate additional specific public safety measures into the POD as a condition of a Right-of-Way Grant for use of federal lands.

Pipeline Operation

During pipeline operation Pacific Connector would comply with the DOT pipeline safety standards as well as regular monitoring and testing of the pipeline. While pipeline failures are rare, the potential for pipeline systems to rupture and the risk to nearby residents is discussed below.

The serious incidents data summarized in table 4.13.9.2-1 include pipeline failures of all magnitudes with widely varying consequences. Table 4.13.9.3-1 presents the average annual injuries and fatalities that occurred on natural gas transmission lines in the 5-year period between 2009 and 2013.

TABLE 4.13.9.3-1

Injuries and Fatalities – Natural Gas Transmission Pipelines

Year	Injuries	Fatalities
2009	11	0
2010 a/	61	10
2011	1	0
2012	7	0
2013	2	0

a/ All of the public injuries and fatalities in 2010 were due to the Pacific Gas and Electric pipeline rupture and fire in San Bruno, California on September 9, 2010.

The majority of fatalities from pipelines are due to local distribution pipelines not regulated by FERC. These are natural gas pipelines that distribute natural gas to homes and businesses after transportation through interstate natural gas transmission pipelines. In general, these distribution lines are smaller diameter pipes and/or plastic pipes which are more susceptible to damage. Local distribution systems do not have large rights-of-way and pipeline markers common to the FERC regulated natural gas transmission pipelines.

The nationwide totals of accidental fatalities from various anthropogenic and natural hazards are listed in table 4.13.9.3-2 to provide a relative measure of the industry-wide safety of natural gas transmission pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories. The data nonetheless indicate a low risk of death due to incidents involving natural gas transmission pipelines compared to the other categories. Furthermore, the fatality rate is much lower than the fatalities from natural hazards such as lightning, tornados, or floods.

TABLE 4.13.9.3-2

Accidental Deaths by Cause

Type of Accident	Number of Fatalities a/
All injuries (unintentional)	123,706
Motor vehicle accident	42,031
Poisoning (unintentional)	29,846
Falls (unintentional)	22,631
Suffocation (unintentional)	5,997
Drowning (unintentional)	3,443
Fire/flame (unintentional)	3,286
Floods b/	89
Lightning b/	54
Tractor Turnovers c/	62
Natural gas distribution lines d/	14
Natural gas transmission pipelines d/	2

a/ All data, unless otherwise noted, reflect 2005 statistics from U.S. Census Bureau (2009).
b/ NOAA National Weather Service, Office of Climate, Water and Weather Services, 30 year average (1982-2011) http://www.weather.gov/om/hazstats.shtml.
c/ Bureau of Labor Statistics, 2007 Census of Occupational Injuries.
d/ PHMSA significant incident files, March 25, 2014. http://primis.phmsa.dot.gov/comm/reports/safety/, 20-year average.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1994 to 2013, there were an average of 62 significant incidents, 10 injuries, and 2 fatalities per year. The number of significant incidents over the more than 303,000 miles of natural gas transmission lines in service indicates that the risk is low for an incident at any given location. The operation of the Pacific Connector pipeline would represent a slight increase in risk to the nearby public.

4.14 CUMULATIVE EFFECTS

4.14.1 Introduction

Cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions" (40 CFR Part 1508.7). This section presents a discussion of the potential cumulative effects associated with the JCE & PCGP Project and includes:

- the basis for the assessment, including the regulatory framework, the list of potentially relevant actions, and the process and criteria used in selecting relevant actions for this evaluation;
- the potential cumulative effects associated with the proposed action when considered together with the relevant past, present, and reasonably foreseeable actions; and
- the conclusions reached in this evaluation.

Based on the regulatory framework, the assessment area, and the issues raised during scoping, a cumulative impact analysis was conducted for the resources analyzed in sections 4.1 through 4.12. The conclusions reached in each of those analyses are presented here. This chapter also addresses the cumulative effects of mitigation projects associated with the BLM and Forest Service LMP amendments.

4.14.2 Basis for Assessment

4.14.2.1 Regulatory Framework

This evaluation of potential cumulative effects is consistent with the following regulations and guidance:

- CEQ *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 CFR Part 1500-1508, 1978 as amended) (CEQ 1986);
- EPA's *Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act* (40 CFR Part 6 [2009]);
- CEQ's *Considering Cumulative Effects under the National Environmental Policy Act* (January 1997) (CEQ 1997b); and
- EPA's *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*, EPA 315-R-99-002 (May 1999).

4.14.2.2 Past Actions That Contributed to the Current Environmental Setting

Existing environmental conditions in the project area (generally including the watersheds crossed by the Pacific Connector pipeline route) reflect extensive changes to natural resources brought about by past human activities. For example, Native Americans have resided in Oregon for many thousands of years and their activities have modified the environment, such as using fire to burn brush and create meadows.

In 1850, there were about 432,808 acres of farmland in Oregon. By 1954, that increased to 21 million acres. The number of farms in the state peaked at 65,000 by 1935. In 2007, 16.4 million acres in Oregon were used for agriculture, with 38,553 farms (Ballard 1959; Sorte et al. 2011). Table

4.14.2.2-1 shows the number of farms and farm acres in the counties crossed by the Project. Farming activities have modified the environment through land clearing and planting of non-native species.

TABLE 4.14.2.2-1

Farms in the Counties Crossed by the Project

County	Number of Farms	Land in Farms (acres)
Coos	746	145,675
Douglas	2,095	396,984
Jackson	1,976	244,055
Klamath	1,207	675,127
Four County Total	**6,024**	**1,461,841**

Source: U.S. Department of Agriculture National Agricultural Statistics Service (2009)

Small agricultural villages evolved into market centers after they were connected by roads and railroads. By 1920, half of the state's population was considered to be urban. In 2009, about 560,000 acres of non-federal land was urban, and 1.3 million acres was in low-density residential use in Oregon (Letterman 2013).

Oregon has lost an estimated 38 percent of its original wetlands (Morlan 2000). Most Oregon estuaries have been significantly altered historically, mostly through the diking and draining of marshes in the early to mid-1900s for agricultural use, and urban development. Between 1870 and 1970, tidal wetlands within the Coos Bay estuary decreased an estimated 66 percent (Oregon Progress Board 2009).

Cutting of forests in the region began with Euro-American settlement. Initially, forests in the valley floors were cleared to make way for agriculture. Lowland areas close to population centers were logged first, followed eventually by less accessible areas in more mountainous terrain.

Shortly after World War II, improvements in the gas-powered chain saw and transportation led to increased logging in the Pacific Northwest, with a shift to timber sales on federal lands. There was a boom in demand for wood products during the 1950s and 1960s, with a post-war need for framing lumber and plywood for new housing. More than 70 plywood plants opened in Oregon between 1940 and 1960, including plants in North Bend, Coos Bay, and Coquille. As timber was removed from private lands, a greater percent was cut on federal lands. In 1952, western Oregon's peak year for cutting timber, about one-third of the 10.4 billion board feet harvested came from federal lands. By 1963, more timber was cut on federal than private lands.

In 1994, the NWFP was developed, which protected up to 80 percent of the remaining old-growth forest on federal lands and set a cap of harvest at 1.2 billion board feet, down 70 percent from 1970s levels. In Oregon, about 10.5 million acres of non-federal land was forested in 2009. This is down less than 2 percent from the amount of non-federal forested land in 1979 (Letterman 2013).

As a result of over a century of logging and fire control, the forests of the Pacific Northwest presently consist of a fragmented mosaic of recent clearcuts, thinned stands, and young plantations interspersed with uncut natural stands. The remaining natural stands range from 1,000-year-old or older forests with large trees to relatively young, even-aged stands that have regenerated following wildfires. Because wildfires and windstorms often killed only some of the trees in a stand, natural stands are frequently characterized by a mixture of trees that survived a catastrophic event and

younger trees that filled in the understory after the event. Where many large old trees remain in the overstory, these stands are usually referred to as "old growth," "late successional," or "ancient" forests (FEMAT 1993). Where only scattered individuals or patches of large old trees remain and the majority of the stand consists of young or mature trees, stands are referred to as "mixed age" or even "young." Mixed-age stands are particularly common in some areas, such as the Oregon Coast Range, where extensive fires occurred in the 1800s. Species associated with or dependent on these late-successional and old-growth forests, such as the NSO and MAMU, have been negatively impacted by habitat loss (see section 4.7 of this EIS).

Today, Oregon's environment reflects a mixture of natural processes and human influences across a range of conditions, from areas defined by relatively natural structures and functions to areas completely dominated by human activities (Oregon Progress Board 2000) and federal lands are managed primarily for aquatic and terrestrial wildlife habitats with an emphasis on hazardous forest fuels reductions. In the past decade, large, stand-replacing wild fires have been among the central issues affecting public lands in southwest Oregon. Since the inception of the NWFP in 1994, the majority of the NSO habitat loss in the region has been the result of stand-replacing wildfire.

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for not taking this approach. A catalog and analysis of all past actions would be impractical to compile. Current conditions have been affected by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Finally, the CEQ issued an interpretive memorandum on June 24, 2005, regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The cumulative effects analysis in this EIS is also consistent with the Forest Service implementing NEPA Regulations (36 CFR 220.4(f)) (July 24, 2008), which state, in part:

> *CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all*

> *individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making. (40 CFR 1508.7)*

For these reasons, this cumulative impact section recognizes past impacts as expressed by current environmental conditions as described in the previous sections of this EIS (sections 4.1 through 4.12).

4.14.2.3 Scope of the Analysis

Cumulative impacts may result when the environmental effects associated with both the temporary and permanent activities of a proposed project are added to impacts associated with other past, present, or reasonably foreseeable future projects. Although the individual impact of each separate project might not be significant, the additive or synergistic effects of multiple projects could be significant. This cumulative analysis focuses on potential impacts from the proposed Project on resource areas or issues where their incremental contribution would be potentially significant when added to the potential impacts of other actions. An action should meet the criteria below to be included in our cumulative analysis:

- affect a resource potentially affected by the proposed Project;
- cause this impact within all, or part of, the geographic project area; and
- cause this impact within all, or part of, the timespan for the potential impact from the proposed project.

For the purposes of this analysis, the temporal extent of other projects would start in the recent past and extend out for the expected duration of the impacts caused by the Project. Recent past, current, and future actions were identified through communications with federal cooperating agencies and local counties. "Reasonably foreseeable actions" are proposed projects or developments that have applied for a permit from local, state, or federal authorities or which are publicly known.

The geographic extent of the area considered in the cumulative effects analysis varies by the project and by resource. The cumulative impact analysis area for a resource may be substantially greater than the corresponding project-specific area of impact in order to consider an area large enough to encompass likely effects from other projects on the same resource. The CEQ (1997b) recommends setting the geographic scope based on the natural boundaries of the resource affected, rather than jurisdictional boundaries. For example, they suggest that the watershed is likely the appropriate geographic boundary for analyzing water quality and the airshed for analyzing air quality. We have used the fifth-field HUC or watershed as our basic analysis area for most resources. Watershed analyses were prepared at the fifth-field level by the various federal land management agencies having jurisdiction over the federal lands within the watersheds. These watershed analyses provide a description of the range of natural variability of the important physical and biological components of the watershed. The Pacific Connector pipeline route would cross 19 fifth-field watersheds (figures 4.14-1a and 4.14-1b).

Current and reasonably foreseeable projects within the 19 fifth-field watersheds crossed by the Project that may cumulatively impact resources that would be affected by construction and operation of the Project are listed in table 4.14.2.3-1. The acres of impact associated with these projects, the acres impacted by the Project, and the cumulative acres impacted are displayed by watershed in table 4.14.3-1.

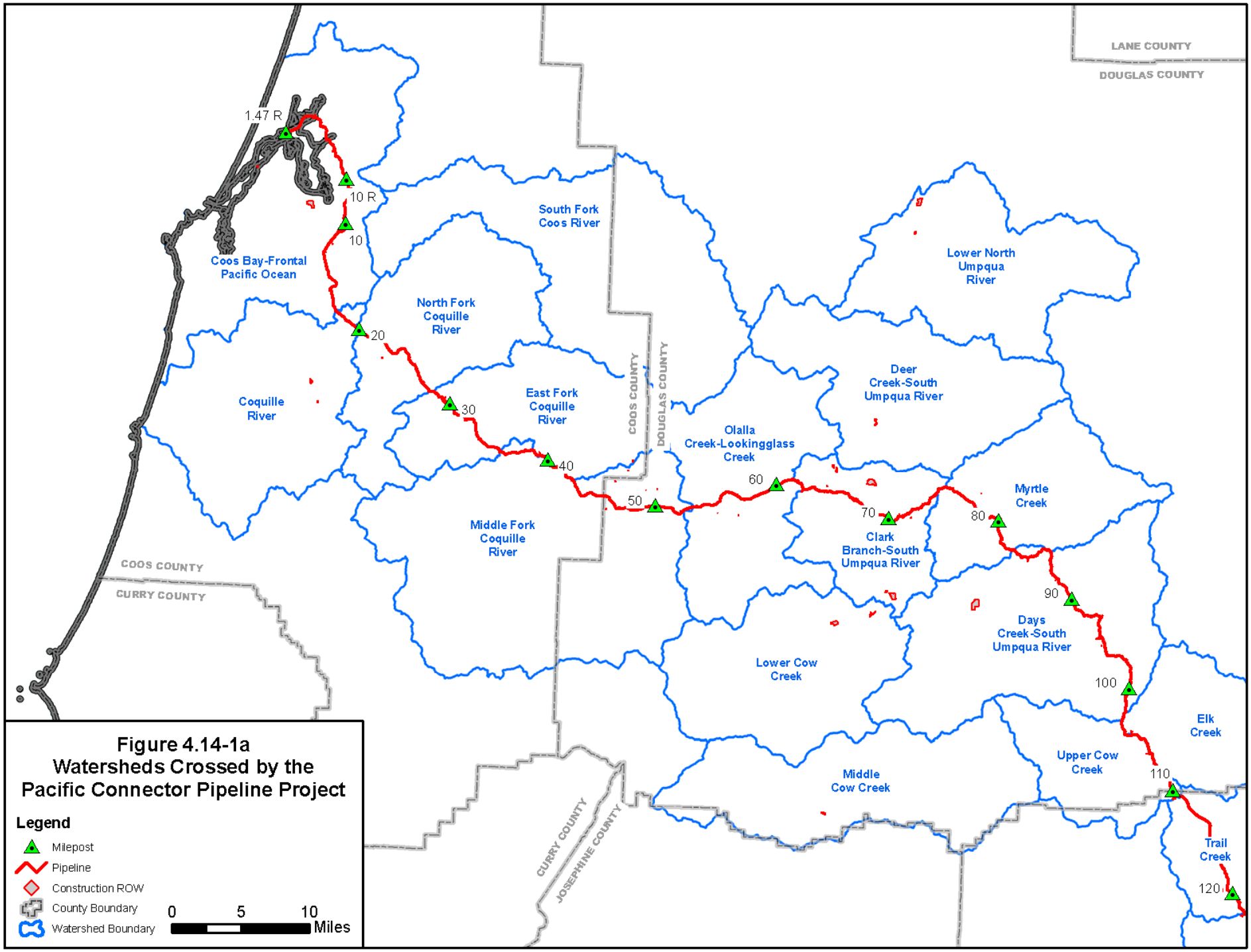


Figure 4.14-1a
Watersheds Crossed by the Pacific Connector Pipeline Project

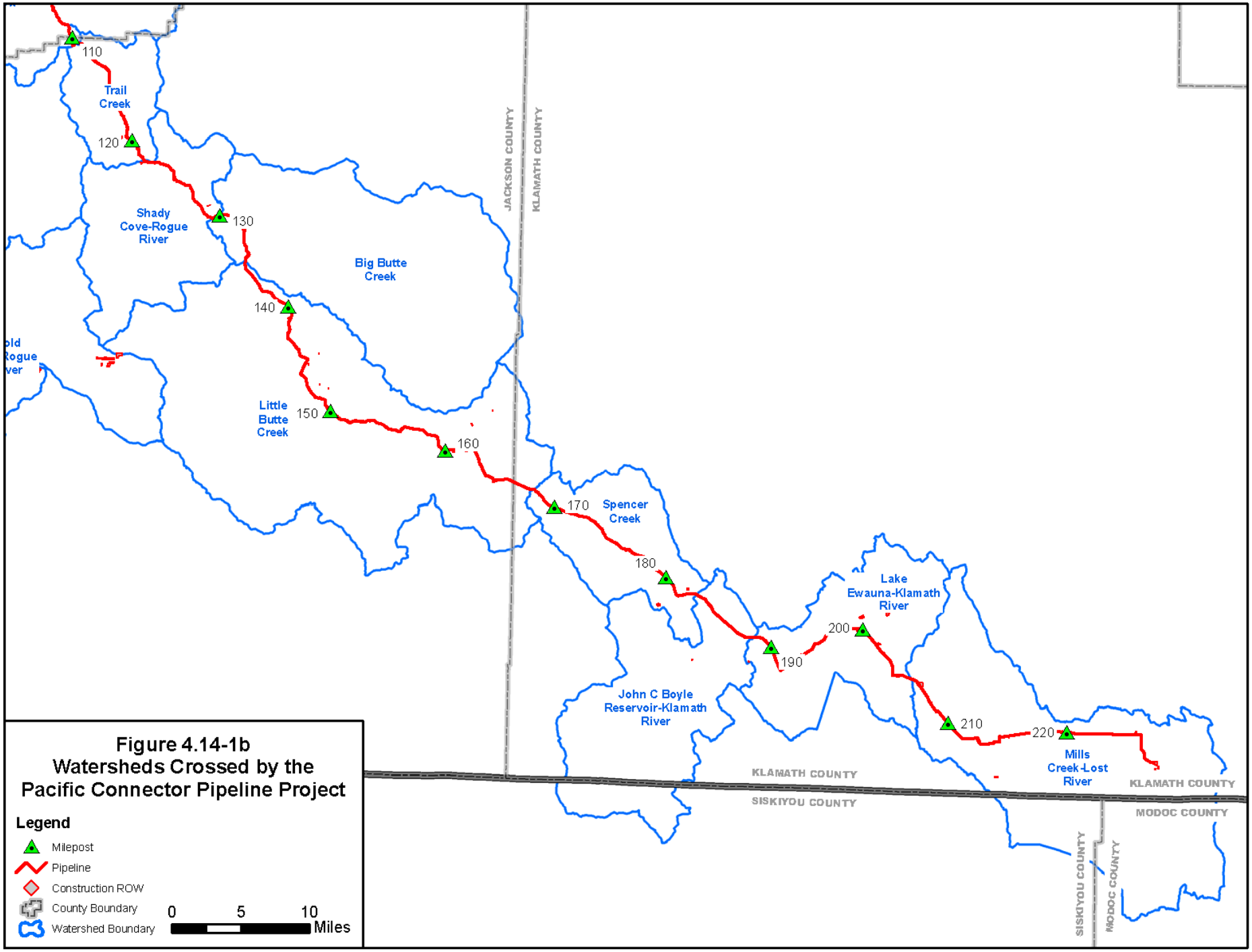


Figure 4.14-1b
Watersheds Crossed by the
Pacific Connector Pipeline Project

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
Coos Fourth-Field Watershed b/				
COE Permits and Mitigation	Wetland impacts Wetland Mitigation Stream impacts (4.0 miles) Stream restoration or enhancement (0.6 mile)	38 48 No Acre estimate No Acre estimate	Wetland Riparian Aquatic	2009-2013
Coos Bay-Frontal Pacific Ocean Watershed				
Principle Power Windfloat Pacific Demonstration Project	Principle Power proposes to deploy five floating platforms that could support wind turbines capable of generating a total of up to 30 MW. The platforms would be located in deep water in the Pacific Ocean about 15 miles offshore of Coos Bay, Oregon.	N/A	Marine	2012-unknown
Port - Coos Bay Railroad Bridge Rehabilitation, Port of Coos Bay	In February 2005, the Port completed Phase One of its rehabilitation of the railroad bridge over Coos Bay. The Port has applied for $12.7 million in Tiger III transportation grant funding for Phase Two of the project. Phase Two would consist of additional structural steel repair and replacement, application of a protective coating, and other work as needed.	N/A	Aquatic	2005-2014
Port - Trans-Pacific Parkway Realignment, Port of Coos Bay	The Port realigned portions of the Trans-Pacific Parkway on the North Spit during the planning and engineering for the North Spit Rail Spur. Construction was completed in 2010.	3	Forest, Wetland	2010
Port - North Spit Barge Slip at Southport, Port of Coos Bay	The Port partnered with Southport Forest Products to develop a multimodal barge facility with access to the North Spit Spur Railroad Line and the Trans-Pacific Parkway, and the privately-owned barge slip is now in use for intermodal cargo movements, and can handle ocean going barges able to move inbound logs, outboard wood chips, and a variety of break bulk general cargo.	1	Estuarine, Marine	2007-2013
Port - Charleston Marina Master Plan and Improvements	The Port completed an interbasin restroom; 2,400 lineal feet of curbing, sidewalks, landscaping, lighting, and storm drains to Boat Basin Road; constructed a paddlecraft launch site near the entrance to South Slough; placed utilities underground at the Charleston Shipyard; constructed a new fish cleaning station near the Charleston Marina boat launch; and partly completed paving, parking, sidewalk, curbing, and other enhancements around the Oregon Institute of Marine Biology's interpretive center.	1	Upland vegetation	2007-2014
Port - Maintenance Dredging, Port of Coos Bay	The Port is currently seeking Department of Army authorization to conduct maintenance dredging in and around the Charleston marina, shipyard, and deep water fleet mooring area as well as at 18 independent terminal locations in the Coos Bay estuary.	31	Estuarine, Marine	unknown
Port - Channel Modification	In 2007, the Port received authorization from the COE to pursue studies necessary to determine whether or not a channel modification project should be recommended to the U.S. Congress for funding.	33	Estuarine, Marine	2007-2017
COE Coos Bay Jetties Rehabilitation Project	COE Civil Works is currently investigating several repair design alternatives with the primary goal of extending the functional life of the north and south jetties and maintaining deep-draft navigation through the Coos Bay navigation channel entrance.	120	Estuarine, Marine	2015 to 2025
Coos Tribes – Cultural Museum	Planning for a village at Hollering Place, a 20-30,000 square foot hotel, convention center, and spa bordering Hollering Place Wayside in the city of Coos Bay.	1	Upland Vegetation	2015-2016

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
Coos Tribes — Tribal Gaming Facility	Casino Approximately (10,000 sq. ft.) at Ocean Grove Blvd, Coos Bay	1	Upland Vegetation	2014
City of Coos Bay – Downtown Revitalization Project	Redevelopment of four downtown buildings and the McAuley Hospital in the city of Coos Bay	1	Urban	2015
COE Coos Bay Navigation Channel Maintenance Dredging	The COE conducts annual dredging of the Coos Bay Federal Navigation channel in four areas: (1) Coos River Entrance Channel (500,000 to 1 million cubic yards [CY] removed annually from river mile [RM] -1 to 1); (2) Coos River Navigation Channel (150,000 to 300,000 CY removed annually from RM 1 to 12); (3) Coos River Navigation Channel (1 million CY removed every 5-7 years from RM 12 to 15); and (4) Charleston Access Channel (50,000 CY removed annually from the Charleston Channel). Dredged material is placed within multiple authorized and approved in-water material placement locations, including both ocean and in-bay sites.	Acres Vary by River Condition and Year	Estuarine, Marine, Aquatic	Ongoing, annually between April and November
Coos County Airport District – Southwest Oregon Regional Airport Expansion	In 2013, the Airport District prepared an update to its Airport Master Plan. The Master Plan calls for the extension of Runway 4-22 by an additional 400 feet, sometime in the near future.	1	Estuarine, Marine,	2014 - 2019
Ocean Grove Housing Development, Coos Bay	In 2013, Ocean Grove Development Group broke ground for its residential subdivision that over the next several years could include about 766 houses in the city of Coos Bay.	72	Forest, Wetland	2013-unknown
BLM – Catching Creek Conversion Timber Sale	Hardwood conversion c/ 0.4 mile temporary road construction 1.8 miles renovation.	61 (24 RR d/) 1 5	Forest, Wildlife, Riparian	2017
BLM – Wilson Creek 4 Timber Sale	Stand density management Hardwood conversion 1.0 mile temporary road construction 1.9 miles renovation	138 (34 RR d/) 119 (84 RR d/) 3 5	Forest, Wildlife, Riparian, Aquatic	2018
BLM – Whistle Stop Timber Sale	Stand density management Hardwood conversion 0.2 mile temporary road construction 0.6 miles renovation	75 (31 RR d/) 96 (45 RR d/) <1 1	Forest, Wildlife, Riparian	2018
BLM – Other CT Timber Sales	Commercial Thinning Density Management Thinning	19 (3 RR d/)	Forest, Wildlife, Riparian	2016
BLM – Whiskey Train Timber Sale	Stand density management 0.2 miles new construction 0.2 miles of improvement 0.7 miles of renovation	85 (22 RR d/) 1 1 2	Forest, Wildlife, Riparian	Ongoing (sold 2013)

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
BLM – Pathfinder Timber Sale	Stand density management 0.1 miles new construction 0.1 miles of improvement 0.1 miles of renovation	42 (34 RR d/) 1 1 1	Forest Wildlife Riparian	Ongoing (sold 2013)
Coquille Fourth-Field Watershed /b				
COE Permits	Wetland impacts Wetland Stream impacts (20.5 miles)	7 No Acre estimate	Wetland Riparian Aquatic	2009-2013
Coquille (Middle Main) Watershed				
BLM – Calloway Creek Timber Sale	Stand density management Hardwood conversion 2.2 miles temporary road construction, 1.1 miles road improvement, and 1.7 miles renovation	265 (110 RR d/) 127 (56 RR d/) 6 7	Forest, Wildlife, Riparian,	2018
BLM – Whistle Stop Conversion Timber Sale	Hardwood conversion 0.2 mile road renovation	2 (1 RR d/) <1	Forest, Wildlife, Riparian	2017
BLM – Hungry Mountain Timber Sale	Stand density management Hardwood conversion 1.5 miles temporary road construction	178 (77 RR d/) 57 (26) 4	Forest, Wildlife, Riparian	2018
BLM – West Cunningham Timber Sale	Stand density management (2 acres are within the pipeline ROW; 1 of which is in RR) Hardwood conversion.	222 (66 RR d/) 67 (34 RR d/)	Forest, Wildlife, Riparian	2016
BLM – Wilson Creek 4 Timber Sale	Stand density management Hardwood conversion 0.2 mile temporary road construction 0.6 mile renovation	69 (20 RR d/) 4 <1 2	Forest, Wildlife, Riparian	2017
BLM- Other CT Timber Sales	Commercial Thinning Density Management Thinning	19 3 RR	Forest, Wildlife, Riparian	2016
North Fork Coquille River Watershed				
BLM – Manual Maintenance	Brush and hardwood control of young stands (<11 years old)	36 (1 RR d/)	Forest, Wildlife, Riparian	Unknown
BLM – Cloud 19 CT Timber Sale	Stand density management 0.1 mile temporary road construction 0.3 mile renovation	180 (105 RR d/) <1 <1	Forest, Wildlife, Riparian	2016

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TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
BLM – Hungry Mountain Timber Sale	Sand density management Hardwood conversion including 0.5 mile temporary road construction 1.9 miles renovation	37 (10 RR d/) 38 (17 RR d/) 1 5	Forest, Wildlife, Riparian	2018
BLM – Iron Monkey CT Timber Sale	Stand density management (96 are within the pipeline ROW, 5 of which are in Riparian Reserve)	173 (100 RR d/)	Forest, Wildlife, Riparian	Ongoing (sold 2014)
BLM – North Fork 25 Timber Sale	223 acres of stand density management, including 50 acres in Riparian Reserve (9 acres of the 223 are within the pipeline ROW, 1 of which is in Riparian Reserve) 0.7 mile temporary road construction (0.2 of which is in the pipeline ROW) 0.2 mile renovation (0.1 of which is in the pipeline ROW)	223 (50 RR d/) 2	Forest, Wildlife, Riparian	Ongoing (sold 2014)
BLM – Steele 23 CT Timber Sale	Stand density management (7 acres of the 278 are within the pipeline ROW, 2 of which are in Riparian Reserve) 1.2 miles road construction 1.1 miles improvement (0.2 of which are in the pipeline ROW)	278 (118RR d/) 3 3	Forest, Wildlife, Riparian	Ongoing (sold 2015)
BLM – Cloud 19 CT Timber Sale	Stand density management 0.4 mile temporary road construction 0.5 mile improvement	77 (22 RR d/) <1 1	Forest, Wildlife, Riparian	2016
BLM – Woodward 11 Timber Sale	Stand density management Hardwood conversion 0.5 mile temporary road construction 1.1 miles improvement, and 3.1 miles renovation	171 (100 RR d/) 75 (18 RR d/) 1 11	Forest, Wildlife, Riparian	2017
BLM – North Coquille Junction Timber Sale	1.5 miles renovation (0.2 of which are in the pipeline ROW)	5	Wildlife,	2015
Rock Prairie Timber Sale	Hardwood conversion 0.2 mile temporary road construction 0.3 mile renovation	30 (10 RR d/) <1 <1	Forest, Wildlife, Riparian	2016
BLM – Parkview Timber Sale	Stand density management Hardwood conversion 0.4 miles temporary road construction 5.4 miles renovation	251 (119 RR d/) 43 (23 RR d/) 1 14	Forest, Wildlife, Riparian	Ongoing (sold 2013)
BLM – S. Bridge Timber Sale	Stand density management Hardwood conversion 0.6 mile temporary road construction, 4.1 miles renovation 0.4 mile existing road decommission e/	322 (100 RR d/) 9 (5 RR d/) 2 10 1	Forest, Wildlife, Riparian	Completed (2014)

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
BLM – Vaughns Junction Sale	Stand density management Hardwood conversion 0.1 mile temporary road construction 0.5 mile improvement and 0.5 miles renovation.	109 (71 RR d/) 9 (5 RR d/) <1 3	Forest, Wildlife, Riparian	Completed (2014)
BLM – Dora Timber Sale	Stand density management Hardwood conversion 0.3 mile temporary road construction, 0.1 mile improvement, and 0.5 miles renovation	67 (36 RR d/) 9 (6 RR d/) 1 <1	Forest, Wildlife, Riparian	2016
BLM – Hidden Gem Timber Sale	Stand density management Hardwood conversion (4 acres are in pipeline ROW, 1 acre of which is Riparian Reserve 0.5 mile temporary road construction 2.6 miles renovation (0.2 of which is in the pipeline ROW)	137 (59 RR d/) 44 (26 RR d/) 1 5	Forest, Wildlife, Riparian	2016
BLM – Steele Cherry Timber Sale	Stand density management Hardwood conversion	31 (16 RR d/) 40 (12 RR d/)	Forest, Wildlife, Riparian	2016
BLM – Yankee Timber Sale	Stand density management Hardwood conversion 0.1 mile temporary road construction and 2.9 miles renovation	88 (46 RR d/) 68 (39 RR d/) <1 7	Forest, Wildlife, Riparian	2015
BLM – Honcho Creek Fish Culvert Replacement	Replace a culvert on Honcho Creek with a fish passage design.	1 RR	Riparian	2015
BLM – ERFO Road repairs	Repair 2014 storm damage on 2 sites: Middle Creek Rd – repair fill slope (riparian); Blue Ridge - replace culvert (riparian).	2 RR	Riparian	2016
BLM –Steel Trap Density Management Thinning (DM)	Stand density management Hardwood Conversion 0.81 miles of New Road Construction 4.4 miles of renovation	295 (98 RR) 38 3 10	Forest Wildlife Riparian	Ongoing Sold (2014)
BLM – Zumwalt CT Commercial thinning	Stand density management Hardwood Conversion 1.2 miles of New Road Construction 1.6 miles of renovation	202 (4 RR) 18 (6RR) 4 3	Forest Wildlife Riparian	2016
BLM – *Maintence Shop CT* Commercial thinning	Stand density management 0.55 miles of New Road Construction 2.85 miles of renovation	34 (51RR) 2 6	Forest Wildlife Riparian	Ongoing Sold (2015)
BLM – *Johns Creek CT* Commercial thinning	Stand density management 0.47 miles of New Road Construction 5.96 miles of renovation	87 (60 RR) 2 13	Forest Wildlife Riparian	2015

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
BLM – 2 *Buck Shuck CT* Commercial thinning	Stand density management 0.93 miles of New Road Construction 4.7 miles of renovation	129 (69 RR) 3 10	Forest Wildlife Riparian	Ongoing Sold (2014)
BLM – *Hidden Gem CT* Commercial thinning	Stand density management Hardwood Conversion 1.2 miles of New Road Construction 6.3 miles of renovation	124 (100 RR) 43 (21 RR) 4 14	Forest Wildlife Riparian	2016
BLM – *Wimer CT* Commercial thinning	Stand density management 0.29 miles of New Road Construction 2.4 miles of renovation	34 (45 RR) 1 5	Forest Wildlife Riparian	2017
BLM – *Llewellyn CT* Commercial thinning	Stand density management Hardwood Conversion 0.97 miles of New Road Construction 3.12 miles of renovation	72 (33 RR) 69 (30 RR) 4 7	Forest Wildlife Riparian	2017
BLM – *Other CT Timber Sales* (TS were analyzed in the Lone Pine EA)	Stand density management 0.56 miles of New Road Construction 4.6 miles of renovation	98 (8 RR) 2 10	Forest Wildlife Riparian	Planning w/i 5 years
BLM – Whiskey Train Timber Sale	Stand density management 0.1 miles new construction 0.1 miles of improvement 0.1 miles of renovation	42 (34 RR) 1 1 1	Forest Wildlife Riparian	ongoing (sold 2013)
BLM – Pathfinder Timber Sale	Stand density management 8.9 miles of new construction 1.0 miles of improvement	178 (82 RR) 23 3	Forest Wildlife Riparian	ongoing (sold 2014)
BLM – Thunderbolt Timber Sale	Stand density management 0.9 miles of new construction 3.0 miles of renovation	211 (91 RR) 2 8	Forest Wildlife Riparian	ongoing (sold 2013)
BLM – Blue 35 Timber Sale	Stand density management 1.4 miles of new construction 4.3 miles of renovation	261 (102 RR) 4 11	Forest Wildlife Riparian	ongoing (sold 2013)
East Fork Coquille Watershed				
BLM – Scattered Skeeter Density Management Thinning	Thin mid-seral forest in LSR and Riparian Reserves, includes 52 acres of alder conversion 1.1 miles of temporary new road construction 0.2 mile of road improvement, 24.4 miles of road renovation 11.3 miles of road decommissioning.	568 (113 RR d/) 3 63 28	Forest, Wildlife, Riparian	Completed (2012)
BLM – Broken Wagon Density Management Thinning	Thin mid-seral forest in LSR and Riparian Reserves (includes 126 acres of alder conversion in LSR and Riparian Reserves) 1.3 miles of temporary new road construction 0.1 mile road improvement, 20.6 miles road renovation 3.1 miles of road decommissioning.	178 3 18 8	Forest, Wildlife, Riparian	Completed (2011)

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
Methane Energy Corp (MEC), Coos County Methane Project	If determined to be economically feasible, 30 to 60 well pads housing up to 300 production wells Pipeline connections from the wells to existing or planned pipelines.	150 to 300 No Estimate Available	Water Quality	Feasibility evaluation ongoing
BLM – Crosby Timber Sale	Stand density management Hardwood conversion 1.4 miles temporary road construction and 1.8 miles renovation	226 (90 RR d/) 25 (5 RR d/) 8	Forest, Wildlife, Riparian	Ongoing (sold in 2014)
BLM – Steele Cherry Timber Sale	Stand density management Hardwood conversion	159 (80 RR d/) 28 (17 RR d/)	Forest, Wildlife, Riparian	2016
BLM – Yankee Timber Sale	Stand density management Hardwood conversion 1.5 miles temporary road construction, 0.6 miles improvement, and 6.7 miles renovation.	260 (130 RR d/) 64 (30 RR d/) 22	Forest, Wildlife, Riparian	2015
BLM – East Cherry Timber Sale	Hardwood conversion	64 (20 RR d/)	Forest, Wildlife, Riparian	Ongoing (sold in 2014)
BLM – Wagon Road Pilot Timber Sale	Regeneration harvest Stand density management in Riparian Reserve Hardwood conversion in Riparian Reserves 1.1 miles temporary road construction 1.1 miles improvement, and 2.9 miles renovation.	96 5 9 3 10	Forest, Wildlife, Riparian	Ongoing (sold 2012)
BLM – ERFO Road repairs	repair 2014 storm damage on 2 sites: W. Fk Brummet – repair fill slope (riparian); Weaver Sitkum - repair fill slope, replace two culverts (riparian).;	2 RR	Riparian	2016
BLM – Weed Treatment	Herbicide treatment of roadside noxious weeds (55 acres on BLM, 3 of which are in the pipeline ROW, 57 on private lands)	112	Vegetation	Unknown
BLM – Steel Trap DM Density Management Thinning	Stand density management 0.43 miles of renovation	24 (4 RR) 2	Wildlife Riparian	Sold (2014)
BLM – Weed Treatment	Herbicide treatment of roadside noxious weeds (132 acres on BLM land, 3 of which are in the pipeline right-of-way, 39 acres on private lands)	171	Vegetation	Unknown
BLM – Suicide Bar Commercial Thinning	Thinning; Temporary Road Construction; Road Renovation, Improvement and Maintenance.	No Estimate	Forest, Wildlife,	Unknown
BLM – *Brownstone CT* Commercial thinning	Stand density management 1.3 miles of New Road Construction 9.4 miles of renovation	231 (112 RR) 5 21	Forest Wildlife Riparian	Ongoing Sold (2014)
BLM – *My Frona CT* Commercial thinning (Was Frona Flats CT)	Stand density management 1.09 miles of New Road Construction 4.65 miles of renovation	150 (23 RR) 4 10	Forest Wildlife Riparian	Ongoing Sold (2014)

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TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
BLM – *Weekly CT* Commercial thinning	Stand density management 0.16 miles of New Road Construction 4.85 miles of renovation	86 (95 RR) 1 11	Forest Wildlife Riparian	Ongoing Sold (2014)
BLM – *Steel Cherry CT* Commercial thinning	Stand density management Hardwood Conversion 0.19 miles of New Road Construction 6.8 miles of renovation	97 (70 RR) 26 (23 RR) 1 15	Forest Wildlife Riparian	2016
Middle Fork Coquille Watershed				
BLM – Bear Creek Campground Decommission	Decommission previously closed campground adjacent to the Middle Fork Coquille River. Activities include removing asphalt, subsoiling, seeding, mulching, and planting.	2 RR	Riparian	2015
BLM – Manual Maintenance	Brush and hardwood control (stands <11 yrs old); 3 acres of which are within the pipeline ROW	65	Forest, Wildlife, Riparian	Unknown
BLM – Weaver Tie Timber Sale	Stand density management Hardwood conversion 0.2 mile temporary road construction 0.3 miles renovation.	27 (7 RR d/) 43 (21 RR d/) <1 <1	Forest, Wildlife, Riparian	2015
BLM – Weed Treatment	Herbicide treatment of roadside noxious weeds (132 acres on BLM land, 3 of which are in the pipeline right-of-way, 39 acres on private lands)	171	Vegetation	Unknown
BLM – Suicide Bar Commercial Thinning	Thinning; Temporary Road Construction; Road Renovation, Improvement and Maintenance.	No Estimate	Forest, Wildlife,	Unknown
BLM – ERFO Road repairs	Repair 2014 storm damage on 3 sites: Camas weaver Tie – repair fill slope; Lower Signal Tree - replace culvert (riparian); Big Creek – repair fill slope (riparian)	2 RR	Riparian	2016
South Umpqua Fourth-Field Watershed b/				
COE Permits and Mitigation	Wetland impacts Wetland creation Stream impacts (56.4 miles) Stream restoration or enhancement	33 15 No Acre Estimate No Acre Estimate	Wetland Riparian Aquatic	2009-2013
Olalla Creek-Lookingglass Watershed				
BLM – Suicide Bar Commercial Thinning	Thinning; Temporary Road Construction; Road Renovation, Improvement and Maintenance	No Estimate	Forest, Wildlife,	Unknown
Clark Branch- South Umpqua River Watershed				
–	No identified current or reasonably foreseeable projects			
Myrtle Creek Watershed				
–	No identified current or reasonably foreseeable projects			
Days Creek-South Umpqua River Watershed				
–	No identified current or reasonably foreseeable projects			

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
Elk Creek Watershed				
Forest Service – Weed Treatment	50 acres per year. Hand pulling and cutting.	50/year	Vegetation	Ongoing
Forest Service – Current Grazing	Cattle grazing	9,963	Range	Unknown
Forest Service – Proposed Tiller Aquatic Restoration Project	2 culvert replacements, 7 miles instream habitat improvement, 5 sump maintenance sites, 142 acres Riparian reserve thinning, 1 pond habitat improvement	N/A	Riparian, Aquatic	Expect implementation in 2017
Anticipated Clear Cutting on Private Land	Timber harvest	150	Forest Wildlife Riparian	Unknown
Forest Service – Proposed Elk Creek Collaborative Watershed Restoration Project	Commercial thin, Fuels reduction Prescribed burn, Precommercial thin, Weed treatment Planting, 2 culvert replacements and 5 miles road decommissioning	200 500 250 100 50 50	Forest Wildlife Riparian Air Quality Aquatic	Expect implementation to begin in 2015
Upper Rogue Fourth-Field Watershed b/				
COE Permits	Wetland impacts Stream impacts (16.0 miles)	33 No Acre Estimate	Wetland Riparian Aquatic	2009-2013
Upper Cow Creek Watershed				
Forest Service – Cattle Grazing	Grazing	8,250	Range	ongoing
Anticipated Clear Cutting on Private Land	Timber harvest	270	Forest Wildlife Riparian	Unknown
Forest Service– Red Mountain Stewardship	Shaded fuel break Commercial thinning	1,366 240	Forest Wildlife	Expect implementation to begin in 2015
Forest Service – Proposed Tiller Aquatic Restoration Project	1 culvert replacement	N/A	Aquatic, Riparian	Expect implementation in 2017

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
Trail Creek Watershed				
Forest Service – Cattle Grazing	Grazing	4,230	Range	ongoing
BLM – Tiller-Trail Highway Realignment Project (BLM lands)	Highway realignment	7	Forest Wildlife	Implemented in 2014.
BLM – Proposed Trail Creek Forest Management	Restoration thinning Riparian thinning Hazardous fuels treatment Precommercial thinning 8 pump chances restored, block 4 roads, replace 1 culvert decommission 0.5 mile of road, stream restoration on 0.5 miles	336 13 414 263 N/A 1 N/A	Forest Wildlife Aquatic Riparian	Implementation in 2015
BLM – Proposed Trail Creek Forest Management	Restoration thinning, Riparian thinning, Hazardous fuels treatment, Meadow restoration, Small diameter thinning, 6 pump chances restored, Roadside firewood cutting, 0.8 mile of temporary road construction.	714 75 1,075 282 50 N/A 259 2	Forest Wildlife Riparian	Implementation in 2015
BLM – Proposed Trail Creek Forest Management	Restoration thinning, Hazardous fuels treatment, 2 pump chances restored.	20 1,044 N/A	Forest Wildlife Riparian	Implementation in 2015
BLM – Mouse Trail Timber Sale	Restoration thinning, Pre-commercial thinning	1,000 500	Forest Wildlife	Expect implementation FY 2015
Shady Cove-Rogue River Watershed				
–	No identified current or reasonably foreseeable projects			–
Big Butte Creek Watershed				
–	No identified current or reasonably foreseeable projects			–
Little Butte Creek Watershed				
BLM – 2004 Deadwood Complex EA (Allotment Management Plan Update for Five Allotments)	Grazing on the South Butte Allotment	400	Range	Unknown

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
BLM – 2009 Fish Lake and Rancheria Allotment Management Plan Update	Grazing on the Fish Lake Allotment	1,000	Range	Unknown
BLM – 2004 Deadwood Complex EA (Allotment Management Plan Update for Five Allotments)	Grazing on the South Butte Allotment Grazing on the Conde Allotment	900 1,100	Range	Unknown
BLM – 2004 Deadwood Complex EA (Allotment Management Plan Update for Five Allotments)	Grazing on the South Butte Allotment	5,300	Range	Unknown
BLM – 2009 Fish Lake and Rancheria Allotment Management Plan Update	Grazing on the Fish Lake Allotment	6,500	Range	Unknown
BLM – 2013 Big Elk Cinder Pit CE (DM will be published within next 6 months)	Excavation of cinders from an existing cinder quarry	5	Quarry	Unknown
BLM – 2004 Deadwood Complex EA (Allotment Management Plan Update for Five Allotments)	Grazing on the South Butte Allotment, Grazing on the Deadwood Allotment, and Grazing on the Conde Allotment	7,000 4,900 2,200	Range	Unknown
BLM – 2004 Deadwood Complex EA (Allotment Management Plan Update for Five Allotments)	Grazing on the South Butte Allotment	8,700	Range	Unknown
BLM – 2004 Deadwood Complex EA (Allotment Management Plan Update for Five Allotments)	Grazing on the South Butte Allotment, Grazing on the Deadwood Allotment	3,400 13,400	Range	Unknown
BLM – Salty Gardner DNA	Hazardous fuels treatment	540	Vegetation	FY 2014 - 2015
Bieber Salt Forest Management FY 2016, Salty Gardner DNA	Upland vegetation treatment, Hazardous fuels treatment	756 721	Vegetation	FY 2016
BLM – Bieber Salt Forest Management FY 2016, Salty Gardner DNA	Upland vegetation treatment, Hazardous fuels treatment	763 932	Vegetation	FY 2016
Spencer Creek Watershed				
Forest Service – Buck Indian Allotment	Grazing	20,000	Range	Ongoing annually

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
Forest Service – Dead Indian Memorial and Clover Creek Highways Noxious Weed Treatment	7 miles of weed treatment	N/A	Vegetation	Ongoing annually
Forest Service – Lakewoods WUI Harvest Project	Variety of fuels treatments surrounding the Lakewoods private land subdivision. Commercial harvest approximately 70 acres.	 70	Forest Wildlife	Unknown
Forest Service – Indian Grazing Allotment	Cattle grazing	10,646	Range	Unknown
Forest Service – Road Maintenance	Variety of routine road maintenance activities	No Estimate		Unknown
BLM – Walters Glade Timber Sale and Vegetation Management	Commercial and pre-commercial vegetation management	1,271	Wetland Riparian Aquatic	2016-2020
BLM – Spencer Creek Thinning	Small Diameter thinning	300	Wetland Riparian Aquatic	2015-2020
John C. Boyle Reservoir-Klamath River/Lake Ewauna-Upper Klamath River/Mills Creek-Lost River Watersheds				
BLM – Keno Timber Sale	Vegetation Treatment, timber Sales and Small diameter thinning	3,863	Riparian Timber Wildlife	2015-2021
BLM – Swan Lake Hydro Electric Pumped Storage Project	Hydro-electric pumped storage project on BLM and Private 500 kV power line Swan Lake Rim to Malin public and private	400 110	Riparian Timber Wildlife	2020
BLM – Bryant Mountain Timber Sale	Vegetation Treatment	1,372	Riparian Timber Wildlife	2015
BLM – Bryant Mountain Juniper Treatment	Vegetation Treatment Fuels Reduction	1,761	Riparian Timber Wildlife	2015
COE Permits and Mitigation	Wetland impacts Wetland mitigation Stream impacts (0.3 mile) Stream restoration and enhancement (<0.1 mile)	2 <1 No Acre Estimate No Acre Estimate	Wetland Riparian Aquatic	2009-2013
PacifiCorp. Klamath Dam Removal	In April 2013, the U.S. Department of the Interior released a Final EIS for the Klamath Dam Removal Project. Congressional approval is needed prior to removing the dams, as well as actions by FERC and other regulatory agencies.		Riparian Aquatic	2020

TABLE 4.14.2.3-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/

(By Fifth-Field Watersheds unless noted)

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
Velocitel Cell Tower	Construction of a cell tower on Stukel Mountain, in south-central Oregon.	<1	Vegetation	2015
Memory Care Center	A new 28-unit (36-bed) memory care center on Jade Terrace adjacent to the Sky Lakes Medical Center and the Oregon Institute of Technology.	1		2014
FedEx Company	New FedEx distribution center and office on the western side of Altamont Drive just west of the Klamath Regional Airport.	4		2014

a/ Most future activities on private lands, such as commercial harvests, are not publically available. These activities are expected to continue at current rates.
b/ COE projects are tracked at the fourth-field watershed. Fourth-field watersheds generally include more than one fifth-field watershed.
c/ Hardwood conversion, as used in this document, refers to the clearing of deciduous trees and shrubs in order to plant conifer trees.
d/ Total acres followed by the portion of the total acres that are within Riparian Reserves (RR) in parentheses.
e/ The Northwest Forest Plan defines decommissioning as "To remove those elements of a road that reroute hillslope drainage and present slope stability hazards." Decommissioning generally restores natural drainage, removes unstable fill material, and establishes vegetation cover on the road surface to reduce erosion.
Coos Tribes – Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

Additional projects within the watersheds are anticipated to occur as population growth continues in the region. Over the past decade, the regional population has grown at a rate over 8 percent. Associated with that population growth would be the construction of residential subdivisions, commercial developments, and roads and utilities, together with the maintenance and upgrading of the existing infrastructure. These actions may affect a range of natural resources, including soils, waterbodies and wetlands, vegetation, and wildlife. There is also the potential that over time federal and state agencies and private conservation organizations may implement measures that may gradually improve habitat, water quality, and air quality throughout the project area. It is not possible to quantify or assess the potential cumulative impacts or benefits that may accrue from all possible future projects within the watersheds crossed by the pipeline route.

Projects and events that may occur but are not practical to predict or identify in table 4.14.2.3-1 include the following.

- **Reciprocal Rights-of-Way Actions**. All of the fifth-field watersheds are covered by multiple reciprocal road use and rights-of-way agreements enacted between the BLM and/or Forest Service and adjoining industrial forest landowners. While requests are frequently received, under the terms of these agreements, to construct new roads or to renovate, improve, and use existing roads, there is no practical means to forecast the timing and location of such requests. Historically, the BLM Districts receive between about 5 and 10 crossing requests annually from major timber companies, which may or may not involve construction of new roads. NFS lands generally consist of large, contiguous blocks of land, rather than the checkerboard pattern typical of BLM lands; therefore, the Forests receive few requests for new road access.
- **Temporary Hauling Permits**. Requests are received from time to time from private individuals without reciprocal road use and rights-of-way agreements for permits to haul forest products over BLM- and Forest Service–controlled roads. As with non-discretionary actions permitted under reciprocal road use and rights-of-way agreements, there is no practical means by which to forecast the timing and location for such requests. Historically, the BLM Districts receive less than five requests annually from small landowners, which may or may not involve construction of new roads.
- **Other Actions on Federal Lands**. Within the Coos Bay BLM District, BPA has ongoing access road improvement work (rocking). It is anticipated this action will continue for the next several years. Additionally, the BLM and Forest Service have programs to actively control noxious weeds. The BLM is exploring the possibility of expanding its herbicide control program to include invasive species in the future.
- **Ongoing Operation and Maintenance of the Klamath Project by Reclamation.** Originally authorized in 1905, the Klamath Project now includes three storage reservoirs, 1,400 miles of canals and drains, 37 pumping plants, and two tunnels to provide service to water users in the Klamath Basin.
- **Road Maintenance.** Road maintenance activities would be conducted by the state and counties, and private timber companies.
- **Ongoing Commercial Activities.** Many activities on private land that go unreported could affect natural resources, including timber harvests and commercial fishing. Mitigation Proposed to Offset Unavoidable Project Impacts

- **Wildfires.** Wildfires and the corresponding actions to suppress these fires on federal, state, and private land are anticipated to continue at or above the rate experienced during past decades (fire regimes are discussed in section 4.5.1.2). Adverse effects include the loss of mature and old forest and the habitat they provide to species associated with these forest stages.

In addition to the projects identified in table 4.14.2.3-1, restoration and enhancement projects have occurred and are expected to continue to occur across the watersheds affected, which would help offset the cumulative impact of past, present, and reasonably foreseeable actions. This would include the off-site mitigation measures required by the Forest Service, BLM, FWS, COE, and other agencies to offset unavoidable impacts due to the Pacific Connector Pipeline crossing of federal lands (refer to section 4.1 and appendix F for a discussion of mitigation on BLM and Forest Service lands). Working with the Forest Service, BLM, and FWS, Pacific Connector developed a CMP that includes measures to offset unavoidable impacts on federal lands, and allow the BLM and Forest Service to amend certain portions of their LMPs because specific impacts would be mitigated. These mitigation measures are reasonably foreseeable actions, and have been included in this EIS in the evaluation of impact on those resources for which the mitigations are designed to address. These measures are summarized by category in table 2.1.4-1 in chapter 2 of this EIS and are discussed in more detail in appendix F. They include habitat and vegetation improvements (creation of down wood and snags, stand density management, riparian plantings, and noxious weed monitoring and treatment); placement of LWD and providing large wood pieces for restoration projects; road decommissioning, paving, and maintenance to reduce sedimentation; protecting springs and seeps; cattle exclusions; culvert replacements; visual impact mitigations, and other beneficial projects. These mitigation projects are being analyzed programmatically as a part of the proposed action in this EIS. It is anticipated that many of these projects would require a secondary site-specific project-level NEPA analysis prior to implementation. Those secondary site-specific project-level NEPA analyses would tier to this EIS as provided in the CEQ NEPA regulations at 40 CFR 1502.20 and 1508.28(b). Mitigation proposed as part of the Project is displayed in table 2.1.4-1 in chapter 2, along with the beneficial and adverse effects of each type of action. As discussed in table 2.1.4-1, the CMP activities would mitigate Project effects on federal lands in the long term, but may add to short-term effects.

4.14.2.4 Cumulative Effects from U.S. Army Corps of Engineers Portland District Regulatory Branch Actions

This section identifies actions authorized by the COE within the affected watersheds. The COE's Regulatory Program is based upon two primary statutory authorities. Under Section 404 of the CWA, the COE authorizes the discharges of dredged and fill material into waters of the United States; and under its Section 10 of the RHA authority, the COE regulates structures in navigable waters. When reviewing projects for potential authorization, the COE utilizes mitigation sequencing. Project proponents are required to demonstrate they have avoided impacts where practicable and minimized or restored unavoidable impacts. The COE considers the need for compensatory mitigation for those impacts that are unavoidable. Compensatory mitigation is a third step in a sequence of actions that must be followed to offset impacts to aquatic resources. The 1990 MOA between the EPA and the U.S. Department of the Army establishes the three-part mitigation sequencing process comprised of avoidance, minimization, and compensation. The goal for the COE and EPA is to facilitate and execute a "No Net Loss" aquatic resource protection policy to ensure aquatic resources of the U.S. do not decrease in size

but are offset or increased through land development processes. The impacts listed below include projects whose purpose may include commercial, residential, or public development and may include wetland or stream restoration or other actions. The COE Operations and Maintenance Business Information Link (OMBIL) Regulatory Module currently uses the fourth-field HUC or watershed to track cumulative effects to wetlands. Fourth-field watersheds are a higher order than fifth-field watersheds (e.g., a fourth-field watershed generally includes more than one fifth-field watershed). Therefore, the COE tracks wetland impacts over a larger area than would be the case if fifth-field watersheds were used.

For the period March 2009 to 2013, the COE authorized impacts to 37.7 acres of wetland and 21,189 linear feet of stream within the Coos fourth-field watershed (17100304). This fourth-field (8-digit) HUC encompasses the Coos Bay-Frontal Pacific Ocean watershed outlined in this section of the document. Mitigation required for these authorizations includes 47.9 acres of wetland creation, restoration, or enhancement and 3,400 linear feet of stream restoration or enhancement. Application reviews and permit authorizations will likely continue at the current rate due to population growth and land use. The proposed action is moderate compared to other activities in the Coos watershed.

COE permits for the period March 2009 to 2013 authorized impacts to 6.9 acres of wetland and 119,590 linear feet of stream within the Coquille fourth-field watershed (17100305). This fourth-field (8-digit) HUC encompasses the Coquille (Middle Main), North Fork Coquille River, East Fork Coquille, and Middle Fork Coquille subwatersheds (also referred to as fifth-field watersheds) outlined in this section of the document. Application reviews and permit authorizations will likely continue at the current rate due to population growth and land use. The proposed action is moderate compared to other activities in the Coquille watershed.

COE permits for the period of March 2009 to 2013 authorized impacts to 33.1 acres of wetland fill and 297,832 linear feet of stream within the South Umpqua fourth-field watershed (17100302). This fourth-field (8-digit) HUC encompasses the Olalla Creek-Lookingglass, Clark Branch-South Umpqua River, Myrtle Creek, Days Creek-South Umpqua River, Elk Creek, and Upper Cow Creek subwatersheds outlined in this section of the document. Mitigation required for these authorizations includes 15.2 acres of wetland creation, restoration, or enhancement and 1,327 linear feet of stream restoration or enhancement. Application reviews and permit authorizations will likely continue at the current rate due to population growth and land use. The proposed action is moderate compared to other activities in the South Umpqua watershed.

COE permits for the period March 2009 to 2013 authorized impacts to 39.8 acres of wetland and 84,386 linear feet of stream within the Upper Rogue fourth-field watershed (17100307). This fourth-field (8-digit) HUC encompasses the Trail Creek, Shady Grove-Rogue River, Big Butte Creek, and Little Butte Creek subwatersheds outlined in this section of the document. Application reviews and permit authorizations would likely continue at the current rate due to population growth and land use. The proposed action is moderate compared to other activities in the Upper Rogue watershed.

COE permits for the period March 2009 to 2013 authorized impacts to 1.6 acres of wetland and 410 linear feet of stream within the Upper Klamath fourth-field watershed (18010206). This fourth-field (8-digit) HUC encompasses the John C. Boyle Reservoir-Klamath River and Spencer Creek subwatershed outlined in this section of the document. Mitigation required for these

authorizations includes 0.28 acre of wetland creation, restoration, or enhancement and 220 linear feet of stream restoration or enhancement. Application reviews and permit authorizations would likely continue at the current rate due to population growth and land use. The proposed action is moderate compared to other activities in the Upper Klamath watershed.

COE permits for the period March 2009 to 2013 authorized impacts to 0.8 acre of wetland fill and 1,161 linear feet of stream within the Lost River fourth-field watershed (18010204). This fourth-field (8-digit) HUC encompasses the Lake Ewauna-Upper Klamath River and Mills Creek-Lost River subwatersheds outlined in this section of the document. Application reviews and permit authorizations would likely continue at the current rate due to population growth and land use. The proposed action is moderate compared to other activities in the Lost River watershed.

4.14.3 Cumulative Effects on Resources

Cumulative effects are discussed by resource below. For each resource, the potential direct and indirect impacts associated with the Project are discussed in relation to the cumulative effects that may occur if the other current or reasonably foreseeable projects overlap in time or space.

The temporal period where effects may overlap those of other projects varies; short-term effects may last only a few years, while long-term effects may last for decades. Only projects that occur or have remnant effects within the period of time where the effects of this Project occur or remain could be considered to have a cumulative effect. Similarly, the geographic extent of the effects of other projects must overlap those of this Project to have a cumulative effect. Impacts included in the following discussion are those for which temporal scales and impact footprints coincide with impacts addressed in the previous sections (4.1 through 4.12).

The impacts from the reasonably foreseeable projects listed in table 4.14.3-1 are presented in acres and as a percentage within each watershed and are summed with the Project's expected impacts. The values presented for project-related mitigation on federal lands are approximate and may be subject to change within or between watersheds as a result of changing conditions and agency management priorities. In some of these watersheds, the cumulative impacts from the other projects represent a relatively large percentage of the total watershed area. In most cases, however, the largest projects (by area of impact, which does not necessarily correlate with greatest magnitude of impact) involve ongoing cattle grazing (Elk Creek South Umpqua, Little Butte Creek, Upper Cow Creek, Spencer Creek and Trail Creek watersheds), vegetation thinning (Middle Fork Coquille River, Elk Creek South Umpqua, Olalla-Lookingglass, and Trail Creek watersheds), or Indian grazing allotment (Spencer Creek watershed).

TABLE 4.14.3-1

Cumulative Acres Impacted by Watershed by the Project, Related Mitigation Projects, and Other Projects a/

Activity	Acres	Percent of Watershed
Watershed: Coos Bay – Frontal	187,098	
Other Identified Projects b/	657	0.4
Jordan Cove LNG Terminal and Pacific Connector Pipeline and Associated Facilities, including the non-jurisdictional South Dunes Power Plant	560	0.3
Project-related Mitigation on Federal Lands	67	<0.1
Cumulative Area Impacted	***1,284***	***0.7***

TABLE 4.14.3-1

Cumulative Acres Impacted by Watershed by the Project, Related Mitigation Projects, and Other Projects a/

Activity	Acres	Percent of Watershed
Watershed: Coquille (Middle Main) River	112,081	
Other Identified Projects	1,008	0.9
Pacific Connector Pipeline and Associated Facilities	63	<0.1
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***1,071***	***1.0***
Watershed: North Fork Coquille River	97,928	
Other Identified Projects	2,824	2.9
Pacific Connector Pipeline and Associated Facilities	151	0.2
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***2,975***	***3.0***
Watershed: East Fork Coquille River	85,828	
Other Identified Projects	2,235	2.6
Pacific Connector Pipeline and Associated Facilities	196	0.2
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***2,431***	***2.8***
Watershed: Middle Fork Coquille River	197,176	
Other Identified Projects	241	0.1
Pacific Connector Pipeline and Associated Facilities	281	0.1
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***522***	***0.3***
Watershed: Olalla Creek – Lookingglass Creek	103,109	
Other Identified Projects	0	0
Pacific Connector Pipeline and Associated Facilities	159	0.1
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***159***	***0.1***
Watershed: Clark Branch – South Umpqua River	59,577	
Other Identified Projects c/	0	0
Pacific Connector Pipeline and Associated Facilities	514	0.9
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***514***	***0.9***
Watershed: Myrtle Creek	197,314	
Other Identified Projects c/	0	0
Pacific Connector Pipeline and Associated Facilities	279	0.1
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***279***	***0.1***
Watershed: Days Creek – South Umpqua River	76,250	
Other Identified Projects c/	0	0
Pacific Connector Pipeline and Associated Facilities	842	1.1
Project-related Mitigation on Federal Lands	1,000	1.3
Cumulative Area Impacted	***1,842***	***2.4***
Watershed: Elk Creek South Umpqua	54,895	
Other Identified Projects	1,313	2.4
Pacific Connector Pipeline and Associated Facilities	42	<0.1
Project-related Mitigation on Federal Lands	2,370	4.3
Cumulative Area Impacted	***3,725***	***6.7***
Watershed: Upper Cow Creek	47,416	
Other Identified Projects	1,876	3.9
Pacific Connector Pipeline and Associated Facilities	95	0.2
Project-related Mitigation on Federal Lands	2,004	4.2
Cumulative Area Impacted	***3,8975***	***8.3***

TABLE 4.14.3-1

Cumulative Acres Impacted by Watershed by the Project, Related Mitigation Projects, and Other Projects a/

Activity	Acres	Percent of Watershed
Watershed: Trail Creek	28,867	
Other Identified Projects	6,055	21.0
Pacific Connector Pipeline and Associated Facilities	240	0.8
Project-related Mitigation on Federal Lands	1,260	4.4
Cumulative Area Impacted	***7,555***	***26.2***
Watershed: Shady Cove – Rogue River	74,268	
Other Identified Projects c/	0	0
Pacific Connector Pipeline and Associated Facilities	143	0.2
Project-related Mitigation on Federal Lands	866	1.2
Cumulative Area Impacted	***1,009***	***1.4***
Watershed: Big Butte Creek	43,813	
Other Identified Projects c/	0	0
Pacific Connector Pipeline and Associated Facilities	82	0.2
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***82***	***0.2***
Watershed: Little Butte Creek	238,598	
Other Identified Projects	3,712	1.6
Pacific Connector Pipeline and Associated Facilities	649	0.3
Project-related Mitigation on Federal Lands	703	0.3
Cumulative Area Impacted	***5,064***	***2.1***
Watershed: Spencer Creek	54,420	
Other Identified Projects	70	0.1
Pacific Connector Pipeline and Associated Facilities	231	0.4
Project-related Mitigation on Federal Lands	397	0.7
Cumulative Area Impacted	***698***	***1.3***
Watershed: John C. Boyle Reservoir – Klamath River	84,703	
Other Identified Projects d/	-	-
Pacific Connector Pipeline and Associated Facilities	70	<0.1
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***70***	***<0.1***
Watershed: Lake Ewauna – Upper Klamath River	78,038	
Other Identified Projects d/	-	-
Pacific Connector Pipeline and Associated Facilities	501	0.6
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***501***	***0.6***
Watershed: Mills Creek – Lost River	110,118	
Other Identified Projects d/	5	<0.1
Pacific Connector Pipeline and Associated Facilities	488	0.4
Project-related Mitigation on Federal Lands	0	0
Cumulative Area Impacted	***493***	***0.4***

Note: Minor changes to the proposed route in order to avoid Survey and Manage species' habitat and other sensitive resources, are ongoing. Therefore, the project acres presented in this table are approximate values. Estimates of watershed level-impacts presented in this table are not expected to change based on these minor route changes.

a/ Other Identified Projects include only those listed in table 4.14.2.3-1 resulting in new disturbance (e.g., continued grazing on existing allotments is not included). Project related mitigation on federal lands include only those projects listed on table 2.1.4-1 in chapter 2.

b/ Includes the TransPacific Railway Realignment, Channel Modification is estimated to impact 102 acres within Coos Bay.

c/ No projects have been identified in this watershed.

d/ Acres impacts associated with Klamath Basin dam removal are not included in this table. The project has not been approved by Congress; therefore, the scope of the impacts depends on whether all or part of the project is implemented.

Numbers are not exact; columns do not sum correctly due to rounding.

4.14.3.1 Land Use

Impacts on land use would occur when a project results in a permanent or long-term change in the way a property is used; for example, the conversion of one type of land use (e.g., agricultural land) to another type (e.g., industrial land). This would occur at new permanent access roads, and new permanent aboveground facilities, that are not currently utility rights-of-way or industrial facilities. An example of a long-term land use change would be the clearing of forest for a right-of-way and its operational maintenance in an herbaceous state.

Construction of the Jordan Cove LNG terminal and related facilities would affect about 76 acres of open land, 111 acres of forest, and 180 acres of industrial land (see table 4.1.1.1-1). After construction, the operational footprint of the terminal and related facilities would occupy about 251 acres, which should be considered industrial land. Therefore, land use would change for about 70 acres of land at the terminal location. The upland portion of the Jordan Cove LNG terminal tract is currently zoned 5-WD and 6-WD intended for water-dependent industrial uses, while the power plant tract is zoned IND for industrial use within the Beach and Dune Area with Limited Developmental Suitability according to the CBEMP.

We contacted the local planning offices in the four counties crossed by the Project in order to identify foreseeable developments in the counties crossed by the Project. Based on these discussions, we are not able to identify any large residential or commercial developments in the city of North Bend, with one exception. The Coos County Airport District is planning to extend one of the runways at the Southwest Oregon Regional Airport. The airport is less than 1.0 mile from the terminal.

Within the city of Coos Bay, one residential development and several smaller projects have been identified (table 4.14.2.3-1). Starting in 2013, Ocean Grove Development Group LLC broke ground on vacant land where they propose to construct about 766 houses on approximately 72 acres south of Ocean Boulevard over the next several years (Thornton 2013). The plan would convert current open land and wetlands to residential or developed urban uses. The development is approximately 3 miles south of the LNG terminal. Other projects planned within the city of Coos Bay include two museums, a casino, and Coos Bay's Downtown Revitalization Project.

Other future projects in the Coos Bay region would include the COE navigation channel improvement project, and the Principle Power Windfloat Pacific Demonstration project. In 2012, Principle Power obtained a $4 million DOE grant to begin development of its proposed Windfloat Pacific Demonstration Project in the deep water of the Pacific Ocean about 15 miles off the coast of Coos Bay, where it would anchor five wind turbines capable of generating up to a total of 30 MW. In 2013, Principle Power submitted an application to the BOEM to lease about 15 acres on the outer continental shelf. On February 6, 2014, BOEM issued its *Notice of Determination of No Competitive Interest for the Windfloat Pacific Project Offshore Oregon*.[190] In 2012, Principle Power entered into an agreement with the Port to lease the western berth of Jordan Cove's marine slip for an assembly area for its turbines, before they would be towed to the open ocean. That assembly area would cover about 33 acres of wetlands at Henderson Marsh. BOEM has yet to evaluate the project under its planning procedures and produce an environmental assessment. The schedule for that environmental review process has not been announced.

[190] See 79(25) FR 7225.

The Port has proposed multiple future development projects in Coos Bay, including its "Oregon Gateway Marine Terminal Complex," which included a dry bulk cargo berth on the west side of the Jordan Cove slip; an intermodal container terminal complex at Henderson Marsh; and a coal shipping terminal. However, the Port was never able to obtain sponsors or customers for these planned projects. Jordan Cove is now proposing a single-user slip, with no commercial berth on the west side. Also, Jordan Cove would construct a tsunami berm on the west side of the slip between the terminal and Henderson Marsh, which may preclude future commercial development in this area.

In January 2014, the Port informed the COE that it wanted to pursue the expansion of the Coos Bay navigation channel under Section 204 of the Water Resources and Development Act, in which case a non-federal sponsor could fund the project. The Port indicated that it would have a consultant produce an administrative draft EIS for the channel improvement project in 2016. The proposed expansion of the Coos Bay navigation channel is not related to the Jordan Cove Project. The Coast Guard has limited the size of LNG vessels that could transit to the Jordan Cove terminal to 148,000 m^3 in capacity, and vessels of that size could use the existing navigation channel without increasing its depth or width.

The proposed route for the Pacific Connector pipeline would cross about 145 miles of forest, 37 miles of agricultural land, 27 miles of range land, and 18 miles of urban/developed land (see section 4.1.2.2). Within the currently forested area that would be cleared of trees during pipeline installation, there would be a long-term land use change where the 30-foot-wide corridor centered on the pipeline within the operational easement would be maintained in an herbaceous state, affecting about 843 acres. While the loss of mature forest cleared in other portions of the construction right-of-way would be a long-term impact on vegetation, due to the time required for trees to regrow, the area outside the 30-foot-wide right-of-way would not see a change in land use. The area would be replanted with suitable tree species and continue to support forests.

The other locations where land use would change over the long term would be where Pacific Connector would construct and operate new access roads and new aboveground facilities. Pacific Connector proposes to construct 15 new access roads, totaling about 0.6 mile in length, and impacting about 2 acres in total. These new roads would convert about a quarter of an acre of agricultural land, 1 acre of range, and 1 acre of forest to industrial or developed land. At the aboveground facilities combined, about 1 acre of forest, 1 acre of agricultural land, and 31 acres of range would be permanently converted to industrial land use (see table 4.1.2.2-3).

This land use conversion is relatively small in comparison to the total acres of existing land use types in southwestern Oregon. In 2009, in the four counties crossed by the proposed route (Klamath, Jackson, Douglas, and Coos), there were about 2,107,000 acres of non-federal forest, 343,000 acres of mixed forest and agricultural land, and 290,000 acres of intensive agricultural land. In Klamath County alone, there was 302,000 acres of rangeland in 2009. According to the ODF, 98 percent of non-federal land in the state used for forest, agriculture, or range in 1974 was still in those same land uses in 2009 (Herstrom et al. 2011).[191] According to NOAA Coastal Services Center (2014) data, there has been a loss of about 2,586 acres of agricultural land in Jackson County, and a net gain of about 858 and 257 acres in Douglas and Coos Counties,

[191] The Herstrom et al. (2011) study did not list any rangeland acres for Coos, Douglas, or Jackson Counties.

respectively, since 1996 (NOAA Coastal Services Center's 2014 analysis does not include Klamath County).

Table 4.14.2.3-1 provides a list of other projects that may reasonably occur in the same watersheds that would be crossed by the pipeline route. The BLM and Forest Service projects related to the Pacific Connector mitigation packages also include land use changes on federal lands, allocating approximately 1,896 acres of Matrix to LSR. This represents a relatively minor reallocation of BLM and NFS lands that would be subject to LSR standards and guidelines. The BLM and Forest Service manage more than 665,000 acres of federal land in the 19 watersheds crossed by the Project.

Timber harvests or other silvicultural actions would not be considered to have cumulative impacts on land use. This is because harvests or other silvicultural actions are forest land use projects, and their implementation would not convert or alter the designated future use of these areas.

The removal of four dams in the Klamath Basin (if approved and implemented) would also affect recreational and agricultural land uses. The removal of the dams would alter lake-based recreational opportunities to river-based recreation; however, there are a number of other public reservoirs and lakes in the region that could be utilized. If dam removal is implemented as planned, approximately a quarter of a million acres of farmland in the Klamath Basin would no longer be irrigated. However, there are approximately 16.3 million acres of farmland in Oregon. The ODA reported that approximately 58,000 acres of farmland in the state has been lost to development in the past 28 years (ODA 2012b).

Other foreseeable projects in the Klamath area include an electric transmission substation occupying 45 acres of a 150-acre site and three geothermal power plants (each occupying approximately 10 acres) and their associated transmission lines (no information is available on the length of these lines). One geothermal power plant site is currently zoned for Forestry/Range by the County. The other two power plant sites and the substation site are zoned for EFU.

The analysis area is vast; the 19 watersheds crossed by the pipeline include more than 2,035,450 acres. While there would be cumulative impacts on land use when all of the other projects are combined, the magnitude of that impact would be minimal at the landscape scale. The Pacific Connector Pipeline Project would include measures that would minimize impacts on land use, such as co-locating the pipeline adjacent to existing rights-of-way where feasible, and replanting forested areas within the temporary construction corridor. Therefore, we conclude that the Pacific Connector Pipeline Project, together with other identified future projects in the area, would not alter the use of large tracts of land, or have significant adverse cumulative impacts on regional land use.

4.14.3.2 Geological Resources

There are two ways that the Project, in addition to other projects in the region, may have cumulative impacts on geological resources: (1) they may affect existing mineral resources, such as mines, quarries, or oil and gas wells; or (2) they may be subject to natural geological hazards. There are no existing mines or mineral extraction activities in close proximity to the Jordan Cove terminal. Pacific Connector identified 20 mines or mineral extraction locations within 500 feet of its pipeline right-of-way. However, the pipeline could potentially interfere with future mining

and reclamation activities on lands adjacent to the right-of-way and cumulatively contribute to limiting the future expansion of surface mines or the development of new mineral resources lands adjacent to the right-of-way. Pacific Connector would utilize 42 locations as rock sources or disposal areas, totaling about 175 acres. About 20 of those sites are existing quarries. Pacific Connector would not expand these sites beyond the existing or previously disturbed footprints. In addition, Pacific Connector's use of those sites for rock sources or disposal should not preclude their use for similar purposes by other entities in the future, after the pipeline is installed and the right-of-way restored. Rock removal and use from quarries managed by the BLM and the Forest Service may occur related to other projects utilizing rock resources, including road construction, road maintenance, and off-site mitigation/restoration projects. Removal of rock from quarries on federal lands is at the discretion of the agency, and rock needed for use by the agencies would be reserved. Rock stored in quarries as a result of pipeline construction could be used or sold by the agencies in the future. Other than mineral material sites (rock quarries), there are no reasonably foreseeable mining projects that would increase cumulative effects in the project area.

It is not known if the other projects listed on table 4.14.2.3-1 would be in close proximity to mines or mineral extraction activities, or if they would cross areas with geological hazards. Timber harvests, new road construction, and other developments have the potential to adversely affect slope stability. Projects on federal lands would use BMPs and design standards applicable to the site conditions and would avoid unstable areas. Consequently, the Project, in conjunction with the foreseeable projects listed in table 4.14.3-1, is not expected to contribute significantly to cumulative impacts related to geologic hazards at the watershed level, including landslides and fault movements.

4.14.3.3 Soils and Sediments

Cumulative impacts on soils and sediments include erosion and compaction resulting from the Project and other projects in the region. Low-level contaminated soils were found within the LNG terminal site (within the Ingram Yard and mill site). The ODEQ issued Weyerhaeuser a "partial no further action" determination for the Ingram Yard and Mill site, and included conditions that certain wastes be managed appropriately if they are disturbed (SHN 2015). A solid waste authorization letter was submitted to ODEQ in July 2014. This letter stated, per guidance from ODEQ, Jordan Cove would provide prior notice to ODEQ should any grading or ground disturbance activities be planned to occur on Ingram Yard. Provisions for long-term disposal of disturbed Ingram Yard soils and any other specific mitigation measures would be specified in the final engineering design. Additionally, mercury is present at levels above Clean Fill screening criteria in sediments within portions of the Kentuck Slough mitigation site (within the golf course irrigation pond). These sediments would be removed to an off-site disposal facility.

No prime farmland soils exist at the LNG terminal site, but approximately 15 percent of soils are at the LNG terminal site are considered farmland of statewide importance. However, no portion of the LNG terminal site are currently being used for cropland. Approximately 31 percent of the soils crossed by the proposed route of the Pacific Connector pipeline are classified as prime farmland or farmland of statewide importance (not all of these soils are currently in agricultural production). With the exception of approximately 30 acres associated with aboveground facilities, the Project would only affect crop production for one to two years.

Within the Jordan Cove terminal, about 98 acres of Waldport Fine Sand would have a high erosion potential. About 7 percent of the soils crossed by the Pacific Connector pipeline route would be highly susceptible to wind erosion, and about 41 percent would be susceptible to water erosion. Jordan Cove would minimize impacts on soils by following the FERC staff's *Plan*, its Plan, and its project-specific ESCP. Pacific Connector would minimize impacts on soils by following our *Plan* and its project-specific ECRP that incorporates supplemental information on sensitive soils (NSR 2015).

Actions listed in table 4.14.2.3-1, as well as additional activities likely to occur on private lands, such as urban expansion, timber harvests, new transmission lines, and road construction, could contribute to cumulative effects on soils. However, many of these projects would include mitigation to offset impacts. For example, projects listed in table 4.14.2.3-1 include approximately 20 miles of new road construction (impacting about 50 acres of soil). The table also includes nearly 55 miles of road decommissioning designed to improve soil conditions and restore natural drainage patterns.

If the four PacifiCorp dams along the Klamath River are removed by 2020, between 5.4 and 8.6 million cubic yards (1.2 and 2.3 million tons) of sediment backed up behind the dams would be released downstream. The reservoirs would be drawn down during the winter months, when precipitation, river flow, and turbidity are naturally highest. Results from a sediment mobility analysis indicated that this would result in a short-term increase in suspended sediment concentrations for about two years following dam removal. After drawdown of the reservoirs, revegetation would limit future erosion.

Any increase in land clearing and soil disturbance due to construction activities has the potential to contribute to cumulative impacts on soils and sediment. By implementing the measures discussed above in section 4.3, the Project would minimize incremental impacts on soils. Other federal projects would also employ BMPs that limit effects on soil and sediment. BLM and Forest Service LMPs include specific standards designed to avoid detrimental soil impacts and sediment delivery to streams. These standards are designed for the specific site conditions found in each management area. With the exception of three watersheds, cumulative impacts would affect from less than 0.1 percent to less than 3.0 percent of all the land in the watersheds crossed by the Project (table 4.14.3-1). The exceptions are the Elk Creek (6.7 percent), Upper Cow Creek (8.4 percent), and Trail Creek (26.2 percent) Watersheds. While the combined projects would result in an increase in erosion, given the small proportion of the landscape affected by these projects, erosion control BMPs, and restoration on federal lands, we conclude that the Project, when added to other projects in the region, would not result in significant cumulative effects on soils at the watershed level.

4.14.3.4 Water Resources and Wetlands

Groundwater

No EPA-designated sole source aquifers would be affected by the Project. The foundations for structures at the Jordan Cove terminal and the pipeline trench would be too shallow to affect local aquifers. The LNG terminal would result in 34 acres of impervious surface, which should not have significant impacts on the recharge of regional groundwater. About 30 acres would be covered by Pacific Connector's aboveground facilities. There are four wells within the Roseburg Forest Products tract. Jordan Cove would not obtain any water from the Roseburg wells nor

would any construction activities for the terminal have any impacts on the Roseburg wells. Water to be used during construction and operation of the LNG terminal facilities would come from the existing CBNBWB water line. The CBNBWB water supply is derived from groundwater wells on the North Spit. About 1,766 million gallons of water would be used during terminal construction, and about 483 million gallons per year would be used during operation of the facilities, including the South Dunes Power Plant. We reviewed a USGS study analyzing the watershed's rainfall, geology, and hydrology for the North Dune aquifer that concluded 10 million gallons per day may safely be withdrawn (out of the 17 million gallons per day available; Jones 1992). Jordan Cove would prevent the contamination of groundwater from spills of hazardous materials during construction and operation of its facilities by following its Project-specific SPCCP. Therefore, we conclude that the Jordan Cove Project would not have a significant cumulative impact on groundwater resources.

Pacific Connector would use about 62 million gallons of water, obtained from commercial or municipal sources, private supply wells, or surface water sources, for hydrostatic testing of its pipeline. Hydrostatic test water would be discharged in vegetated uplands to promote infiltration and recharge groundwater resources. However, some water would likely be discharged in different watersheds than it was drawn from. Pacific Connector identified eight water wells within 150 feet of its pipeline route; all are used for irrigation, not drinking water. To prevent the spilling of oil or fuel during construction from contaminating groundwater resources, Pacific Connector would follow the measures outlined in its Project-specific SPCCP and its *Groundwater Supply Monitoring and Mitigation Plan*.

Construction of the pipeline would require clearing of about 6,000 acres of vegetation, which would consequently lower the transpiration potential in the immediate area of the right-of-way. This may result in a minor increase in the groundwater supply in the root zone. Over 9,500 acres of forest management activities spread over eight fifth-field watersheds are identified in table 4.14.2.3-1, including thinning of young stands and harvest of mature stands, would also reduce transpiration and could temporarily increase groundwater until the forest vegetation regrows. The Project, in combination with the reasonably foreseeable silvicultural actions listed in table 4.14.2.3-1, are not expected to result in substantial effects on groundwater yields, or peak or base flows, because sufficient forest canopy would remain in all watersheds crossed. Forest regrowth in past clearcut harvest units would increase canopy closure and transpiration levels, reducing peak flows. Therefore, potential cumulative impacts on groundwater from cumulative activities in these watersheds are not expected to be significant.

The removal of four Klamath River dams and their associated reservoirs (if implemented) would likely reduce groundwater supplies in the Klamath River Basin (USDOI and CDFG 2012). Section 4.4.6.1.2, Ground Water Recharge, of the Klamath Facilities Removal EIS (USDOI and CDFG 2012) concludes that water pooled in reservoirs feeds groundwater and that dam removal would allow more of the rain and snowmelt to quickly flush through the area rather than being retained in the reservoir. Also, more water may be pumped from area wells to replace water currently taken from the reservoirs. While the Klamath River Basin dam removal project would affect groundwater resources in the region, the Pacific Connector Pipeline Project is not expected to significantly add to these effects on groundwater.

Surface Water

Lower Coos Bay, within the project area, is listed on the Oregon 303(d) list as water quality limited for fecal coliform. There would be no discharge of sanitary waste from the Project to Coos Bay; therefore, the Project would not contribute to cumulative impacts on fecal coliform levels in Coos Bay. Other projects we identified in the Coos Bay watershed that may affect surface waters include COE maintenance of the navigation channel, and the Port's proposed navigation channel improvement project.

Within the Coos Bay estuary, short-term cumulative impacts can be expected from the access channel construction, pipeline trenching across Hayes Inlet, and COE channel maintenance dredging. Construction of both the access channel and the pipeline across Haynes Inlet would be scheduled during the recommended ODFW in-water work periods between October and mid-February to minimize impacts on aquatic species in the estuary. The main impacts from dredging and trenching in the bay would be turbidity and the extent of the sediment plume. Those impacts would be temporary and localized. Pipeline installation across Haynes Inlet would take less than three weeks, and the sediment plume would dissipate to background levels within 200 feet. Pacific Connector would minimize impacts on Coos Bay by following the measures outlined in its *Report on Preliminary Pipeline Study Haynes Inlet Water Route*.

The pipeline route would cross 19 fifth-field watersheds, with proposed access roads crossing an additional five watersheds. The construction of the Pacific Connector pipeline would affect waterbodies at 265 locations; 35 of these locations are not crossed by the pipeline but are located within the right-of-way or workspaces. Thirty-five waterbodies crossed, in 10 fifth-field watersheds, are listed as Category 4 and 5 with impaired water quality. Pacific Connector would cross 29 of the waterbodies with limited water quality using dry-crossing techniques, while five others would be crossed with bores, HDDs, or DP technologies. Potential cumulative impacts within the fifth-field watersheds could include turbidity and sediment from construction and runoff from areas cleared during construction. Again, impacts would be temporary and localized. Most dry-crossings would be done within a 48-hour time frame, during the ODFW recommended in-water work windows. Suspended sediment levels in streams would return to background levels within 100 feet of a crossing. Pacific Connector would reduce erosion and sedimentation into streams by following the measures outlined in the FERC staff's *Plan* and *Procedures* and its ECRP.

The projects listed on table 4.14.2.3-1 include approximately new road construction, 99 miles of road improvement and renovation, and 55 miles of road decommissioning. These projects involve vegetation removal and soil disturbance and have the potential to generate sediment. Standard BMPs and LMP standards designed to protect soil would be implemented to reduce sediment. In addition, table 4.14.2.3-1 identifies 10 culvert replacements and 7.5 miles of instream habitat improvement. These projects are likely to cause short-term increases in turbidity.

Removal of riparian vegetation that provides shade at the edge of streams can increase water temperatures. Pacific Connector's water temperature studies predicted a maximum increase of 0.2°C within one 75-foot clearing. The analysis showed that elevated water temperatures would return to ambient levels within a maximum distance of 25 feet downstream of the pipeline corridor. All temperature impacts were predicted to decrease with time as vegetation returns to

provide shade, with significant recovery occurring between 5 and 10 years following disturbance. If another project resulted in shade removal along the same waterbody, at or near the proposed crossing location, there could be a cumulative effect to stream temperature. However, because measurable temperature increases are only expected to occur within streams with extremely small flow volumes, the contribution of this Project to cumulative stream temperature changes would be minimal. Regrowth of forests in past clearcut harvest areas, especially on federal lands, is expected to improve riparian conditions over the next several decades. In addition, mitigation for the Project is designed to improve riparian and aquatic conditions over time.

Taken together, the Project and the projects identified in table 4.14.2.3-1 are not expected to cause significant cumulative impacts to surface waters. Where silvicultural actions occur on federal lands, standards and guidelines/management direction for Riparian Reserves, LSRs, and the Matrix would continue to be consistent with the ACS. Therefore, no substantial effects on water yields and peak and base flows would be anticipated. Forest clearing associated with pipeline construction and operations, as well as from foreseeable forestry operations, would not have a substantial influence on water yields, peak flows, or base flows within any of the watersheds crossed by the Project. Table 4.14.3-1 shows that the Project, project-associated mitigation, and other known projects would generally affect less than 3 percent of most watersheds. The exceptions are the Elk Creek (6.7 percent), Upper Cow Creek (8.4 percent), and Trail Creek (26.2 percent) Watersheds (table 4.14.3-1). The Trail Creek watershed has the greatest level of disturbance; however, this is primarily due to clearing within the transient snow zone, which is not likely to have a measurable influence on peak flows (as discussed in section 4.4.2.5). The ODF's Riparian Management Area rules in OAR 629-635 0000 through 0310 would protect stream banks on non-federal lands, requiring buffer widths based on stream type and size. In riparian areas on private lands, shrubs and trees will be planted across the right-of-way for a width based on Riparian Management Area widths or to the limit of the existing riparian vegetation where the riparian vegetation does not extend to 100 feet. Therefore, we would not expect Project impacts to water resources to be cumulatively significant.

Wetlands

Approximately 38 acres of wetlands would be impacted by construction of the Jordan Cove LNG Project. Jordan Cove developed a *Compensatory Wetland Mitigation Plan* to address unavoidable impacts to wetlands. Impacts on freshwater wetland resources would be mitigated via the West Bridge and West Jordan Cove Mitigation Sites (see Part A of Jordan Cove's draft *Compensatory Wetland Mitigation Plan*). Impacts to estuarine wetland resources would be mitigated via the Eelgrass Mitigation Site and Kentuck Slough Mitigation Site (see Part B of Jordan Cove's *Compensatory Wetland Mitigation Plan*).

The Pacific Connector pipeline route would cross approximately 9.4 miles of wetlands. Construction of the pipeline would initially impact 195.9 acres of wetlands. After pipeline installation, most wetlands would be restored. However, forested wetlands within the 30-foot-wide portion of the operational easement would be permanently converted to herbaceous wetlands. Pacific Connector would reduce impacts on wetlands by following our *Procedures*. Approval of Project-specific wetland mitigation plans by agencies would be required prior to issuance of permits.

BLM and Forest Service projects listed in table 4.14.2.3-1 are not expected to adversely affect wetlands. Wetlands on federal lands are protected under the respective LMPs. Removal of the four Klamath Dams would adversely impact approximately 245 acres of wetland, most of which would be temporary (USDOI and CDFG 2012). Restoration actions identified in the Reservoir Management Plan would restore 272 acres of wetlands. Other projects may also affect wetlands. For example, the 69-acre Ocean Grove residential development site in the Coos Bay watershed contains wetlands. The developer is still in the permitting stage and wetland protection and mitigation have not been finalized. NOAA Coastal Services Center (2014) data indicate that there has been a net gain of 211 acres of wetland in Coos County, 1,600 acres in Douglas County, and 25 acres in Jackson County since 1996. Based on the relatively small amount of wetlands that would be permanently affected by operation of the Project, and proposed mitigation, we conclude that it would not incrementally add to cumulative significant adverse impacts on wetlands within a regional context.

4.14.3.5 Vegetation and Timber

Construction of the Jordan Cove LNG terminal and related facilities would affect about 397 acres of vegetation. This would include impacts on about 102 acres of forested and woodland, 200 acres of shrubs, herbaceous, or other associations, and 95 acres of disturbed land. Approximately 251 acres of this impact would be permanent loss, as the vegetation would be replaced by operational industrial facilities. To compensate for the loss of habitat resulting from vegetation removal, Jordan Cove would acquire a total of about 259 acres at three off-site parcels for the long-term preservation of about 102 acres of coastal dune forest, 1 acre of riparian forest, and 62 acres of shrubs.

Construction of the Pacific Connector pipeline would impact approximately 4,523 acres of vegetation. This would consist of 2,882 acres of forested lands, 643 acres of grasslands/shrublands, 103 acres of wetland/riparian areas, and 896 acres of agricultural areas. Of the forested land crossed, about 821 acres of LSOG, 821 acres of mid-seral, and 1,240 acres of clear-cut or regenerating forests would be impacted. On federal lands, about 17,379 MBF of timber would be cut and removed from the pipeline right-of-way. During operation of the Pacific Connector Project, a 30-foot-wide corridor along the pipeline right-of-way would be kept clear of trees that have roots that could compromise the integrity of the pipeline coating, resulting in a long-term loss of 158 acres of LSOG forests, 156 acres of mid-seral forests, and 215 acres of clearcut/regenerating forests. Pacific Connector would fund various projects on federal lands that would mitigate for the impacts related to amendments to the BLM and Forest Service LMPs. Projects to improve forest structure and health and reduce the effects of wildfires are included in this mitigation package.

Table 4.14.3-1 shows that Project-related impacts range from less than 0.01 percent to nearly 3 percent of the affected watersheds. Impacts on vegetation from the Project, other federal projects, and other foreseeable actions generally affect less than 3 percent of any watershed (the exceptions being Elk Creek-South Umpqua, Upper Cow Creek, and Trail Creek watersheds). NOAA Coastal Services Center (2014) data indicate that there has been a net loss of about 47,270 acres of forest in Jackson, Douglas, and Coos Counties (and a corresponding gain in shrubland) since 1996. Implementation of new LMPs on both BLM and NFS lands in the 1990s resulted in a substantial reduction in lands available for timber harvest due to the establishment of LSRs and Riparian Reserves. Regrowth in previously harvested areas will, over time, result in

more area supporting LSOG. The actual rate of regrowth will be affected by the level of management activity by land allocations as well as the level of disturbance from fires, insects, and diseases. Therefore, we would not expect Project impacts due to vegetation and timber disturbance to be cumulatively significant at either the region or watershed level due to size of the Project footprint relative to the extent of vegetation cover in the analysis area.

4.14.3.6 Wildlife and Aquatic Resources

Wildlife

Any increase in local traffic volume due to Project construction has the potential to contribute to cumulative direct impacts to wildlife due to animals being struck by vehicles traveling to and from construction sites. Species most susceptible to vehicle-related mortality include those that are inconspicuous (salamanders, frogs, snakes, small mammals), have limited mobility (amphibians), burrowing species (mice and voles, weasels, beaver, frogs and toads, snakes, subterranean mollusks), wildlife with behavioral activity patterns making them vulnerable, such as deer that are more active at dusk and dawn, and wildlife that may scavenge roadside carrion (Leedy 1975; Bennett 1991; Forman and Alexander 1998; Trombulak and Frissel 2000). Less mobile species are more susceptible to direct mortality related to Project construction activities. More mobile species are likely to temporarily relocate to adjacent similar habitats during Project construction.

Jordan Cove has filed a plan to mitigate for loss of habitat by preserving about 259 acres of forest and shrub vegetation at three off-site parcels. Jordan Cove and Pacific Connector would reduce impacts on migratory birds by following the measures outlined in their *Migratory Bird Conservation Plan.*

Construction of the Pacific Connector pipeline would create edge habitats through contiguous forest and woodland vegetation types. Different species composition and abundance occur in edge habitats (Forman and Gordon 1986) than within patch interiors. Habitat fragmentation is an ongoing process within the watersheds crossed by the Project, as a result of many factors, including timber harvests, agricultural expansion, utility construction, and urban and residential development. These sources of habitat fragmentation are expected to increase in the foreseeable future, except in LSRs where fragmentation would slowly decrease as interior stand conditions expand and roads are decommissioned. Project construction and related habitat alteration would contribute to cumulative impacts to important wildlife habitats such as late serial forest and snags and down wood. Following construction, habitat and ecosystem function would be restored in place where possible and, where not possible, off-site mitigation would occur.

In addition to thinning, planting, and fuel reduction (discussed above), proposed mitigations on federal lands to benefit wildlife include:

- decommissioning roads in LSRs that are identified by the BLM and the Forest Service as being no longer required for management activities, which reduces fragmentation, barriers to movement of less mobile species, and vehicle-related injury and mortality;
- acquiring title or easement to private lands adjacent/near the pipeline that could be managed/preserved as late successional habitat, which increases connectivity; alternatively, Pacific Connector may find and acquire these easements or properties and deed them to a conservation organization or trust;

- conversion of Matrix lands to LSR, which allows more land to be managed for late successional species; and
- creating snags, which provides habitat for primary and secondary cavity nesting species.

The BLM and Forest Service have identified ongoing and reasonably foreseeable future actions that have occurred or will occur within the watersheds that also would be affected by the pipeline (table 4.14.2.3-1). Those activities have affected and will continue to affect wildlife in many ways. Silvicultural actions, such as density management projects, are expected to improve dispersal and late-successional habitat conditions. Furthermore, treatments, such as density management or hardwood conversion to restore large conifers to Riparian Reserves, would also improve habitat conditions in the long term and would function to minimize potential cumulative watershed habitat impacts.

There are more than 2 million acres within the 19 watersheds crossed by the Project (665,000 acres of which are federal lands). Given the landscape scale of all the combined acres within the watersheds of the project area, the incremental increase in habitat fragmentation caused by the Project, with other known projects in the region, would not have a significant cumulative impact on wildlife.

Aquatic Resources

Potential impacts on marine aquatic species from the Jordan Cove LNG Project include LNG vessel strikes on marine mammals and sea turtles while traveling in the waterway to and from the Jordan Cove terminal; fish stranding from LNG vessel wakes; introduction of non-native species during the release of ballast water from LNG vessels; entrainment or entrapment during water intake for engine cooling while an LNG vessel is at the dock; changes in water temperature in the slip from release of engine cooling water or loading of LNG; increases in erosion, sediments, or turbidity into Coos Bay caused by propeller wash, construction of terminal facilities; and the inadvertent release of LNG, oil, or fuel, and stormwater runoff from the terminal. Slow LNG vessel speed in the Coos Bay navigation channel would produce small wake waves not capable of causing significant shoreline erosion or fish strandings. The Coast Guard has regulations for ballast water releases that would prevent the introduction of exotic non-native species. The limited amount of water used for LNG vessel engine cooling at the berth would result in percentages of entrainment and entrapment that would not be much greater than natural levels of mortality for invertebrate larval stages in Coos Bay. Further, sedimentation would be reduced by Jordan Cove following its ESCP, and the chance for spills of hazardous materials would be reduced by Jordan Cove following its SPCCP.

The Pacific Connector pipeline also has the potential to affect marine species within the Coos Bay estuary, during its wet open-cut crossing of Haynes Inlet. Many of the waterbodies that would be crossed by, or adjacent to, the pipeline are known or assumed to have fish. Impacts the pipeline may have on aquatic species when crossing waterbodies could include increases in erosion, sedimentation, and turbidity, and minor increases in water temperature due to reduction of shade where riparian vegetation is removed along stream banks; however, those impacts would be temporary and localized. The wet open crossing of Haynes Inlet would take less than three weeks, and would result in increases in TSS of 50 mg/l up to 100 feet away. Likewise, dry crossings of streams along the pipeline route would be accomplished in less than two days each, with TSS increased to 20 mg/l within 100 feet downstream of individual crossings. Pacific

Connector would reduce sedimentation by following our *Procedures* and its ECRP. The applicant's average estimate for temperature increase at 15 modeled stream crossings was 0.03°F, which would not significantly affect aquatic resources. These temperature effects were generally reinforced by site-specific assessments performed for the BLM and Forest Service on perennial stream crossings on BLM and NFS lands (NSR 2015). These specific BLM and Forest Service studies also noted rapid cooling in vegetated sections below the crossing. Even with estimated increases, temperatures would remain in a suitable range for fish stocks.

About 20 miles of new temporary road construction, about 100 miles of road renovation, and about 55 miles of road decommissioning, as well as riparian improvements, culvert replacement, dam removal, and other projects listed in table 4.14.2.3-1, would affect aquatic habitats. Most impacts would be short term. Removal of the four Klamath River dams would have adverse short-term impacts due to increases in turbidity. However, dam removal would have beneficial long-term impacts on aquatic habitat by restoring natural flow regimes and reducing low oxygen levels and high water temperatures, and removing obstacles for fish migration.

The watershed conditions from the past actions are expected to improve over the long term because of current management direction and practices outlined in the current land and resource management plans, standards and guidelines, and BMPs that apply to all management actions on federal lands. Forest practices on private timber lands are subject to ODF regulations designed to protect water quality and fish and wildlife habitats. Further, watershed associations have been formed throughout the project area to accomplish watershed restoration activities to achieve long-term sustainable watershed health. Therefore, the Project, in combination with reasonably foreseeable silvicultural actions or other projects that may occur within the watersheds crossed by the Pacific Connector pipeline, would not cause significant cumulative effects to aquatic species or habitats.

4.14.3.7 Threatened and Endangered Species

Federally-listed threatened, endangered, and proposed species, and anticipated impacts on these species that may result from the Project. Our findings of effects on listed species were presented in detail in the BA we submitted to the FWS and NMFS in February 2015. While the BA considers cumulative effects from the Project and from foreseeable projects on private lands, the cumulative effects considered in this FEIS also include foreseeable projects and activities on federal land.

Table 4.7.1-1 lists 33 federally listed species or ESUs that may occur within the project area. We have determined that the Project is not likely to have an adverse effect on 18 listed species or ESUs, and that the Project is likely to have an adverse effect on the remaining 15 listed species or ESUs. These include the fisher, MAMU, NSO, green sturgeon, eulachon, two coho salmon ESUs, Lost River sucker, shortnose sucker, vernal pool fairy shrimp, Applegate's milk-vetch, Gentner's fritillary, large-flowered meadowfoam, and Kincaid's lupine. The listed species that the Project "may have adverse effects" on, as defined by the ESA, are discussed in more detail below.

Fisher (West Coast DPS)

The pipeline route would remove approximately 858 acres of LSOG habitat, including snags that could serve as fisher dens. Fishers have been observed infrequently in the vicinity of the Project, but if present, could be disturbed by pipeline construction.

Proposed federal mitigation projects described in section 2.1.4 in chapter 2 (table 2.1.4-1) on NFS and BLM lands could benefit fishers. These projects include stand thinning to improve the growth of trees, fuel reduction to reduce wildfires, and the reallocation of Matrix land to LSR. Forest clearing associated with the Project, coupled with timber harvests (primarily on private land) and forest clearing for new developments, would contribute to cumulative effects to this species. Based on the rate of LSOG forest loss between 1996 and 2006, we estimated that other projects would remove a total of about 5,042 acres of LSOG between 2012 and 2017 on non-federal lands within the fisher analysis area. There are approximately 330,360 acres of LSOG habitat within the fisher analysis area across the four physiographic provinces crossed by the pipeline route. The Project would remove about 0.26 percent of LSOG habitat in the analysis area. Cumulative effects on fisher would be minimized by Project design features, mitigation measures proposed for NSO that would benefit the fisher (including off-site habitat enhancement), and the fact that other projects on federal lands would be required to comply with the ESA.

Marbled Murrelet (MAMU)

Pacific Connector identified 168 occupied and presumed occupied MAMU stands within 0.25 mile of the proposed action, or within 0.5 mile of federally designated critical habitat that would be affected by the proposed action. Habitat would be removed from 25 of those stands by the Project. Construction of the Project would remove a total of about 901 acres of MAMU habitat, including about 55 acres of suitable habitat removed from 25 stands. There is the potential that indirect impacts could extend over a total of about 6,767 acres of suitable nesting habitat in the project area, where Project-related noise, primarily use of access roads, may affect MAMU behavior, including breeding activities. Other foreseeable projects on federal lands listed in tables 2.1.4-1 and 4.14.2.3-1 are designed to be neutral or beneficial to MAMU.

Removal of suitable nesting habitat by harvest of mature and old-growth timber has been cited as the primary reason for the decline of MAMUs (FWS 1992). Forest clearing associated with the Project, coupled with continued timber harvest (primarily on private land) and forest clearing for other development projects, would contribute to cumulative effects on this species. FWS estimates there is approximately 408,621 acres of occupied suitable MAMU habitat in Oregon, which is 51 percent of reported suitable habitat (McShane et al. 2004). Within the analysis area, there are about 13,743 acres of suitable habitat and 13,020 acres of recruitment habitat. We estimate that construction of the pipeline would remove about 0.4 percent of the suitable habitat and 2 percent of the recruitment habitat in the analysis area. Therefore, we conclude that cumulative impacts on MAMU would not be significant.

Northern Spotted Owl (NSO)

The pipeline route would cross through 99 NSO home ranges and 10 nest patches. Sixty-two activity sites occur in federally designated CHUs. About 37 miles of pipeline route would cross 7 designated critical habitat sub-units. Project construction would remove a total of about 522

acres of NRF habitat for NSO, including high NRF habitat, of which 137 acres would be permanently lost within the 30-foot-wide corridor maintained in an herbaceous state.

Proposed federal mitigation projects described in section 2.1.4 in chapter 2 (table 2.1.4-1) on NFS and BLM lands would benefit NSO to varying degrees. These projects include stand thinning to improve the growth of trees, fuel reduction to reduce wildfires, and the reallocation of Matrix land to LSR. Forest clearing associated with the Project, coupled with timber harvests (primarily on private land) and forest clearing for new developments, would contribute to cumulative effects to this species. Based on the rate of LSOG forest loss between 1996 and 2006, Pacific Connector estimated that other projects would remove a total of about 5,997 acres of high NRF and 10,348 acres of NRF habitat between 2012 and 2017 on non-federal lands within the physiographic regions crossed by the pipeline route. There are approximately 94,529 acres of suitable NRF/high NRF habitat, and 56,118 acres of dispersal habitat within the provincial analysis area across the four physiographic provinces crossed by the pipeline route. The Project would remove about 0.6 percent of suitable NRF/high NRF habitat and 1.2 percent of total available dispersal habitat in the provincial analysis area. There are about 3,478,365 acres within the four federally designated CHUs for NSO within the provincial analysis area; the Project would remove about 489 acres of NSO habitat within the CHUs. Cumulative effects on NSOs would be minimized by Project design features, mitigation measures (including off-site habitat enhancement), and the fact that other projects on federal lands would be required to comply with the ESA.

North American Green Sturgeon – Southern DPS

The NMFS has designated critical habitat for the Southern DPS of North American green sturgeon to include all tidally influence area of Coos Bay, up to Catching Slough. Project-related impacts on green sturgeon within Coos Bay would include shoreline erosion from LNG vessel waves, fish stranding from vessel wakes, increased sedimentation or turbidity caused by propeller wash or dredging of the access channel and trenching of the pipeline across Hayes Inlet, and entrainment and impingement from vessel water intake at the Jordan Cove LNG terminal berth. Slow LNG vessel speed in the Coos Bay navigation channel would not cause major shoreline erosion or fish strandings. Dredging to create the Jordan Cove access channel and construction of the pipeline across Haynes Inlet would be done within a short timeframe, with minor amounts of suspended sediments raised within a few hundred feet of the work areas. These temporary and localized Project-related impacts are not likely to have significant population-level effects on green sturgeon.

Other projects in Coos Bay that could contribute to cumulative impacts on green sturgeon include the Port's improvements to the Charleston Marina, and both channel maintenance dredging and the proposed channel widening project that would conducted by the COE. Both the Port and the COE would have to implement measures that would minimize impacts on aquatic resources in the bay; and the COE would have to satisfy the requirements of the NEPA and ESA. Therefore, we conclude that these other projects, in addition to the JCE & PCGP Project, would not have significant cumulative impacts on green sturgeon.

Pacific Eulachon – Southern DPS

NMFS has identified the eulachon southern DPS as those populations which spawn in rivers south of the Nass River in British Columbia, Canada, to and including the Mad River in California (NMFS 2008b). The southern DPS has been further segregated into four subareas:

Klamath River, Columbia River, Fraser River, and British Columbia coastal rivers south of the Nass River (NMFS 2008b). While 16 distinct regions in Washington, Oregon, and California have been designated as critical habitat, none has been designated in the Coos Bay estuary. Their known distribution in the project area is limited to the outer half of Coos Bay, and the coastal marine environment.

Project-related impacts on Pacific eulachon within Coos Bay and nearshore marine environment would include potential burial from dredge spoil discharge at Site F just outside of Coos Bay, and potential entrainment during LNG water intake. Stranding from ship wake is unlikely due to fish size and low wave height, and sediment from dredging would be limited in amount and distribution not causing substantial effects directly or indirect to these fish.

Other projects in Coos Bay that could contribute to cumulative impacts to eulachon similar to those for green sturgeon include marina development, and maintenance dredging and discharge. These actions would be dealt with through other NEPA, ESA, and permitting process that would consider their effects to eulachon. Therefore, we conclude that these other projects, in addition to the JCE & PCGP Project, would not have substantial cumulative impacts on eulachon.

Coho Salmon (Southern Oregon/Northern California Coast [SONCC] ESU and Oregon Coast ESU)

The SONCC coho salmon ESU extends along the coast of the Pacific Ocean from Punta Gorda, California, to Cape Blanco, Oregon. The project area includes two components that encompass the SONCC coho salmon ESU: (1) the marine environment overlapped by the EEZ off the coast of southwestern Oregon; and (2) the riverine environments of four fifth-field watersheds crossed by the pipeline, including the Trail Creek, Shady Cove-Rogue River, Big Butte Creek, and Little Butte Creek sub-basins.

The Oregon Coast coho salmon ESU includes all naturally spawned populations of coho in Oregon coastal streams south of the Columbia River and north of Cape Blanco. There are three Critical Habitat subbasins that coincide with the Project: South Umpqua Subbasin and Coquille Subbasin, which are crossed by the Pacific Connector pipeline; and Coos Subbasin (HUC 17100304), which includes the Coos Bay estuary where the LNG terminal and slip and the in-water portion of the Pacific Connector pipeline route would be located.

Project-related impacts to both the SONCC ESU and Oregon Coast ESU overlapping the marine environment of the EEZ and Coos Bay are similar to that mentioned for the green sturgeon above. Project-related impacts on fish in upland streams include bank erosion and increased turbidity, as well as loss of shade from removal of riparian vegetation, which can raise water temperatures. As discussed above under impacts on aquatic resources, the pipeline would cross most streams in a day or two, with minimal suspended sediments downstream. The removal of riparian shade by pipeline clearing would raise most stream temperatures less than a degree at the crossings. Those impacts would be temporary and localized, and would not cause significant population-level effects on listed salmon species that occupy streams crossed by the Pacific Connector pipeline. The BLM and Forest Service mitigation actions were developed in consideration of the recovery plan objectives for this species.

Cumulative effects to SONCC and Oregon Coast coho salmon would also be generated by timber harvesting within the same waterbodies (from the point of crossing downstream to the

farthest extent of project effects on water quality) and on their associated riparian zones. Forest clearing, especially riparian forest clearing, affects salmon habitat. While the ODF Administrative Rules provide some protection to fish-bearing streams on state and private land, the narrower riparian zones described in the ODF Administrative Rules for forest practices provide less protection to streams and riparian areas than regulations on federal lands. Effects on coho salmon from future timber harvests on state and private lands are assumed to be similar to those that have occurred in the past and are not expected to result in a significant improvement to coho salmon habitat. Management on federal lands consistent with the ACS, including actions intended to maintain and restore Riparian Reserves and LSRs is expected to improve coho salmon habitat over time, in spite of timber harvests on non-federal lands. Maintaining forested areas along streams is particularly critical in preserving important stream habitat qualities for coho salmon. The Project is estimated to remove about 25 acres of LSOG riparian forest, or about 2 percent of the total in the four fifth-field watersheds containing the SONCC coho salmon. The Project is estimated to remove about 14 acres of LSOG riparian forest, or about 0.03 percent of the LSOG combined in the 10 fifth-field watersheds containing the Oregon Coast coho salmon.

Overall, Pacific Connector would clear only a very small area of riparian vegetation adjacent to salmon-bearing streams, in relationship to the size of the total watersheds that contain both SONCC and Coastal Oregon ESUs. Therefore, we conclude that the Project would not incrementally add greatly to the cumulative impacts of other projects that may affect SONCC and Coastal Oregon coho salmon ESUs.

Lost River and Shortnose Suckers

The present distribution of the Lost River sucker and shortnose sucker include the Lost River, Upper Kamath Lake, Clear Lake, Tule Lake, Gerber Reservoir, the Klamath River downstream to the Copco Reservoir, and the Sprague and Williamson Rivers, Wood River, Willow Creek and Crooked Creek. Pacific Connector proposes to cross the Klamath River using an HDD between July and October, and would use dry open-cut methods to cross the Lost River between July 1 and March 31. There are seven intermittent-flowing drainages in Klamath County that are presumed to provide suitable habitat for Lost River sucker and shortnose sucker when the streams are wet that would be crossed by the pipeline using dry open trench methods between July 1 and March 31 when the area would not support these fish species (i.e., when the waterbodies are dry). Within the Klamath Basin, the pipeline route would cross 26 irrigation facilities related to Reclamation's Klamath Project. Twenty-three of those irrigation ditches would be crossed using dry open-cut methods during the winter, when they are either dry or contain low water levels, in accordance Pacific Connector's *Klamath Project Facilities Crossing Plan* and its *Winter Construction Plan for the Klamath Basin*. The C Canal and the G Canal would be bored. Construction along Spread 5 between MPs 188.0 and 228.1 would be conducted between October of pipeline Year One and November of Year Two.

Turbidity generated by the crossing of waterbodies in the Klamath Basin using dry open-cut methods would be low enough to not affect any Lost River sucker or shortnose sucker downstream of the crossing locations. There is no riparian vegetation along those stream banks that provide shade that would be removed by the Project, so the pipeline crossings should not raise water temperatures. Because of the Project design BMPs, and mitigation plans that would be implemented by Pacific Connector during construction of its pipeline through the Klamath

Basin, the Project should not greatly incrementally add to adverse cumulative impacts on the Lost River sucker and shortnose sucker.

All land within the Klamath River-John C. Boyle Reservoir watershed, 99 percent within the Lake Ewauna-Upper Klamath River watershed and 94 percent within the Lower Lost River fifth-field watershed, is non-federal. Degradation of water quality due to livestock grazing, agriculture, and timber harvest has resulted in hyper-eutrophic conditions in Upper Klamath Lake. That in turn has led to algal blooms with increased mortality of suckers when oxygen depletions occur due to eutrophication, particularly during summers when high temperatures combined with nutrient loading from pumping diked wetlands and runoff from farms.

Removal of the four Klamath dams would, if implemented, greatly improve habitat for Lost River suckers and shortnose suckers over the long term. The USDOI and CDFG (2012) EIS estimates that removing the dams would open 420 miles of historic habitat for the first time in more than a century and restore aquatic conditions favorable to these two species. Dam removal is scheduled to take place in 2020, if approved by Congress.

Vernal Pool Fairy Shrimp

Vernal pool fairy shrimp are imperiled throughout their range by urban development, agricultural conversion, recreational activities such as OHV use, and human-made changes to hydrologic patterns. Much of the vernal pool habitat in the vicinity of the Project can be found within Jackson County; concentrated within the Agate Desert, Table Rocks, and White City core areas. Human population in this region grew by almost 19 percent between 2000 and 2010. The Jackson County planning department is currently reviewing multiple permit applicants for projects proposed within and around these core vernal pool areas. Although Jackson County was not able to provide a comprehensive list or details regarding these projects, any developments that could potentially affect vernal pool habitat would be required to comply with COE and ODSL requirements as well as consult with the FWS regarding potential effects that the proposed development could have to ESA listed fairy shrimp.

Five pipe yards proposed by Pacific Connector are located within the Eagle Point and Sams Valley quadrangles are within 3 miles of 10 designated CHUs for vernal pool fairy shrimp within the Vernal Pool Complex – Agate Desert, Jackson County, Oregon. Project use of pipe storage yards may indirectly affect hydrology upon which vernal pools and associated vegetation are dependent, indirectly affecting individuals, habitat and designated critical habitat within 527 feet of the proposed action (20 acres of habitat is considered essential for intact hydrology and 527 feet is the radius of a circle with an area of 20 acres). Nine vernal pools (approximately 0.2 acre) within and adjacent to the proposed right-of-way that are on private lands (MPs 145.34 and 145.40) may also provide suitable habitat for the vernal pool fairy shrimp; however, this suitable habitat has not been surveyed for vernal pool fairy shrimp. Without surveys to confirm non-occupancy, direct effects from construction of the pipeline to vernal pool fairy shrimp and their habitat are unknown at this time.

According to the FWS Recovery Plan, there is about 3,650 acres of vernal pool fairy shrimp habitat within the Agate Desert area. The identification of about 0.2 acres of vernal pool habitat within the right-of-way is a small portion of the total habitat in the region. Pacific Connector would avoid using areas that may contain vernal pool fairy shrimp, and if this species is found

during survey efforts, Pacific Connector would implement proper sedimentation control barriers to minimize potential impacts to vernal pool fairy shrimp. We conclude that although the Project may result in a small incremental addition to the cumulative impacts of all projects, any adverse effects of the Project on vernal fairy shrimp would not be significant.

Applegate's Milk-vetch, Gentner's Fritillary, Large-flowered Meadowfoam, and Kincaid's Lupine

We have determined that the Project is likely to adversely affect four federally listed plant species: Applegate's milk-vetch, Gentner's fritillary, large-flowered meadowfoam, and Kincaid's lupine (see section 4.7 of this EIS and our BA). Except for large-flowered meadowfoam, botanical surveys sponsored by Pacific Connector found these species present within or adjacent to the pipeline construction right-of-way. Pacific Connector's *Compensatory Mitigation Plan* included a *Federally-listed Plant Conservation Plan* for the Applegate's milk-vetch, Gentner's fritillary, Kincaid's lupine, and Cox's mariposa lily. In general, the plans include the following measures:

- equipment would be inspected and cleaned prior to working in the areas where the plants have been found;
- known plant populations would be fenced and protected;
- individual plants in the construction right-of-way that cannot be avoided would be salvaged;
- topsoil would be segregated along the right-of-way in all plant areas; and
- specific seed mixtures would be used during restoration of the areas.

In the case of Gentner's fritillary and Cox's mariposa lily, bulbs and seeds would be collected for off-site replanting. Those new populations would be monitored over time.

In addition to the applicant prepared *Federally-listed Plant Conservation Plan* and the BLM and Forest Service required mitigation discussed above, the applicant filed with FERC an Amendment to the Draft Compensatory Mitigation Plan (appendix F-2) related to compensatory mitigation for impacts to Applegate's milk-vetch, Gentner's fritillary, and Kincaid's lupine. The amendment lists the following measures aimed at compensating for impacts to these ESA listed plants (these are direct quotes from the Amendment):

A. *Fund conservation easements/land acquisition and third party management/maintenance for ESA-listed plants, as identified by the Service including at least $39,108 for Applegate's milkvetch, at least $48,500 for Kincaid's lupine, and at least $47,400 for Gentner's fritillary. (Estimates provided here are for conservation easements; if acquisition was necessary to secure these parcels, the cost would be roughly double.)*

B. *Contribute a combined $114,940 towards additional third party acquisition or research in place of the salvage BMP for both Applegate's milkvetch and Kincaid's lupine.*

C. *Contribute $20,000 to the work of a Service-approved conservation entity in place of the second year of surveys and the associated avoidance and minimization BMPs for Gentner's fritillary.*

D. *Contribute $24,500 to the work of a Service-approved conservation entity in place of the second year of the seed collection BMP for Applegate's milkvetch and Kincaid's lupine.*

E. *Decision-making and receipt and management of funds for parts A-D would be vested as described for the Conservation Program, except that, at the discretion of the Service, funds may be provided directly by Pacific Connector to applicable action entities rather than a third-party fund manager or, if a fund manager is utilized, might be different than the Conservation Program Fund Manager.*

Threats to federally listed plant species include urban development, road and utility line installation and maintenance, agricultural conversion, livestock grazing, timber harvests, recreational activities such as OHV use, fire suppression, spread of invasive weeds, and use of herbicides. Other private projects that may affect listed plant species would include timber harvests. Regulations related to plants listed under the ESA only apply to federal lands or to private lands that are part of a federal permitted action. These species are also protected on state lands due to the state listing of these four species as endangered.

We conclude that although the Project may result in a small incremental addition to the cumulative impacts of all projects, any adverse effects of the Project on these species would not be significant.

4.14.3.8 Visual Resources and Recreation

Visual Resources

LNG vessel traffic in the Coos Bay navigation channel would not have significant cumulative visual impacts, given the short duration of their transit, and the historical use of the Port by deep-draft commercial ships. The largest features of the Jordan Cove LNG terminal complex would be the two storage tanks, which would each be 180 feet high and 267 feet wide, and the HRSG stacks at the South Dune Power Plant which would be about 100 feet tall. These facilities would be most visible from North Bend (south side of McCullough Bridge and Airport Lane) and the bay side of the North Spit (Southport barge dock and BLM boat launch). Cumulative visual impacts would be minimized by the fact that the LNG terminal would be located next to the existing Roseburg Forest Products industrial plant and the color and form of the facilities are anticipated to blend in with the surrounding dunes and industrial setting.

The Pacific Connector pipeline route would not fully meet VRM Class II objectives on BLM lands in the short term at two locations (near the community of Trail and along Clover Creek Road). Implementation of the measures of Pacific Connector's *Aesthetics Management Plan* would ensure long-term compliance with BLM VQOs at these locations (appendix R-8). The pipeline would meet Forest Service visual standards except for three locations within the Rogue River National Forest and two locations within the Winema National Forest. The amendments proposed by the Forest Service (see section 4.1) would enable a finding of consistency with the respective LMPs, primarily by extending the time necessary to allow time for revegetation within and adjacent to the pipeline corridor.

Reasonably foreseeable timber harvests in the watersheds crossed by the pipeline corridor are listed in table 4.14.2.3-1. The majority of the foreseeable timber harvests on federal lands involve thinning younger stands to speed the development of LSOG habitat in LSRs and on the

Matrix lands. These thinning prescriptions would not result in new openings in the forest canopy. Timber harvests on private and state lands would likely result in new openings, which would adversely impact visual resources to varying degrees across the landscape.

Project effects would be minimized by design features and mitigation measures. When considered together, the Project and associated BLM and Forest Service mitigation projects listed in table 2.1.4-1 would not result in significant adverse cumulative visual impacts.

Recreation

The Pacific Connector pipeline route would cross the Hayes Inlet Water Trail, a small segment of the Upper Rock Creek ACEC, three National Scenic Byways (U.S. Highway 101, State Highway 62, and U.S. Highway 97), and one National Scenic Trail (the PCT). Pacific Connector would implement the measures outlined in its *Recreation Management Plan* to minimize impacts on the PCT and the Haynes Inlet Water Trail and their recreational users.

Recreational boaters average about 31,560 trips per year in Coos Bay, the majority of which are for fishing. Dispersed recreational activities, such as hiking, biking, horseback riding, OHV and snowmobile use, hunting, boating, fishing, swimming, and cross-country skiing, occur on public lands throughout southern Oregon, including within the four BLM Districts and three National Forests that would be crossed by the Pacific Connector pipeline route. It has been estimated that in an average year there are about 203,000 hunting trips, and about 3.3 million wildlife viewing trips in Coos, Curry, Douglas, Jackson, Josephine, Klamath, and Lake Counties, Oregon, combined. Given the Project design features, and proposed mitigation measures, we conclude that the Project would not greatly incrementally add to cumulative impacts from other projects on recreational activities or resources.

4.14.3.9 Socioeconomics

During the approximately four years it would take to construct the Jordan Cove LNG terminal and related facilities, an average of 922 workers would be employed. Non-local construction workers and their families would average about 1,109 people. To reduce the pressure on local housing that may be in demand during the tourist season, Jordan Cove would have the majority of its non-local workers reside at its NPWHC.

Construction of the LNG terminal and related facilities would cost about $3 billion in 2011 dollars. About $2.6 billion would be for materials, equipment, and other expenditures, with $653 million of that amount spent in the states of Oregon and Washington combined. Total wages during terminal construction would be $412 million, with $364 million in wages going to people who reside in the states of Oregon and Washington. During construction, Jordan Cove's employees would pay a total of up to $40 million in income taxes to the state of Oregon.

During operation, the LNG terminal would employ 145 people, of which about 70 percent would be local hires. It was estimated that the Jordan Cove LNG terminal would generate about $58 million in annual operating expenses, including payroll, benefits, and contributions to Coos County. Each year during operation of the terminal, Jordan Cove would make contributions through Coos County's Bay Area Enterprise Zone in lieu of taxes. These contributions would consist of $20 million a year in funding for education and $10 million for urban renewal.

An average of about 1,400 workers would be employed over the two-year period it would take to construct the Pacific Connector pipeline and related aboveground facilities. About 700 of the Pacific Connector construction workers would be non-local, and if ten percent brought their families that would bring a total of 840 people to the area. About 30 percent of non-local workers would provide their own temporary housing, such as RVs or pop-up trailers, and about 6 percent of all workers would share accommodations. In the four counties crossed by the pipeline route there are a total of about 7,889 hotel and motel rooms, and about 21,169 rental units available to house non-local workers.

For both the Jordan Cove and Pacific Connector Projects combined, there would be total direct employment of 7,073 FTEs during the entire period of construction, an indirect impact of an additional 5,120 non-project jobs, and 7,353 induced other jobs. The companies would spend a combined total of $4.5 billion to build both the terminal and pipeline, supporting approximately $1.2 billion and $974 million in indirect and induced economic output, respectively. The projects would also support a total of $1.7 billion in direct, indirect, and induced GDP in Oregon and Washington.

Recent, current, or proposed actions that may cumulatively affect resources are identified in table 4.14.2.3-1. Identified projects in the vicinity of the LNG terminal include an off-shore wind energy project, and a runway extension at the Southwest Oregon Regional Airport. Principle Power received a DOE grant in 2012 to develop the 30 MW Windfloat Pacific Demonstration Project about 15 miles off the coast of Coos Bay. Although project-specific data are not available, using the DOE's National Renewable Energy Laboratory's (NREL) Jobs and Economic Development Impact model for offshore wind projects, it is possible to approximate potential regional economic impacts associated with the Principle Power Project. Based on average offshore wind development industry data, construction of the Principle Power facility would directly employ 50 FTE during construction and indirectly support 129 FTE jobs elsewhere in the regional economy, with total earnings of approximately $13.3 million (NREL 2014).

The updated Airport Master Plan for the Southwest Oregon Regional Airport identifies short-, intermediate-, and long-term capital improvement plans that extend from 2013 through 2032 (RS&H 2013). The total cost for the planned runway extension is estimated to be about $27 million, with $19.1 million (70 percent of the total) expected to spent in 2017 (RS&H 2013). These expenditures along with other proposed capital improvements at the airport would support direct and indirect employment and income and result in positive local and regional economic impacts.

The majority of the reasonably foreseeable projects along the length of the pipeline are forest practices projects identified by the BLM and Forest Service. The workforces for these projects may overlap with the Pacific Connector workforce for a period of several weeks. In 2012, a total of 980 MMBF was harvested in the four counties crossed by the Pacific Connector pipeline. Harvests on federal lands accounted for 16 percent of total in the four counties that year (ODF 2013).

The removal of four dams in the Klamath Basin, were it to occur, would also have regional economic effects on Klamath and Jackson Counties, among others (USDOI and CDFG 2012). Removal of the four dams is estimated to cost about $178 million (in 2012 dollars) and support 1,400 direct and indirect jobs and generate approximately $60 million in income.

We conclude that the Project would not have significant adverse socioeconomic cumulative impacts. Population increases from the influx of non-local workers would be less than the average population increases in the four affected counties during the period 2000 to 2012. There is a large enough regional housing market to accommodate the out-of-town workers, and local community institutions or public services, including fire, police, hospitals, and schools should not be greatly stressed by the Project, as explained in section 4.9. When combined with other projects, the JCE & PCGP Project should have a beneficial effect on the regional economy.

4.14.3.10 Transportation

We found that LNG vessels in the waterway to the Jordan Cove terminal would not have significant adverse impacts on recreational boats in Coos Bay, the commercial fishing fleet, and commercial cargo ships that visit the Port. This is because the LNG vessels would traverse the waterway in a short period of time (less than 2 hours between the K-buoy and the terminal), and Jordan Cove and the LNG vessel operators would follow the measures required by the Coast Guard WSR and LOR.

The Port purchased the CBRL in 2010, subsequently undertaking an extensive repair program and fully reopening the line in 2013. The CBRL can carry cargo consisting of wood products, fertilizer, chromite ore, and organic dairy feed into and out of Coos Bay. Jordan Cove would use the railroad to transport materials to the LNG terminal during construction. Over a two year construction period Jordan Cove would have about 82 cargo ships and 18 barges delivering equipment to the terminal. This would be in addition to the approximately 60 deep draft cargo ships and 50 barges that annually visit the Port, and the 200 commercial fishing boats based out of the Charleston Marina.

Jordan Cove estimated that deliveries by trucks to the terminal during construction would number 1,996 in year one; 17,840 in year two; reach a peak of 48,990 in year three; and reduce to 35,232 in year four. Jordan Cove intends to bus construction workers to the terminal from the NPWHC and two other off-site parking lots. Bus trips would number about 5,850 in year one, 42,250 in years two and three, and 13,000 in year four. In this EIS, we recommend that Jordan Cove revise its *Traffic Impact Analysis* to account for truck and bus traffic during construction.

Pacific Connector would utilize an existing network of about 709 federal, state, county, and private roads to move construction equipment, materials, and personnel to the construction right-of-way from the various contractor and pipe storage yards, as well as from the residential centers in the four counties where personnel would reside. Approximately 73 existing access roads would be modified for construction vehicles. In addition, Pacific Connector would build 13 temporary access roads (totaling 2.2 miles) and 15 permanent access roads (totaling 0.6 mile). The pipeline route would cross 10 major state and federal highways, 2 by open cuts. Pacific Connector would reduce impacts on local traffic by following the measures outlined in its TMP for both federal and non-federal roads.

Cumulative traffic impacts from construction of the Project along with traffic associated with the other projects that have been identified in the watersheds crossed by the pipeline are expected to be short term and localized. The traffic associated with other reasonably foreseeable, primarily silvicultural, actions is expected to be minor and short term because of the small workforce requirements. Typically, silvicultural projects on federal lands require two to three round trips per day by log trucks over several weeks or months to complete. Where timber haul routes for

these projects overlap with proposed road use for the pipeline, minor traffic impacts may occur and cause delays.

Project-related traffic could affect private companies hauling timber on back roads, local residents using regional highway systems, and recreationalists driving to various tourist destinations, including National Forests, and Crater Lake National Park. However, by following its Project design features, and the mitigation measures of its plans, the JCE & PCGP Project would not greatly add incrementally, together with other projects, to cumulative impacts on transportation and traffic.

4.14.3.11 Cultural Resources

At this time, we know that the Project would have adverse impacts on 18 historic properties (NRHP eligible) and may have adverse impacts on at least 43 potential historic properties (unevaluated sites). However, adverse effects to historic properties would be resolved by implementing the procedures outlined in the Project-specific MOA. The MOA also includes provisions for inventorying areas not yet surveyed to identify other historic properties that may be affected by the Project.

Disturbances to cultural resources in the project area not related to the Project could include illegal artifact collecting; intentional destruction or vandalism; and accidental impacts from agricultural, logging, mining, or recreational activities or infrastructure construction and maintenance operations. Oregon state law (ORS 358.905-955) protects archaeological sites on non-federal lands from damages. It is also Oregon state policy (under ORS 390.805-925) to protect historic and archaeological sites located adjacent to designated scenic waterways. On non-federal lands, Native American graves and associated cultural items are protected under ORS 97.740-760.

The Antiquities Act of 1906, NHPA, Archaeological and Historic Preservation Act of 1974, and the Archaeological Resources Protection Act of 1979 protect cultural resources on federal and tribal lands. The NAGPRA would provide for the treatment of Native American graves and items of cultural patrimony found on federal lands.

Any project with a federal nexus would have to adhere to section 106 of the NHPA, including those projects listed on table 4.14.2.3-1 that are federal actions, The federal agencies that would manage those projects would have to follow the regulatory requirements of 36 CFR 800. Under those regulations, the lead federal agency, in consultation with the SHPO, would have to identify historic properties in the APE, assess potential impacts, and resolve adverse effects through an agreement document that outlines a treatment plan.

Because it is not known how other foreseeable actions would affect cultural resources, we cannot make any definitive quantitative statements about the nature of cumulative impacts on historic or archaeological sites. However, we can conclude that given the state and federal laws and regulations that protect cultural resources, mentioned above, it is not likely that there would be significant cumulative impacts on historic properties, resulting from this Project in addition to other projects that may occur in the project area.

4.14.3.12 Air Quality, Climate Change, and Noise

Air Quality

Air quality monitoring data collected throughout Oregon over approximately the last 25 years reflect the cumulative impacts of development, traffic, influences from pollutant transport from upwind, air pollution control regulations, and other factors generally show that pollutant concentrations have been decreasing over time (ODEQ 2012f). In some areas, for some pollutants—i.e., SO_2, NO_2, and $PM_{2.5}$—the trends are relatively flat, especially in recent years.

The most significant emissions sources for the Jordan Cove Project—i.e., the LNG terminal, South Dunes Power Plant, and marine vessels—and other major stationary sources within 50 kilometers (31 miles)—were explicitly modeled to determine cumulative impacts. The air quality modeling confirmed that operation of those facilities would not result in a significant deterioration of air quality.

The primary emissions source associated with the Pacific Connector Pipeline Project is the Klamath Compressor Station, which is approximately 14 miles from the boundary of the Klamath Falls $PM_{2.5}$ nonattainment area. Emissions of $PM_{2.5}$ from the natural gas-fired compressor turbines are extremely low. The primary pollutants emitted by the compressor station are NO_x and CO, and there are no other significant sources of these pollutants nearby that would cause unacceptable cumulative impacts.

Mitigation actions associated with the Project, as well as many of the foreseeable projects listed in table 4.14.2.3-1, are directed at wildland fire and fuels reduction. Those projects that include controlled burning would have a short-term adverse effect on regional air quality; however, they would have a long-term beneficial effect by reducing wildfire. Thus, fuel reduction and fire suppression activities may reduce cumulative effects on air quality, because large wildfires would produce greater amounts of air pollutants.

An additional potential source of air pollution in the Klamath Basin would be the proposed removal of four dams along the Klamath River, if approved by Congress. Dam removal activities, scheduled for 2020, would result in fugitive dust and engine emissions that could contribute to short-term cumulative degradation of basin air quality.

However, as discussed section 4.12.1.4 of this EIS, the increasing use of natural gas that would be provided to southern Oregon through the Pacific Connector interconnection with the existing Williams Grants Pass Lateral at the Clarks Branch Meter Station, replacing the use of other fossil fuels, such as coal and oil, could have a positive effect on regional air quality. Therefore, we conclude that there would be no significant adverse cumulative impacts on air quality due to incremental addition of emissions from construction and operation of the Project.

Climate Change

Climate change is the modification of climate over time, whether due to natural causes or as a result of human activities. Climate change cannot be represented by single annual events or individual anomalies. For example, a single large flood event or particularly hot summer is not an indication of climate change. However, unusually frequent or severe flooding, or several consecutive years of abnormally hot summers over a large region may be indicative of climate change.

The IPCC is the leading international, multi-governmental scientific body for the assessment of climate change. The United States is a member of the IPCC and participates in the IPCC working groups. As identified in section 4.12.1.4, IPCC's latest assessment has identified that "it is assessed that more than half of the observed increase in global average surface temperature from 1951 to 2010 is *very likely* [90-100% probability] due to the observed anthropogenic increase in [well-mixed] GHG concentrations" (Stocker et al. 2013). This conclusion is also supported by the leading United States scientific body on climate change, the USGCRP. Thirteen federal departments and agencies[192] participate in the USGCRP, which began as a presidential initiative in 1989 and was mandated by Congress in the Global Change Research Act of 1990.

The USGCRP has concluded that:

- Global climate is changing and this change is apparent across a wide range of observations. The global warming of the past 50 years is primarily due to human activities (Melillo et al. 2014: 20).
- Carbon dioxide made up 84 percent of U.S. GHG emissions in 2011. Forty-one percent of these emissions were attributable to liquid fuels (petroleum), followed closely by solid fuels (principally coal in electric generation), and to a lesser extent by natural gas. The two dominant production sectors responsible for these emissions are electric power generation (coal and gas) and transportation (petroleum). If emissions from electric generation are allocated to their various end uses, transportation is the largest CO_2 source, contributing a bit over one-third of the total, followed by industry at slightly over a quarter, and residential use and the commercial sector at around one-fifth each (Melillo et al. 2014: 652).
- Impacts extend beyond atmospheric climate change alone, and include changes to water resources, transportation, agriculture, ecosystems, and human health.

The USGCRP issued its Third National Climate Assessment (NCA) titled *Global Climate Change Impacts in the United States* in 2014 summarizing the impacts climate change has already had on the United States and what projected impacts climate change may have in the future. The report includes a breakdown of overall impacts by resource and impacts described for various regions of the United States.

Climate change has modified the environment in the area around the Project and is projected to cause additional changes to the project area. The Second and Third NCAs identify climate change impacts that have occurred along coastal regions in the continental Northwest. Key messages of the Third NCA with respect to the Northwest and Coastal Zone include the following (Mote et al. 2014: 488; Moser et al. 2014: 580):

- Changes in the timing of streamflow related to changing snowmelt have been observed and will continue, reducing the supply of water for many competing demands and causing far-reaching ecological and socioeconomic problems (Mote et al. 2014: 489).

[192] The EPA, DOE, Department of Commerce, DOD, Department of Agriculture, Department of the Interior, Department of State, DOT, Department of Health and Human Services, NOAA, National Science Foundation, Smithsonian Institution, and Agency for International Development.

- In the [Northwest] coastal zone, the effects of sea-level rise, erosion, inundation, threats to infrastructure and habitat. and increasing ocean acidity collectively pose a major threat to the region;
- The combined impacts of increasing wildfire, increased insect outbreaks, and tree diseases are already causing widespread tree die-off and are virtually certain to cause additional forest mortality by the 2040s and long-term transformation of forest landscapes. Under higher emissions scenarios, extensive conversion of subalpine forests to other forest types is projected by the 2080s.
- While the agriculture sector's technical ability to adapt to changing conditions can offset some adverse impacts of a changing climate, there remain critical concerns for agriculture with respect to costs of adaptation, development of more climate resilient technologies and management, and availability and timing of water.
- Coastal lifelines, such as water supply and energy infrastructure and evacuation routes, are increasingly vulnerable to higher sea levels and storm surges, inland flooding, erosion, and other climate-related changes.
- Nationally important assets, such as ports, tourism and fishing sites, in already-vulnerable coastal locations, are increasingly exposed to sea level rise and related hazards. This threatens to disrupt economic activity within coastal areas and the regions they serve and results in significant costs from protecting or moving these assets.
- Socioeconomic disparities create uneven exposures and sensitivities to growing coastal risks and limit adaptation options for some coastal communities, resulting in the displacement of the most vulnerable people from coastal areas.
- Coastal ecosystems are particularly vulnerable to climate change because many have already been dramatically altered by human stresses; climate change will result in further reduction of the loss of the services that these ecosystems provide, including potentially irreversible impacts.
- Leaders and residents of coastal regions are increasingly aware of the high vulnerability of coasts to climate change and are developing plans to prepare for potential impacts on citizens, businesses, and environmental assets. Significant institutional, political, social, and economic obstacles to implementing adaptation actions remain.

Climate impacts are not attributable to any single action. The Project would obtain a PSD Permit, which would limit its emissions of GHGs. Although the Project emissions would contribute to the overall amount of atmospheric GHG, it is possible that the cumulative global impact could be a reduction of GHGs, if natural gas exported by Jordan Cove replaces the burning of coal in power plants in Asia. That being said, the type of displacement that would actually occur depends on a multitude of complex geopolitical and economic factors that cannot reasonably be foreseen.

Noise

Present and reasonably foreseeable future projects and activities could cumulatively impact noise conditions in the project area. Generally, noise impacts are localized, attenuating to low levels within relatively short distances. Sound levels from operation of Jordan Cove's facilities would not exceed an L_{dn} of 51.4 dBA at NSAs. Sound levels from operation of Pacific Connector's Klamath Compressor Station may reach a maximum L_{dn} of 56.1 dBA at an NSA. We have

recommended that Pacific Connector use mitigation measures to reduce the compressor station sound to less than 55 dBA at any NSA.

Other projects constructed in the same area and at the same time as the JCE & PCGP Project would contribute to noise levels. However, because construction noise is temporary and would dissipate with distance, and because Pacific Connector would employ BMPs to mitigate operational noise from its Klamath Compressor Station, we conclude that the Project would not incrementally add to significant adverse cumulative noise levels.

4.14.3.13 Cumulative Effects from Other Proposed LNG Export Projects in Oregon

In addition to the projects listed in table 4.14.2.3-1, there is a proposed bi-directional facility that would be capable of exporting LNG, located at Warrenton, in Clatsop County, Oregon. On June 7, 2013, Oregon LNG filed formal applications with the FERC in Docket Nos. CP09-6-001 and CP09-7-001 for its proposed bidirectional project. On June 25, 2013, Northwest filed a related application for its WEP in Docket No. CP13-507-000. Neither the proposed terminal nor the associated pipeline would affect any of the 19 fifth-field watersheds affected by the JCE & PCGP Project. However, they would affect similar resources as the JCE & PCGP Project within the Pacific Northwest region; therefore, we have included a discussion of these projects in this analysis.

On May 31, 2012, Oregon LNG received DOE approval to export up to 9.6 MMTPA of LNG (equivalent of 1.3 Bcf/d of natural gas) to FTA nations in Docket No. 12-48-LNG. On July 31, 2014, in DOE/FE Order 3465, DOE granted approval for Oregon LNG to export up to 9.6 MMTPA to non-FTA nations for a period up to 20 years. On August 5, 2015, the FERC issued a draft EIS for the Oregon LNG Project and the Northwest WEP.

Construction of the Oregon LNG terminal would affect about 1,427 acres, while construction of the associated pipeline and related facilities would impact about 1,198 acres. Construction of the WEP would disturb about 2,052 acres adjacent to Northwest's existing pipeline system between Sumas and Woodland, Washington, and would cross portions of Whatcom, Skagit, Snohomish, King, Pierce, Thurston, Lewis, and Cowlitz Counties. Like the JCE & PCGP Project, both the Oregon LNG Project and the WEP are located in the vicinity of the CSZ, and the pipeline routes on steep slopes may be susceptible to landslides, so geological hazards would require mitigation. The Oregon LNG pipeline would cross 184 waterbodies, and 340 wetlands totaling 387 acres. The WEP would cross 271 waterbodies, and construction would affect about 177 acres of wetlands. Construction of the Oregon LNG terminal would remove about 25 acres of forest, while construction of the associated pipeline would clear about 930 acres of forest. Construction of the WEP would affect about 349 acres of forest. The Oregon LNG Project may affect 38 federally listed threatened or endangered species, including 8 marine mammals, 4 sea turtles, 16 fish species, 4 birds, 1 upland mammal, 1 upland invertebrate, and 3 upland plant species. The WEP may affect 18 federally listed threatened or endangered species, including 4 fish species, 1 amphibian, 4 birds, 2 mammals, and 4 plant species. Along the route of the Oregon LNG pipeline, 6 archaeological sites were identified, while along the WEP facilities 16 previously recorded sites and 5 newly recorded sites were identified. Because all of the proposed facilities for the WEP are located in the state of Washington, construction and operation of those facilities would not contribute to cumulative effects on resources in Oregon.

Construction of the Oregon LNG Project could occur at the same time as the JCE & and PCGP Project, and would affect similar types of resources; however, these impacts would occur in northern Oregon and in Washington. The Oregon LNG Project would not affect any of the counties or watersheds in southwestern Oregon where JCE & PCGP Project facilities would be located. Because the Oregon LNG Project facilities would not be situated in the same geographic area as the JCE & PCGP Project, we conclude that the Project would not contribute to cumulative impacts on resources within the watersheds crossed by the Pacific Connector pipeline route.

4.14.3.14 Cumulative Impact Conclusions

Construction of the Project, in addition to other projects within the same watersheds crossed by the pipeline during the same timeframe, would have cumulative impacts on a range of environmental resources, as discussed above. We provided information about Project-related impacts and mitigation measures for specific environmental resources, and were able to make some general assumptions about other federal projects identified in table 4.14.2.3-1. For the federal projects, there are laws and regulations in place that protect waterbodies and wetlands, threatened and endangered species, and historic properties, and limit impacts from air and noise pollution. Federal land-managing agencies, such as the BLM and Forest Service, have requirements in their LMPs to protect resources on their lands. We do not have quantitative information about potential or foreseeable private projects in the region. For some resources, there are also state laws and regulations that apply to private projects. Given the Project BMPs and design features, mitigation measures that would be implemented, federal and state laws and regulations protecting resources, and permitting requirements, we conclude that when added to other past, present, and reasonably foreseeable future actions, the JCE & PCGP Project would not have significant adverse cumulative impacts on environmental resources within the watersheds affected by the Project.

5.0 CONCLUSIONS AND RECOMENDATIONS

5.1 SUMMARY OF THE STAFF'S ENVIRONMENTAL ANALYSIS

The conclusions presented in this FEIS are those of the environmental staff of the FERC working in cooperation with the Coast Guard, EPA, COE, BLM, Reclamation, FWS, Forest Service, DOT, and DOE. We (i.e., the Commission's staff) conclude that construction and operation of the Project would result in some limited adverse environmental impacts. However, most of these impacts would be reduced to less-than-significant levels with the implementation of the applicants' proposed mitigation measures and the additional measures we recommend in section 5.2. We developed measures that would appropriately and reasonably avoid, minimize, or mitigate environmental impacts resulting from construction and operation of the proposed Project. We recommend that our specific additional mitigation measures be attached as conditions to any authorizations issued by the Commission. If the Project is found to be in the public interest and is constructed and operated in accordance with the recommended mitigation measures, we conclude that it would be an environmentally acceptable action. Our conclusions are based on information provided by Jordan Cove and Pacific Connector; analyses and field investigations by Commission staff; review of comments from federal, state, and local agencies; and input from public groups and individual citizens.

The Coast Guard is a cooperating agency for the production of this EIS, serving as a subject matter expert for, and providing recommendations on, the maritime safety and security aspects of, the Project. In its LOR issued in 2009, the Coast Guard concluded that the waterway associated with the Jordan Cove LNG Terminal could be made suitable for LNG vessel traffic if the recommendations in its 2008 WSR were implemented, including a TMP. The Coast Guard has indicated that its findings remain valid for the current Jordan Cove LNG export proposal. In its most recent review of the 2014 up-date to Jordan Cove's WSA, the Coast Guard stated, on February 14, 2014, that: "we have no objection to your conclusion that the minor changes do not change the risk associated with the waterway or the facility as originally evaluated in your 2007 WSA." Given the design of LNG vessels, their safety record, and implementation of the risk mitigation measures recommended in the Coast Guard's WSR, it is highly unlikely that LNG would be released from a vessel in transit in the waterway and there should not be any significant adverse impacts on environmental resources within the Zones of Concern.

The DOT has authority to enforce safety regulations and design standards for the LNG terminal and pipeline, under the Natural Gas Pipeline Safety Act. In a June 18, 2014, letter to the FERC, PHMSA stated that it had reviewed the criteria used by Jordan Cove in identifying credible leakage scenarios and establishing the siting for the LNG terminal to confirm compliance with 49 CFR 193, and had no objections to Jordan Cove's methodologies.

The DOE must meet its obligations under Section 3 of the NGA, to authorize the import and export of natural gas, including LNG, unless it finds that the proposed import or export would not be consistent with the public interest. The purpose and need for the DOE action is to respond to the applications filed by Jordan Cove with the DOE. The DOE authorized Jordan Cove to export LNG to FTA nations in 2011, and authorized the export of LNG to non-FTA nations in March 2014.

The COE exerts authorities over waters of the United States pursuant to Section 10 of the RHA, Sections 404 and 408 of the CWA, and Section 103 of the MPRSA, including regulation of the placement of structures or fill in waterbodies and wetlands, and ocean disposal of dredged materials. Jordan Cove and Pacific Connector submitted their comprehensive JPA to the COE in October 2013, and the COE would present its conclusions and recommendations in the permits it may issue in response to the applications.

The EPA has the authority to review and veto the COE decisions on the Section 404 permit. The EPA also co-administers the MPRSA with the COE. The EPA's other responsibilities include the CAA, CWA, and MPRSA.

The FWS would review the Project for compliance with the MBTA and would consult on species and habitats protected by the ESA. Likewise, the NMFS would consult on potential Project effects on ESA listed aquatic species, and impacts on EFH. Concurrent with this draft EIS, the FERC submitted a BA and EFH Assessment to the FWS and NMFS. In response, the Services would produce BOs that provide their conclusions as to whether authorizing the Project may jeopardize the continued existence of any species under their jurisdiction or would adversely modify or destroy designated critical habitat.

The BLM, Reclamation, and Forest Service are federal agencies that administer lands and facilities that would be crossed by portions of the Pacific Connector pipeline. The BLM has authority under the MLA to grant the right-of-way across federal lands, with the concurrence of the Forest Service and Reclamation. In addition, the BLM and Forest Service must amend certain portions of their LMPs to make allowance for the pipeline.

We recognize that the federal agencies with jurisdiction over lands and resources affected by the Project will use the information and analysis contained in this EIS in reaching their own independent conclusions regarding the environmental impacts of the Project on the lands and resources they administer. Nothing in this section should be read to affect the ability of another federal agency to reach a conclusion or impose a requirement that is different from that recommended by Commission staff. Additionally, nothing in this section should be read to affect in any way a federal agency's authority to monitor, enforce, or modify any requirement it imposes on Jordan Cove's or Pacific Connector's construction, operation, maintenance, or decommissioning of the Project.

5.1.1 Land Use

Virtually all of Jordan Cove's upland elements are on privately owned lands. However, Jordan Cove proposes to acquire one parcel from the Port as part of its *Habitat Mitigation Plan*. The majority of the waterway for LNG vessel marine traffic, the access channel to the terminal, and the eelgrass mitigation area would be located in Coos Bay, considered to be waters of the State, with the bottom of the bay managed by ODSL. The waterway is zoned "Deep-Draft Navigation Channel," and LNG vessel traffic would be consistent with this use. The access channel and inter-tidal portion of the slip are zoned Development Aquatic; the upland portions of the LNG terminal are zoned Water Dependent Development Shorelands; and the jurisdictional gas processing plant, and non-jurisdictional SORSC and South Dunes Power Plant are zoned as Industrial land. Therefore, the Jordan Cove terminal facilities would be consistent with these water-dependent industrial uses. Jordan Cove and Pacific Connector have received all necessary conditional use permits, and LUCS from the affected counties.

Construction of the LNG terminal, South Dunes Power Plant, SORSC, and associated facilities would affect a total of approximately 397 acres, of which 178 are currently industrial land, 111 acres of forest, 76 acres of open land (including shrubs and grasslands), and 32 acres of open water. The nearest residential structure to the proposed LNG terminal is about 1.1 miles to the southeast, while the closest commercial buildings are part of the existing Roseburg Forest Products industrial operation adjacent to the proposed LNG terminal site.

The LNG terminal and the western 52 miles of the pipeline route would be within Oregon's Designated Coastal Zone. On August 1, 2014, Jordan Cove and Pacific Connector submitted an application to the ODLCD to obtain a coastal zone consistency determination. We recommend that the Commission not allow construction to proceed until after the ODLCD makes a finding that the Project is consistent with the CZMA.

Land ownership along the pipeline route is approximately 31 percent federal, 68 percent private, and 1 percent state lands. About 62 percent of the land that would be crossed is classified as forest, 16 percent is agricultural land, 12 percent is rangelands, and about 8 percent is urban or built-up lands. Ten residences were identified within 50 feet of the pipeline construction right-of-way, and Pacific Connector has proposed site-specific measures to minimize impacts on these residences.

Effects on Federal Lands

The pipeline would cross approximately 31 miles of NFS lands and 40 miles of BLM lands. In addition, the route would cross 26 irrigation facilities under the jurisdiction of Reclamation. On NFS lands, land types affected would include 512 acres of forest, 32 acres of urban-built-up or transportation-utility lands, 28 acres of barren lands or quarries, 8 acres of rangelands, 2 acres of beach ("beach" category in GIS, in this case banks along Rogue River), and less than 1 acre each of wetlands and water. On BLM lands, affected land would include approximately 669 acres of forest, 60 acres of rangeland, 54 acres of urban-built-up or transportation-utility lands, 2 acres of barren lands/quarries, 1 acre of water, and 0.8 acres of wetlands.

Construction of the Pacific Connector pipeline would disturb NWFP land allocations, including about 91 acres of Riparian Reserves on BLM and NFS lands, of which an estimated 32 acres would be within LSOG forest. About 369 acres of designated LSRs would be directly affected by the pipeline on NFS lands, and 168 acres on BLM lands. In addition, 42.1 miles of Matrix lands would be crossed.

To make allowance for the pipeline, the BLM and Forest Service are proposing a number of amendments to their LMPs that would be specific to the Pacific Connector Pipeline Project if authorized. Four amendments are proposed on BLM lands (2 for the Coos Bay District, 2 for the BLM Roseburg District), and 15 amendments on NFS lands (6 on the Rogue River National Forest, 4 on the Umpqua National Forest, and 5 on the Winema National Forest). In addition, one amendment is proposed that would apply to all the affected administrative units on both BLM and NFS lands.

In consultations with the BLM and Forest Service, Pacific Connector developed an extensive off-site mitigation program on federal lands that is included in the proposed action to ensure that the objectives of the affected LMPs are achieved. Measures range from reallocation of Matrix lands to LSRs, to fire suppression, to habitat protection and enhancement. Reclamation is also

working closely with Pacific Connector to develop a mitigation plan that would address impacts to the Klamath Project.

5.1.2 Geology

The Jordan Cove LNG Terminal is situated within the Pacific Border geomorphic province, on a site mantled by thick dune sheets, underlain by weathered sandstone. Through consultations with DOGAMI, we identified 11 faults located within 150 km of the Jordan Cove terminal; of which the CSZ is the most important. While recently (last 170 years) the Coos Bay area experienced only low to moderate seismic activity; large megathrust earthquakes have occurred along the CSZ prior to the written historical record. Intense ground shaking, lateral spreading, and subsidence caused by an earthquake pose design issues for the terminal site. A further series of geotechnical studies would be performed during detailed design, and ground improvements would be used to mitigate the liquefaction hazard. We recommend that detailed designs and final geotechnical investigations be submitted for our review and approval prior to construction.

A tsunami generated by a megathrust earthquake on the CSZ would present the greatest inundation risk at the Jordan Cove terminal. However, the site-specific tsunami studies coupled with Jordan Cove's proposed mitigation measures indicate that the site is not unsuitable due to tsunami hazards. Jordan Cove has designed the LNG terminal so that foundations for facilities in the process area would be above the run-up height of the worst-case tsunami wave, and the LNG storage tanks would be surrounded by a storm surge barrier with a peak crest elevation of + 60 feet.

The Pacific Connector pipeline route begins within the Klamath Basin, which is part of the larger Basin and Range physiographic province of the Great Basin; an area characterized by ridges and valleys that are separated by faulting (Burns 1998). The route would then head westward over the High Cascades sub-province, a chain of geologically active volcanoes with high andesitic peaks, and the Western Cascades sub-province, an ancestral range of deeply eroded (extinct) volcanoes. The route then passes through the Klamath Mountains physiographic province, which consists of several complex geological terrains composed of metamorphosed and fractured volcanic and marine sedimentary rocks. The pipeline route would proceed over the Coast Range physiographic province, an area underlain by estuarine and alluvial deposits in lowland areas and sedimentary rocks in the uplands, and terminate at the Oregon Coast. Between the mountain ranges are several valleys, predominantly filled with recent alluvial materials.

With the exception of the CSZ, the pipeline route would cross a series of Quaternary and Holocene age fault zones mostly through the Klamath Basin, between MPs 172 and 213. Prior to pipeline construction, Pacific Connector has committed to engaging a geotechnical firm to evaluate and design the proposed pipeline crossing of the Klamath Graben Fault system, South Klamath Lake Section (near MP 213). Pacific Connector would have the trench examined during construction for evidence of stratigraphic offsets potentially related to ground rupture. If such features are observed, Pacific Connector would implement additional mitigation measures at these locations, including burying the pipe in a wider trench to be backfilled with loose gravel or sand, which would allow for relatively unrestrained movement of the buried pipe within the zone of fault movement.

High liquefaction and/or lateral spreading potential were identified at six sites (Haynes Inlet, Kentuck Inlet, Willanch Slough, Willis Creek, Rogue River, and Klamath River) along the

pipeline route. Pacific Connector would conduct numerical modeling for these sites prior to construction to estimate the magnitude of liquefaction-induced settlement and lateral spreading that would be expected during an earthquake. If the studies indicate that an earthquake may result in excessive pipe stress, further mitigation design would be needed, including deeper burial below the liquefiable soils, thicker pipe and/or weighting the pipe with a concrete coating.

The pipeline would cross two moderate-risk rapidly moving landslide sites (at MPs 18.1 to 18.2 on private land, and MP 36.9 on BLM land). Implementation of Pacific Connector's ECRP would minimize or avoid the potential for construction to adversely affect slope stability. We recommend that prior to construction Pacific Connector should file final monitoring protocols and/or mitigation measures for any landslide areas that were not accessible during previous studies.

Fluvial erosion may represent a hazard to the proposed pipeline where streams have the potential to expose the pipe as a result of significant channel migration or scour of the streambed. Pacific Connector would design waterbody crossings for the 50-year channel migration condition, and adjusted the pipeline route in high scour potential areas to avoid these hazards. Implementation of the ECRP and use of trench breakers and trench plugs would mitigate potential impacts. In the case of the crossing of Haynes Inlet, the pipeline would be buried 5 feet deep to avoid scour.

The pipeline would be near potential mine hazards at 22 locations, including 15 aggregate or quarry-related mines, which are likely to consist of open excavations. Twenty mineral or mine locations were identified as within 500 feet of the pipeline. The Project should not adversely impact the operation of any existing quarries or mines.

Effects on Federal Lands

A moderate-risk rapidly moving landslide site could not be avoided at MP 36.9 on BLM Coos District land. Pacific Connector would conduct regular monitoring of the pipeline right-of-way across rugged terrain within BLM and NFS lands, including in this area, for previously unidentified landslides or new landslides.

The pipeline would cross Middle Creek, which has a moderate risk for scour, at MP 27.0 on BLM lands. Pacific Connector would design this crossing to withstand estimated potential scour that could occur during 50-year maximum scour events, which would adequately protect the pipeline at this crossing location. This design would be consistent with all requirements in the site-specific restoration plan for Middle Creek prepared by the BLM and submitted to the FERC (NSR 2014).

The proposed route for the pipeline between MPs 108.6 and 110.9 on the Umpqua National Forest avoids the Peavine Quarry within the Umpqua National Forest. At about MP 150.5, the pipeline would be near the Heppsie Mountain Quarry on BLM land. Based on aerial photograph review of the quarry depths, trends, and distances from the pipeline, it was concluded that the quarry likely would extend into a stable rock outcrop that parallels the route, and therefore the pipeline does not pose a risk to future expansion of the quarry. Between MPs 108.6 and 109.4, within the Umpqua National Forest, the pipeline would be within 400 feet of three historic mercury mines in the vicinity of the East Fork of Cow Creek, but would not cross any adits or workings. Soil samples taken in this area did not contain concentrations of mercury that exceeded human health risk screening criteria. To protect its workers from exposure to

unanticipated hazardous materials discovered during construction, Pacific Connector would follow the procedures outlined in its *Contaminated Substances Discovery Plan*.

5.1.3 Soils and Sediments

Waldport Fine Sand, Waldport-Heceta Fine Sands, and Dune Land soils, which make up about 71 percent of the Jordan Cove terminal tract, are susceptible to erosion. Jordan Cove would minimize the potential for erosion by following the measures outline in the FERC's *Plan* and its own *Erosion and Sediment Control Plan*. Grading of the terminal area would require approximately 2.5 mcy of cut and fill.

The Ingram Yard, where the LNG terminal would be located, was formerly used by Weyerhaeuser to store and sort logs, and to spread boiler ash and wood debris from milling operations, and decant solids from its wastewater treatment facility. In the 1970s, the COE deposited materials it dredged from maintenance of the Coos Bay navigation channel on this parcel. However, testing of the site found that most soil samples contained levels of contaminants below state and federal guidelines. The elevation of the terminal tract would be raised to +30 feet for the base of the LNG storage tank area and +46 feet for the liquefaction processing area, using about 1.9 mcy of fill from the excavation and dredging of the marine slip.

At the area of the South Dune Power Plant, Jordan Cove identified contaminated upland soils resulting from past use of the property as a mill. The ODEQ approved a closure plan for the mill site, and Jordan Cove would cover the area with clean sediments from the marine slip and access channel to raise the elevation for the planned South Dunes Power Plant and associated facilities to about +46 feet. To protect its workers from unanticipated contact with contaminated soils, Jordan Cove developed its *Unanticipated Hazardous Waste Discovery Plan.*

Construction of the LNG terminal would require the dredging of about 5.6 mcy of material for the slip and access channel. Sediments that would be dredged from Coos Bay during the creation of the access channel were found not to be contaminated.

During operation of the LNG terminal, Jordan Cove and the Port would have to conduct regular maintenance dredging of the access channel and slip every 3 years for the first 12 years of operation, and after that about every 5 years. In the first ten years of operation of the terminal about 360,000 cy of material would need to be removed to maintain the proper depth of the access channel and slip, while in the next ten years about 330,000 cy would need to be removed. Jordan Cove would have to obtain a permit from the COE for ocean disposal at Site F of operational maintenance dredged materials.

The Pacific Connector pipeline route would cross about 94.3 miles of soils with a high or severe water erosion potential, and 16.2 miles of soils highly susceptible to wind erosion. The pipeline alignment would cross approximately 72 miles of soils classified as prime farmland or farmland of statewide importance. Topsoil salvaging and segregation would occur in areas of privately-owned land mapped as prime farmland or active crops to minimize potential impacts on farm soils and agricultural productivity. While the soils at the Klamath Compressor Station would be prime farmland if irrigated, the land is not irrigated. Potential impacts on soils would be minimized through implementation of the measures specified in the FERC's *Plan* and in Pacific Connector's ECRP.

Effects on Federal Lands

Topsoil would not be segregated on BLM and NFS lands because doing so would increase the corridor width. To reduce erosion and increase soil productivity for revegetation on federal lands, Pacific Connector would follow the recommendations developed by the BLM and Forest Service provided as a supplement to the ECRP as described in NSR (2015). Where the Forest Service has found that Pacific Connector would not meet its standards and guideline thresholds for detrimental soil conditions, it has proposed site-specific amendments to the respective LRMPs for the Umpqua, Rogue River, and Winema National Forests.

5.1.4 Water Resources and Wetlands

There are no EPA-designated sole source aquifers near the Project. There are four existing groundwater wells within the Roseburg Forest Products tract near temporary extra workspace areas to be used by Jordan Cove. We recommend that prior to construction Jordan Cove should file a plan to protect the Roseburg wells. Jordan Cove estimates that it would need a total of approximately 1.7 billion gallons of water for construction and 1.3 million gallons of water per day during operation of the terminal facilities. Water requirements for the LNG terminal would be supplied by the CBNBWB. The CBNBWB has 18 groundwater wells located within the ODNRA to the north of the LNG terminal; however the closest is about 3,500 feet away. To prevent or reduce impacts on groundwater from the accidental release of hazardous materials, Jordan Cove prepared a preliminary SPCCP.

Dredging the access channel and the portion of the slip in Coos Bay would have temporary and localized impacts on water quality. The duration of the dredging in the bay would be 4 to 6 months, with TSS estimated at 500 mg/l in the vicinity of the dredge reducing to 14 mg/l by a distance of 200 feet with a current of 1.0 meter per second.

An LNG vessel at dock at the terminal would discharge approximately 9.2 million gallons of ballast water during the loading cycle to compensate for 50 percent of the mass of LNG cargo loaded. A 148,000 m^3 capacity LNG vessel at the berth would also re-circulate about 6.1 million gallons of water for engine cooling. The discharge of engine cooling water and ballast water is not expected to significantly affect water temperature, salinity, or dissolved oxygen levels in Coos Bay.

While there are no groundwater wells that supply public drinking water systems within 400 feet of the proposed Pacific Connector pipeline construction right-of-way, there are six wellhead protection areas that would be crossed by the pipeline route. Pacific Connector identified eight private wells within 150 feet of the pipeline, but none of these are used for drinking water (irrigation only). Pacific Connector developed a *Groundwater Supply Monitoring and Mitigation Plan;* however, we recommend that the plan be revised to identify all wells, springs, and seeps within 150 feet of the construction right-of-way, and outlines measures that would be implemented to avoid or reduce impacts on these features. Four public water systems that have surface water intakes within 3 miles downstream of waterbodies that would be crossed by the pipeline. Pacific Connector would provide written notification to the authorities of the surface water supply intakes at least one week before beginning in-water work. To avoid or minimize impacts on groundwater resources, Pacific Connector would follow the measures in its ECRP and SPCCP.

The pipeline route would cross 19 fifth-field watersheds, with proposed access roads crossing an additional 5 watersheds. The construction of the pipeline would affect waterbodies at 265 locations; 35 of these locations are not crossed by the pipeline but are located within the right-of-way or workspaces. Pacific Connector produced a *Stream Crossing Risk Analysis*, and impacts on waterbodies would be minimized by following the FERC's *Procedures*. Waterbodies would be crossed during low-flow periods whenever possible and within ODFW recommended in-water construction windows.

Pacific Connector would use conventional bores to cross underneath Kentuck Slough (MP 6.3R), Catching Slough (MP 11.1), and the Medford Aqueduct (MP 133.4). The Coos River (MP 11.1R), Rogue River (MP 122.7), and Klamath River (MP 199.4) would be crossed with HDDs. The western crossing of the South Fork of the Umpqua River would be crossed using DP technologies. The bores, HDD, and DP crossings would eliminate the need for in-water construction activities that could result in sedimentation and turbidity as well as impacts on waterbody banks and beds. Pacific Connector prepared an *HDD Contingency Plan and Failure Procedures* that describe measures to deal with HDD failure and contain an inadvertent release of drilling mud during the HDD process.

Only Haynes Inlet in Coos Bay, between about MPs 1.7R and 4.1R, would be crossed with a wet open cut method. Pipeline construction in Coos Bay would be limited to the ODFW recommended in-water work window between October 1 and February 15, when tides are lowest. Pacific Connector estimated it would take the duration of the fish window to install the pipeline across Haynes Inlet due to logistics of tidal fluctuations, potential mechanical issues affecting production, materials and supply and operation access to lay barges, and accommodation of other boat traffic. Turbidity models show that the trenching would result in concentrations of TSS over 50 mg/l that would be limited to the region within 100 feet of pipeline placement. Thus, impacts on the aquatic environment of the bay would be localized, and temporary. Pacific Connector would minimize impacts by following the measures outlined in its *Report on Preliminary Pipeline Study of the Haynes Inlet Water Route*, including keeping the bucket below the water level, following a turbidity monitoring plan, installing turbidity curtains, and fueling and maintaining equipment more than 150 feet from open water, where practicable.

Except for the wet crossing of Coos Bay, and the use of bores or HDD under six waterbodies, and DP for the first South Umpqua River crossing, Pacific Connector would use dry open-cut methods (including dam-and-pump and fluming) at the remaining waterbody crossings. Again, impacts from dry crossings would be temporary and localized, with most construction occurring at a single crossing within a 48-hour period, and models predicting TSS levels less than 100 mg/l within 10 m downstream of the crossing.

The proposed pipeline would cross three rivers listed on the Nationwide Rivers Inventory: the North Fork of the Coquille River, the East Fork of the Coquille River, and the South Umpqua River. The Pacific Connector pipeline would cross the North Fork of the Coquille River (at about MP 23) and the East Fork of the Coquille River (at about MP 30) using a dry open-cut method. Pacific Connector proposes to use a DP and diverted open cut, respectively, at the two crossings of the South Umpqua River (at about MPs 71 and 95).

The pipeline route would cross 15 fifth-field watersheds with portions located in the transient snow zone (2,000- to 5,000-foot elevation range), affecting about 2,121 acres within the transient snow zone. Only clearing that permanently alters canopy cover could affect long-term peak flows. When only considering forest clearing within these 15 watersheds, pipeline disturbance to forested vegetation types would represent only 0.07 percent of the total area of these watersheds; which we do not consider to be a significant adverse impact.

Removal of shade by clearing streamside riparian vegetation would not greatly increase water temperatures. The maximum predicted increase was 0.3°F at one 2-foot-wide crossing; and modeling indicated that instream water temperatures would return to ambient conditions within a short distance downstream from all crossings.

During construction, Pacific Connector would use a total of about 75,000 gallons per day of water for dust control, sprayed by five trucks per spread. Dust control water could come from 12 private surface sources, with approvals obtained prior to withdrawal.

After backfilling, the pipeline would be hydrostatically tested using approximately 62 million gallons of water, obtained from commercial or municipal sources, private supply wells, or surface water right owners. The pipeline would be tested in approximately 75 sections, each with varying lengths and water volume requirements. Where possible, test water would be released within the same basin from which it was withdrawn. However, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same basin where the water was withdrawn in all cases. Pacific Connector's draft *Hydrostatic Testing Plan* includes measures to prevent the transfer of aquatic invasive species and pathogens. Pacific Connector does not expect to add any chemicals to the hydrostatic test water, with the possible exception of chlorine. The hydrostatic test water would be treated after it is withdrawn, and sources would be screened. When discharged, the test water would be released at low velocities into a vegetated upland adjacent to the construction right-of-way through an energy dissipating device and a straw bale filter or sediment bag.

Approximately 38.0 acres of wetlands would be affected by construction of the proposed LNG terminal and associated facilities (e.g., SORSC, South Dunes Power Plant, and NPWHC), with approximately 35.6 acres of wetlands being permanently affected during operation of the Project (see table 4.4.3.1-1). The vast majority of impacts are associated with wetlands affected by construction of the access channel (which would impact 29.3 acres of wetlands). Jordan Cove developed a *Compensatory Wetland Mitigation Plan* to address unavoidable impacts to wetlands. Impacts on freshwater wetland resources would be mitigated via the West Bridge and West Jordan Cove Mitigation Sites (see Part A of Jordan Cove's *Compensatory Wetland Mitigation Plan*). Impacts to estuarine wetland resources would be mitigated via the Eelgrass Mitigation Site and Kentuck Slough Mitigation Site (see Part B of Jordan Cove's *Compensatory Wetland Mitigation Plan*). These mitigation plans are still being reviewed by the COE, ODSL, and applicable federal and state agencies. Approval of these mitigation plans by these agencies would be required prior issuance of federal and state wetland permits.

The Pacific Connector pipeline route would cross approximately 9.4 miles of wetlands. Construction of the pipeline would initially impact 195.9 acres of wetlands. Approximately 6.0 acres of wetlands would likely have long-term impacts, with about 1.6 acres of this total resulting from wetlands that occur in the permanent maintained operational corridor. Pacific

Connector developed a *Compensatory Wetland Mitigation Plan*, which proposes that the former Kentuck Golf Course in Coos County, which has been acquired by Jordan Cove, would be used to mitigate for the loss of wetlands associated with the pipeline project (see the Pacific Connector's *Compensatory Wetland Mitigation Plan*). To compensate for impacts on estuarine wetlands affected by the crossing of Haynes Inlet, Pacific Connector developed an *Estuarine Wetland/Open Water Mitigation Plan,* with the goal of establishing a one-to-one on-site restoration of all wetlands affected along the crossing of Coos Bay. The COE would issue permits under the RHA and Section 404 of the CWA for the crossing of waters of the United States, including wetlands, and the ODEQ would issue a Water Quality Certification under Section 401 of the CWA. We recommend that construction not begin until all applicable federal permits have been issued.

Effects on Federal Lands

Sixteen watersheds crossed by the Pacific Connector pipeline route include either BLM and/or NFS lands subject to the ACS under the respective LMPs. The ACS was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The ACS includes two designations for Key Watersheds: Tier 1 contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species; and Tier 2 that may not contain at-risk fish stocks, but are important sources of high-quality water. Four watersheds that would be crossed by the Pacific Connector pipeline are designated as Key Watersheds: (1) South Umpqua River (Tier 1); (2) North and South Forks Little Butte Creek (Tier 1); (3) Spencer Creek (Tier 1); and (4) Clover Creek (Tier 2). Within the South Umpqua River watershed, the pipeline would affect about 168 acres of federal lands, which represents less than 0.1 percent of all the federal lands within this watershed. Within the Little Butte Creek fifth-field watershed the pipeline would disturb about 277 acres of federal lands, representing just under 0.25 percent of the total amount of federal land within that watershed. Within the Spencer Creek watershed, the pipeline would affect about 93acres of federal land, representing about 0.2 percent of all the federal land in the watershed.

The BLM, Forest Service and Reclamation would require that temporary equipment crossings of any stream channel (whether intermittent or perennial) on BLM or NFS lands, or irrigation feature (canal, drain) under Reclamation's jurisdiction be accomplished using a bridge, a temporary culvert with temporary road fill to be removed after work is completed, or a low water ford with a rock mat. For crossings of perennial stream, the BLM and Forest Service would require that Pacific Connector obtain site-specific approval prior to any actions related to restoration of perennial stream channels consistent with the relevant site-specific crossing restoration plans developed by the BLM and Forest Service. On crossings of intermittent channel crossings, channels agency representatives would be consulted to develop site-specific restoration plans. On BLM and NFS lands, Pacific Connector would stabilize intermittent stream crossings (whether flowing or not) with temporary sediment barriers. Streambanks would be revegetated with native species and "armored" as needed with LWD and boulders to ensure stability. Channel breakers would be installed on each side of the trench to ensure that subsurface flows are not captured by the pipeline trench. On pipeline crossings of Reclamation facilities, the conditions outlined in attachment O pf the POD would be followed.

Based on a concern that the South Fork Little Butte Creek crossing consists of basalt and andesite bedrock, Pacific Connector conducted a study that determined that the crossing had high hyporheic sensitivity. BMPs that would be implemented to mitigate for this possible effect

include on-site monitoring of trenching and recommendations by a Forest Service representative prior to approval of backfill and restoration actions.

On federally managed land, the Pacific Connector pipeline would cross approximately 0.2 mile of wetlands, affecting a total of approximately 2.2 acres. Long-term wetland vegetation conversion within federally managed lands would occur in approximately 0.2 acre of palustrine forested wetlands as a result of vegetation management on the operational right-of-way. This 0.2 acre of permanent conversion would occur to three wetlands: palustrine forested wetland CW010 located on lands managed by the BLM Coos Bay District, palustrine forested wetland AW309 located on lands managed by the BLM Medford District, and palustrine scrub-shrub/emergent wetland GW-14/FS-HF-CWWW-111-001 (i.e., a tributary to East Fork Cow Creek) managed by the Forest Service (on the Umpqua National Forest).

5.1.5 Vegetation and Timber

The Jordan Cove Project would result in the permanent removal of about 185 acres of vegetation. Jordan Cove would compensate for the loss of vegetative habitat by following the measures of its *Wildlife Habitat Mitigation Plan*, which requires the acquisition of a total of 259 acres at three off-site parcels, including the preservation of about 103 acres of forest and about 153 acres of shrubs and grasslands.

Twelve noxious weed species listed by the ODA were encountered during the field surveys of the proposed LNG terminal site. These were gorse, Canada thistle, English ivy, European beachgrass, Himalayan blackberry, Italian thistle, pennyroyal, poison hemlock, scotch broom, sweet fennel, yellow glandweed, and parrotfeather. To avoid introducing or spreading invasive species, Jordan Cove would follow the recommendations outlined in the Oregon Aquatic Species Management Plan, the Oregon Noxious Weed Strategic Plan, BLM's multi-state EIS Northwest Area Noxious Weed Control Program and its supplements, and the BLM's *Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report*.

Construction of the pipeline would impact approximately 4,523 acres of vegetation. This would consist of 2,882 acres of forested lands, 643 acres of grasslands/shrublands, 103 acres of wetland/riparian areas, and 896 acres of agricultural areas. Of the forested land crossed, about 821 acres of LSOG, 821 acres of mid-seral, and 1,240 acres of clear-cut or regenerating forests would be impacted. Pacific Connector would compensate for the loss of vegetative habitat through actions identified in the CMP, *Migratory Bird Plan*, and *Wildlife Habitat Mitigation Plan*, as well as other plans (see section 5.1.6).

The proposed pipeline would create new direct edge effects (i.e., would be within 300 feet of newly created edges). The restoration and revegetation of the temporary construction right-of-way (outside of the 30-foot maintenance corridor) would reduce edge effects. To minimize the potential for the spread of wildfires Pacific Connector would implement the measures outlined in its *Fire Prevention and Suppression Plan*.

Twelve noxious weeds were documented along the pipeline route during botanical surveys. Within the region around the proposed pipeline, the western pine beetle and fir engraver are the most prevalent insect or disease pathogens within the pipeline project area. Pacific Connector

developed an *Integrated Pest Management Plan* to minimize the potential spread and infestation of weeds along the construction right-of-way, and handle forest pathogens and insects.

Effects on Federal Lands

On BLM land, there would be approximately 801 acres of impact during construction of the pipeline to FOIs, which includes about 174 acres on the Coos Bay District, 335 acres on the Roseburg District, 274 acres on the Medford District, and 18 acres on the Lakeview District. On NFS lands, there would be approximately 587 acres of impacts during construction of the pipeline to PAGs and plant series, which includes about 212 acres on the Umpqua National Forest, 283 acres on the Rogue River National Forest, and 92 acres on the Winema National Forest. Pacific Connector developed a *Right-of-Way Clearing Plan for Federal Lands* (Attachment U of the POD), which outlines how it would clear timber along the pipeline route. Areas within the operational 30-foot-wide maintenance corridor would remain cleared of forest and maintained in an herbaceous state in order to facilitate periodic checks of the pipeline. Pacific Connector would compensate the government for this conversion of lands and payment of fees.

In addition, with the funding provided by Pacific Connector, the BLM and Forest Service would develop, implement, and monitor off-site mitigation projects on federal lands to compensate for impacts associated with proposed amendments to their LMPs. Similarly, Reclamation would develop, implement, and monitor mitigation projects funded by Pacific Connector for impacts to federal facilities. Many of the BLM and Forest Service projects would benefit forest health and contribute to the development of LSOG forest, including: conversion of Matrix land to LSRs; acquiring additional timber lands to replace the converted Matrix land; funding non-commercial silvicultural projects that would create or accelerate the development of old-growth characteristics on federal lands; funding silvicultural projects (pre-commercial or commercial) aimed at reducing fuel loads and minimize the risk of stand-replacing fires; and creating snags to enhance riparian or terrestrial habitat. On Reclamation lands, this mitigation would ensure that the facilities and features of the Klamath Project are maintained and serve their functions over time.

5.1.6 Wildlife and Aquatic Resources

The most common marine mammal noted in Coos Bay during field surveys of the Jordan Cove Project area is the harbor seal. In October 2014, Jordan Cove and Pacific Connector submitted their application for incidental harassment authorization under the MMPA to the NMFS. Piles for berth structures would be driven “in-the-dry” while the terminal slip is separated from the bay by an earthen berm, thus reducing noise impacts on aquatic species. Nevertheless, we recommend that prior to construction Jordan Cove should provide a Monitoring and Adaptive Management Plan for the protection of pinnipeds, marine fish, and shellfish. The potential for LNG vessel strikes on marine mammals and sea turtles in the waterway during transit to and from the proposed LNG terminal is low, given the speed of the LNG vessels and historic records indicating that vessel strikes of marine animals rarely occur.

Because of the slow speed of LNG vessels in the waterway, and the small size of their wake waves, their transit in the Coos Bay navigation channel is not likely to cause major shoreline erosion. Nor would propeller wash from LNG vessels, tugs, and escort boats cause significant displacement of bottom sediments in the access channel and slip. The chance of fish strandings

from LNG vessel wakes is also considered unlikely. Given LNG vessel design, on-board spill kits, safety measures, and implementation of the Coast Guard recommendations in its WSR and LOR, the likelihood of a spill of hazardous liquids from an LNG vessel in transit in the waterway that may adversely impact aquatic species is extremely low.

In the waterway for LNG transit to and from the Jordan Cove terminal, we identified EFH for 82 species of groundfish, 5 coastal pelagic species, 3 species of Pacific Coast salmon, and at least 5 highly migratory species that could be affected by the Project. In order to comply with the MSA, we included our EFH assessment with the BA submitted to the FWS and NMFS.

Dredging for the LNG access channel and slip would remove the current benthic population of organisms within the sediments, including clams, ghost shrimp, and polychaete worms in the estuarine regions. It has been reported that benthic communities on mud substrates in Coos Bay, when disturbed by dredging, recovered to pre-dredging conditions in about one month although due to the large extent of dredging for this project, recovery may take longer. Hydrodynamic and sediment transport modeling for the dredging of the LNG facility showed that the combined background and Project-related suspended sediment concentrations would be well below the lethal level for fish. The dredging would be temporary (lasting not more than 6 months), and impacts would be localized.

The intake of water for engine cooling by LNG vessels at berth could result in entrainment and impingement of small less-mobile aquatic species. However, the amount of water taken in by LNG vessels at berth (estimated to be about 6.1 million gallons) would be an extremely low percent of the total volume of Coos Bay (2.2 million acre feet discharged at mouth), and the loss of aquatic life due to the operation of the Jordan Cove Project would be low in comparison to natural mortality.

Most effects from pipeline construction across streams would result in short-term water quality impacts (e.g., turbidity, water temperature, pH, dissolved oxygen), benthic invertebrate populations, and aquatic species. To improve stream habitat, and mitigate for impacts, Pacific Connector is proposing to install LWD at selected locations and replant riparian vegetation in proportion to that initially removed or two times greater than the final maintained clearing width.

The pipeline in Hayes Inlet was routed to avoid commercial oyster beds. Between MPs 2.9 to 3.2 commercial oyster beds would be adjacent to the route, and oysters may be affected by turbidity and sedimentation on a short-term basis during construction. Native Olympia oysters can be found in Haynes Inlet, so Pacific Connector developed an *Olympia Oyster Mitigation Plan*.

It is possible that invasive species could be introduced from pipeline construction equipment or through hydrostatic testing bringing water from one basin to another. Therefore, we are recommending that Pacific Connector develop a project-specific *Aquatic Species Nuisance Prevention Plan* to ensure these impacts are minimized.

About 178 species of amphibians, reptiles, birds, and mammals were recorded on or adjacent to the Jordan Cove Project site. The primary impact on terrestrial species would be the removal of habitat. Construction of the Jordan Cove Project facilities would affect a total of approximately 27 acres of ODFW-defined Category 2 (essential for wildlife, and limited) habitats, 115 acres of Category 3 (essential but not limited) habitats, and 120 acres of Category 4 (important but not essential and not limited) habitats. To mitigate for the loss of those habitats, Jordan Cove would

acquire about 259 acres at three off-site parcels. We recommend that Jordan Cove file with the Secretary its *Final Wildlife Habitat Mitigation Plan*, together with documentation that the plan was formulated in consultation with appropriate resource agencies such as the ODFW. In addition, we recommend that Jordan Cove document consultations with appropriate resource agencies and develop a final lighting plan that would reduce impacts on wildlife and aquatic resources. We also recommend that both Jordan Cove and Pacific Connector file *Final Migratory Bird Conservation Plans*.

Overall, 47 amphibians and reptiles, 278 birds, and 106 mammal species are known or suspected to occur in habitats crossed by the Pacific Connector pipeline route. Most mobile species disturbed during construction would relocate to adjacent habitat. In general, construction related impacts on wildlife would be short-term, and after the pipeline is installed, the right-of-way would be revegetated and habitats restored. Only forest habitat within the 30-foot-wide maintenance corridor would be converted to herbaceous vegetation. Pacific Connector would minimize habitat loss through its ECRP and its *Habitat Mitigation Plan,* and would avoid or minimize effects to migratory bird species by implementing measures outlined in the *Migratory Bird Conservation Plan*. We recommend that Pacific Connector file with the Secretary its *Final Habitat Mitigation Plan* for impacts on non-federal lands, together with documentation that the plan was formulated in consultation with appropriate resource agencies such as the ODFW. To compensate for the loss of cavities and snags within the construction right-of-way, Pacific Connector would top or girdle trees at the edge. Pacific Connector would also put up nesting boxes within riparian areas.

Effects on Federal Lands

To ensure that the Pacific Connector Pipeline Project is consistent with the objectives of the ACS, which would in turn aid fish populations on federal land, Pacific Connector would (1) donate LWD to agencies/conservation groups to perform in-stream restoration projects; and/or (2) relocate large boulders greater than 24 inches in diameter for use as fish habitat structures.

Pacific Connector would provide funding to the BLM and Forest Service that will be used to mitigate for impacts on habitat where the pipeline crosses federal lands, as described in appendix F. Mitigation actions include decommissioning roads in LSRs that are no longer required for management; funding the replacement of Matrix lands that would be reallocated to LSR; funding non-commercial thinning treatments or other silvicultural projects to create or accelerate development of old-growth characteristics in LSRs and elsewhere on federal land; and creating snags in adjacent habitat.

5.1.7 Threatened, Endangered, and Other Special Status Species

Based on informal consultations with the FWS and NMFS, 39 species protected under the ESA were identified as potentially occurring in the general vicinity of the Project. Within the EEZ and the waterway for LNG marine traffic, there are 7 species of federally listed whales, 2 birds, 4 species of marine turtles, and 4 fish species.

Jordan Cove and Pacific Connector conducted biological surveys to assess the presence of federally listed species or habitats. In addition to the federally listed fish species in Coos Bay, there are two other fish species that could reside in waterbodies along the Pacific Connector pipeline route. One federally listed invertebrate may occupy habitat within and adjacent to the pipeline right-of-way. Because of concerns about the adequacy of surveys for this invertebrate,

we are recommending that Pacific Connector confirm the presence or absence of vernal pool fairy shrimp within potential habitat along the pipeline route and file a plan to avoid both direct and indirect impacts on vernal pool fairy shrimp habitat at proposed or potential storage yards and the pipeline route before use of these areas would be allowed. There are two listed birds along the Pacific Connector pipeline route (MAMU and NSO). While seven federally listed plant species were identified from the literature for the pipeline area, Pacific Connector's botanical surveys located populations of three of those plant species.

The FERC prepared a BA that was submitted to the NMFS and FWS. That BA provides supporting documentation for our findings, summarized below. Based on updated information and ongoing consultation with FWS and NMFS, our effects determinations for the fisher and Pacific eulachon have changed from "not likely to adversely affect" to "likely to adversely affect" since we submitted our BA in February 2015; these updates are reflected in this FEIS.

The Project is ***not likely to adversely affect***:

- the endangered gray wolf
- the endangered blue whale;
- the endangered fin whale;
- the endangered killer whale (Eastern North Pacific, Southern Resident stock);
- the endangered humpback whale;
- the endangered sei whale;
- the endangered sperm whale;
- the endangered North Pacific right whale;
- the endangered short-tailed albatross
- the threatened western snowy plover;
- the threatened streaked horned lark;
- the endangered green turtle;
- the endangered leatherback turtle;
- the endangered olive ridley turtle;
- the threatened loggerhead turtle;
- the threatened Oregon spotted frog;
- the endangered western lily;
- the endangered Cook's lomatium; and
- the endangered rough popcornflower.

The Project is ***likely to adversely affect***:

- the proposed threatened fisher (west coast DPS)
- the threatened MAMU;
- the threatened NSO;
- the threatened green sturgeon (Southern DPS);
- the threatened Pacific eulachon (Southern DPS);
- the threatened coho salmon (SONCC);
- the threatened coho salmon (Oregon Coast ESU);
- the endangered Lost River sucker;
- the endangered shortnose sucker;

- the threatened vernal pool fairy shrimp;
- the endangered Applegate's milk-vetch;
- the endangered Gentner's fritillary;
- the endangered large-flowered meadowfoam; and
- the threatened Kincaid's lupine.

Jordan Cove and Pacific Connector have proposed a CMP to compensate for unavoidable impacts on listed species and their habitats through substitute habitat and/or habitat stewardship. Because some federally listed species and their habitats may be affected, we have requested that the FWS and NMFS develop BOs indicating whether or not the proposed Project is likely to jeopardize the continued existence of a listed species or adversely modify designated critical habitat for those species. We are recommending that, should the Commission choose to issue an Order and Certificate for the Project, initiation of Project construction be made contingent upon the outcome of the completed formal ESA consultations and the content of the BOs.

Effects on Federal Lands

Within the Coos Bay and Roseburg BLM Districts, the Pacific Connector pipeline would clear about 53 acres from occupied MAMU stands. The pipeline would affect suitable habitat for NSO on federal lands, including about 6 acres of KOAC. Five stream crossing by the pipeline route would have known or assumed federally listed fish or habitat present on federal lands.

A total of 50 BLM and Forest Service sensitive species have the potential to be impacted by the Project: 3 mammal, 19 bird, 1 reptile, 1 amphibian, 17 invertebrate, 6 fish, 2 plant, and 1 bryophyte species. In addition, surveys conducted for the Project in and near the project area resulted in numerous observations of S&M species on BLM and NFS lands. These survey results, in combination with results from prior surveys conducted in the vicinity of the project area, were used to identify the S&M species that could be affected by the Project. A total of 87 S&M species could be affected by the Project, including 66 fungi, 13 lichens, 1 bryophyte, 3 vascular plants, 2 mollusks, 1 mammal, and 1 bird. In our DEIS, we recommended that Pacific Connector make minor route adjustments on NFS lands to enlarge protection buffers for three fungi: *C. alveolatus, G. abietus,* and *S. pulvinata.* Pacific Connector agreed to make these adjustments, and filed minor route adjustments with the FERC on January 19, 2015, that comply with Forest Service requirements.

5.1.8 Recreation and Visual Resources

Construction and operation of the Jordan Cove LNG Terminal would have no direct adverse effects on nearby recreational areas; including the ODNRA and Shorelands SRMA. Noise from the terminal would be audible to people recreating in the immediate vicinity; however, based on our analysis it would not be significantly louder than existing ambient noise levels in these areas, where there is also OHV use. Impacts of terminal construction traffic on people driving to recreational areas on the North Spit would be mitigated by Jordan Cove following the measures outlined in its traffic assessment.

Recreational boaters using Coos Bay would have to temporarily move out of the way of an LNG vessel as it passes, as they currently do for other deep-draft commercial ships in the navigation channel. During the construction period that includes dredging within Coos Bay, recreational

boaters would be redirected away from the access channel and slip, which would pose a temporary inconvenience.

The Pacific Connector pipeline route would not cross or affect any county or state parks or recreation areas. It would cross the Haynes Inlet Water Trail in Coos Bay, which is a Water of the State. We are recommending that Pacific Connector document consultations with the Port, Coos County, City of North Bend, ODSL, ODPR, CRTP, and other interested parties regarding the potential impacts on the Haynes Inlet Water Trail and users of the boat ramp along North Bay Drive, and file their comments on the *Recreation Management Plan*.

The most visible part of the LNG terminal would be the LNG storage tanks, which would be about 180 feet tall. While the LNG terminal could be seen from western portions of the city of North Bend, and places within the BLM's Shorelands SRMA, visual impacts would be minimized because the terminal would be situated next to an existing industrial facility (Roseburg Forest Products), there is a forested dune behind the terminal, the storage tanks would be surrounded by a 60-foot-high earthen storm barrier, and a reduced lighting plan would be implemented.

The clearing of forest for the pipeline right-of-way and introduction of new aboveground facilities would have long-term visual impacts. However, visual simulations at KOPs show that with implementation of Pacific Connector's *Aesthetics Management Plan* and its ECRP, over time vegetation would grow up within the temporary right-of-way to reduce visual impacts. Visual impacts at the Klamath Compressor Station would be reduced by using a slated fence and planting landscaping around the facility.

Effects on Federal Lands

The pipeline route would not cross any national parks, developed federal recreation areas, national monuments, national landmarks, wilderness areas, wildlife preserves, wild and scenic river segments, or Indian reservations.

The pipeline route would cross three National Scenic Byways (U.S. Highway 101, State Highway 62, and U.S. Highway 97). The pipeline would be installed under U.S. Highway 101 within the waters of Coos Bay, and Pacific Connector would use HDDs to avoid impacts on State Highway 62 and U.S. Highway 97. These highways would remain open during construction and no vegetation would be removed in the vicinity of the crossings.

The pipeline route would cross the Applegate Branch of the California National Historic Trail in two places; however, at the two crossing locations modern roads have removed traces of the historic trail. One National Scenic Trail (PCT) would be crossed on NFS lands. Pacific Connector would implement the measures outlined in its *Recreation Management Plan* to minimize impacts on the PCT.

The proposed pipeline would cross about 300 feet of the BLM Coos Bay District Upper Rock Creek ACEC. The BLM has found that this crossing would not adversely affect the Relevant and Important values of the ACEC and would not conflict with management of this area. Pacific Connector developed an *Upper Rock Creek ACEC Crossing Plan* to reduce impacts on that land parcel.

Visually, the Pacific Connector pipeline would meet BLM VRM Class IV and Class III objectives, and though the pipeline does not meet VRM Class II objectives in two locations in the short term, plan amendments are not needed because long-term objectives would be met through mitigation in the *Aesthetics Management Plan*.

The pipeline would not meet Forest Service VQO at three locations on Rogue River National Forest and two locations on the Winema National Forest. LMP amendments are proposed in each instance to a longer period for revegetation to meet the visual objects at those locations.

5.1.9 Socioeconomics

With the risk management measures recommended by the Coast Guard in its WSR, LNG vessel marine traffic in the waterway is not likely to have significant adverse impacts on commercial fishermen or other commercial ships. There would be temporary delays for other boats while an LNG vessel passes by.

Construction of the LNG terminal is anticipated to last for 42 months. At its peak, about 2,100 people would be employed. Approximately 15-20 percent of the construction workforce would be expected to commute daily from their homes in the area. The non-local workforce would average about 792 employees over the life of the construction phase and peak at about 1,800 people. There are about 70 hotels, motels, and bed and breakfast inns, 51 mobile home parks, and 69 RV parks or campgrounds within 53 miles of the Jordan Cove LNG Terminal site. Due to concerns about adequate amenity provision for workers and competition with tourists for rooms, Jordan Cove would construct and operate the NPWHC to house employees. NPWHC housing would be offered as a benefit of employment. Jordan Cove estimates that operation of the proposed LNG terminal and non-jurisdictional South Dunes Power Plant would require a permanent staff of 145 people.

Construction of the Pacific Connector pipeline would extend over two years, with an average monthly workforce of 1,400 people. Pacific Connector estimates that approximately 50 percent of the construction jobs for the pipeline would be filled by non-local workers, with a peak of 922 people working over five construction spreads. Pacific Connector identified a total of 7,889 hotel and motel rooms, and 21,169 vacant rental houses in the four counties crossed by the pipeline. Factors that would ameliorate the demand for housing by non-local workers include some employees staying in their own RVs and some employees sharing accommodations. Where housing is constrained in one spread, the construction workers would commute greater distances. Existing infrastructure and social services, including police, fire, health facilities, schools, and public utilities are adequate to serve the needs of the Project needs, and handle the temporary influx of non-local workers during construction.

For both projects combined, there would be total direct employment of 7,073 FTEs during the entire period of construction; an indirect impact of an additional 5,120 non-project jobs; and 7,353 induced other jobs. The companies would spend a combined total of $4.5 billion to build both the terminal and pipeline; supporting approximately $1.2 billion and $974 million in indirect and induced economic output, respectively. The projects would also support a total of $1.7 billion in direct, indirect, and induced GDP in Oregon and Washington over the 4-year construction period.

Jordan Cove estimated that construction of its LNG terminal and related facilities would cost about $3 billion in 2011 dollars. About $2.6 billion would be for materials, equipment, and other expenditures, with $653 million of that amount spent in the states of Oregon and Washington combined. Total wages during construction estimated at about $412 million, with $364 million in wages going to people who reside in the states of Oregon and Washington. It was estimated that the Jordan Cove LNG Terminal would generate about $12 million in direct annual wages during operation. Each year during operation of the terminal, Jordan Cove would make contributions through Coos County's Bay Area Enterprise Zone in lieu of taxes, consisting of about $20 million for education and $10 million for urban renewal.

Pacific Connector estimates that it would cost about $1.74 billion to build its facilities. Total construction payroll is estimated to be $240 million. Costs for materials and equipment bought in or brought to Oregon are estimated at about $464 million. About $33 million would be spent during construction for local contracted services, such as logging and hauling, road improvements, and professional services. During its first year of operation, Pacific Connector would be expected to generate an estimated total of $11.1 million in property tax revenues in the four counties combined that the pipeline crosses. We conclude that the Project would have beneficial impacts on the regional economy.

It is possible that the location of a pipeline near a residence could affect property values. Several studies have shown that the location of a pipeline near a residence does not necessarily depress the sales price. The impact a pipeline may have on the value of a tract of land depends on many factors, including the size of the tract, the values of adjacent properties, the presence of other utilities, the current value of the land, and the current land use.

The Pacific Connector pipeline would cross a mostly rural region. More than 80 percent of the population of the four counties crossed by the pipeline are White. People earning below the poverty line varied from 23 percent in Klamath County to 18 percent in Douglas County. Along the route, to the Project would not adversely affect any communities containing a disproportionally high percentage of minorities, low-income households, elderly, children, non-English speakers, or other vulnerable populations.

Effects on Federal Lands

Pacific Connector prepared a Financial Efficiency Analysis that assesses the net present value of costs and benefits that would accrue to the federal government as a result of construction and operation of the proposed project. Costs and benefits were projected over a 50-year time period, where appropriate, and discounted using a real discount rate of 4 percent. The analysis identifies two sources of direct government revenue: 1) Pacific Connector's payment for timber that would need to be cut, and 2) Pacific Connector's rental payments for construction access and the pipeline right-of-way. The analysis also identifies three sources of government costs: 1) the value of lost timber productivity along the new right-of-way, 2) the value of non-merchantable trees that would need to be cut prematurely (lost timber growth), and 3) the incremental cost of future maintenance for existing roads that Pacific Connector may upgrade above their existing federal maintenance level. The projected net present value of the Pacific Connector pipeline based on this analysis is $5.24 million in 2010 dollars.

5.1.10 Transportation

The Port is currently utilized by about 60 deep-draft commercial cargo ships and 50 barges per year, and Coos Bay is the base for about 200 commercial fishing boats. The addition of about 90 LNG vessel calls to the Jordan Cove LNG Terminal would not have significant adverse effects on the other commercial marine traffic using the Port. Boats in Charleston Marina may need to wait about 20 minutes for an LNG vessel to pass. Historically, the Port handled as many as 300 deep-draft commercial cargo ship visits per year.

Peak construction activities would result in 2,009 inbound and outbound worker vehicle trips each day to the LNG terminal, together with approximately 190 material delivery truck trips per day (excluding weekends). The only road to the terminal is the Trans-Pacific Parkway. Jordan Cove would make improvements at the parkway's intersection with Highway 101, in accordance with its *Traffic Impact Analysis*, to ease traffic congestion. To reduce traffic impacts, Jordan Cove would have its employees park at off-site satellite lots and transport them to the terminal by bus. In addition, some equipment deliveries would be made by rail or by barge. We are recommending that the *Traffic Impact Analysis* be revised.

The Southwest Oregon Regional Airport is located in the city of North Bend, directly across Coos Bay and less than 1 mile from the proposed LNG terminal site. In June 2013, Jordan Cove submitted to the FAA its *Notice of Proposed Construction or Alteration*. On July 24, 2014, the FAA issued 31 Determinations of No Hazard and five Notices of Presumed Hazard. We are recommending that before construction of the LNG terminal begins, Jordan Cove should file documentation of continuing consultations with the FAA and the Southwest Oregon Regional Airport, the results of any additional studies conducted by the FAA, and copies of official determination of findings made with respect to the proposed LNG terminal and related facilities, including the resolution of the five Notices of Presumed Hazard.

About 709 existing roads would be used for access during construction of the Pacific Connector pipeline. Pacific Connector has estimated that modifications of 73 existing access roads may be required outside of the existing road bed resulting in about 14 acres of disturbance. In addition Pacific Connector would put in 13 new TARs during construction, affecting about 5 acres, and would permanently maintain 15 new access roads during operation of the pipeline, impacting a total of about 2 acres. All new temporary roads would be decommissioned and the areas restored to preconstruction conditions following completion of construction.

It is projected that 80 percent of the workforce for each pipeline spread would be transported from the contractor yard to and from the right-of-way on crew buses, with the remaining 20 percent using their own vehicles and moving from site-to-site along the right-of-way using local roads and highways. Pacific Connector developed a TMP for non-federal lands that outlines measures to reduce impacts on non-Project road users. We are recommending that prior to pipeline construction, Pacific Connector document that it provided its TMP to ODOT and the affected counties, and file the agency comments together with a revised plan.

The pipeline right-of-way could attract unauthorized OHV, snowmobile, and dispersed motorized access. Pacific Connector's *Recreation Management Plan* describes measures to be employed on both public and private lands to control unauthorized OHV use, including barriers.

Effects on Federal Lands

The Pacific Connector pipeline would use all or portions of 138 roads that would cross BLM lands for access to the pipeline right-of-way during construction, 58 roads on NFS lands, and 11 roads under Reclamation jurisdiction. Pacific Connector would need to construct 1 new TAR with a total length of approximately 0.3 mile on BLM land affecting less than 1 acre. They would need to construct 3 new PARs on BLM lands, with a total length of less than 0.1 mile, affecting approximately one-quarter acre. No new TARs or PARs would be built on NFS lands; however, 2 existing decommissioned roads would be reconstructed as temporary roads and then decommissioned upon completion of use. Pacific Connector developed a federal TMP (POD Attachment Y) to that describes the measures to be employed in the construction, use, and maintenance of roads under the jurisdiction of BLM, Forest Service and Reclamation. This TMP also includes details regarding timber removal and construction access road improvements, maintenance and management of use before, during and after construction. This TMP applies to agency-managed roads located on agency and privately-owned lands.

5.1.11 Cultural Resources

Archaeological investigations for the Jordan Cove Project one site at the marine slip (35CS221), one at the SORSC (35CS227), and one at the Kentuck Slough Wetland Mitigation Area (35CS263). The site at the marine slip and the SORSC are of undetermined HRHP eligibility pending additional investigations. It is possible that impacts at the SORSC site could be avoided. The site at the Kentuck Slough Wetland Mitgation Area should be avoided; however an archaeologist should monitor work during construction.

As of May 2013, about 201 miles of the currently proposed pipeline route were covered by surveys, as well as 92 TEWAs fully surveyed, 6 TEWAs partially surveyed, 475 miles of access road, 26 pipe or contractor yards, 16 rock source or disposal areas, and the proposed locations for compressor and meter stations. The surveys identified 104 archaeological sites and 152 isolated finds. All of the isolated finds, and 29 sites on non-federal lands were determined to not be eligible for the NRHP, and require no further work. There are 19 sites on non-federal lands that can be avoided, or where the Project would have no adverse effects. There are 18 sites on non-federal lands of undetermined eligibility to the NRHP that may be affected by the pipeline project and require additional investigations. Nineteen sites on non-federal land are potentially eligible for the NRHP, cannot be avoided, and require additional testing to determine their NRHP eligibility. Thirteen sites on non-federal land are eligible for the NRHP, cannot be avoided, and require treatment in the form of future data recovery excavations. The FERC reached these determinations of eligibility and effect in consultation with the SHPO.

In 2011 we produced an MOA for resolving adverse effects at the historic properties identified for the Jordan Cove LNG import project and Pacific Connector sendout pipeline proposed under Docket Nos. CP07-441-000 and CP07-443-000. The MOA offered a phased approach to future cultural resources investigations. If the newly proposed LNG export project is authorized, we would seek to amend the MOA to cover the facilities under Docket Nos. CP13-483-000 and CP13-492-000.

The FERC staff and the applicants have contacted Indian tribes that may attach religious or cultural importance to sites in the APE. We have received comments from the Coos Tribes, Cow Creek Tribe, and Klamath Tribes. We are recommending that Jordon Cove file its final MOU

with interested Indian tribes, and that Pacific Connector should file documentation of meetings with the Cow Creek Tribe and Klamath Tribes and any agreements reached with the tribes.

We have not yet completed the process of complying with the NHPA for this Project. Jordan Cove has not yet completed testing at site 35CS221. Cultural resources inventories have not yet been completed for the entire APE for Pacific Connector. Pacific Connector has about 31 miles left of the currently proposed pipeline route to survey, and intends to conduct deep geoarchaeological testing at the three river crossings where HDDs would be used. We are recommending that Jordan Cove and Pacific Connector not construct or use any of their proposed facilities, including related ancillary areas for staging, storage, temporary work areas, and new or to-be-improved access roads, until all studies and consultations necessary to complete compliance with the NHPA have been completed.

Effects on Federal Lands

Eighteen archaeological sites are on BLM lands. Twelve of these have been evaluated by the BLM as not eligible for the NRHP and require no further work. However, the SHPO has indicated disagreement with the BLM's "not eligible" determination for two of these sites. The BLM is currently working with the SHPO to resolve this disagreement. One site should be avoided. Five sites are eligible for the NRHP and cannot be avoided. Those five historic properties would require data recovery excavations to mitigate adverse effects.

Six sites are on NFS lands. Two sites are evaluated as not eligible for the NRHP and require no further work. Three sites should be avoided. One site (historic Dead Indian Memorial Highway) is eligible for the NRHP, but crossing it would have no adverse effects.

The Pacific Connector pipeline route would cross 19 irrigation features (some multiple times) associated with the Klamath Project that are under the jurisdiction of Reclamation. The Klamath Project has been determined eligible for the NRHP, however, the SHPO believes the pipeline would have no adverse effects on the Klamath Canal System, because Pacific Connector proposes to cross irrigation ditches in the Klamath Basin via dry open cut during the low water period of the winter, and would restore all canals back to their previous condition after construction.

5.1.12 Air Quality, Greenhouse Gases, and Noise

Air pollutants would be emitted as a result of both construction and operation of marine vessels on the waterway for LNG marine traffic, the LNG terminal and South Dune Power Plant, the Pacific Connector pipeline and aboveground facilities. The location of the Jordan Cove terminal is within an air basin in attainment with federal air quality standards.

During construction, a temporary reduction in ambient air quality may result from emissions and fugitive dust generated by construction equipment. Emissions from equipment during construction would be temporary and would not result in a significant impact on regional air quality or result in any violation of applicable ambient air quality standard.

In March 2013, Jordan Cove submitted an air quality permit application to the ODEQ. The Project's PSD permit application demonstrates that applicable requirements have been met. For all pollutants, the combined impacts at the points of highest concentration during operation of the

Jordan Cove facilities are well below the applicable NAAQS and the PSD increments. Therefore, we conclude that the Project would have no significant impacts to regional air quality.

The Klamath Compressor Station and approximately 4.3 miles of pipeline would be located within the Klamath Falls $PM_{2.5}$ nonattainment area, and approximately 325 feet of pipeline route would be located within the PM_{10} maintenance area. Pacific Connector has not yet filed an air permit application; however, ODEQ would only issue the Project a permit if the applicant can demonstrate compliance with applicable PSD increments and NAAQS to ODEQ's satisfaction. The compressor station could have 1-hour NO_2 impacts that approach the NAAQS; however, the screening model is highly conservative and the applicant would be required to address this issue as part of the air permitting process.

Operation of the Project itself would be a significant source of GHG emissions (2.1 million metric tonnes CO_2e/yr), but could be an important reducer of global GHG to the extent that it displaces the current (and projected increasing) coal use in Asia. That being said, FERC stresses that the type of displacement that would actually occur depends on a multitude of complex geopolitical and economic factors that cannot reasonably be foreseen.

The NSAs closest to the LNG terminal are single-family homes in the city of North Bend (NSA1) about 1.4 miles south of the center of the proposed LNG terminal site. Given existing noise levels in the area, the LNG terminal construction noise would not have significant impact on NSAs.

Noise from operation of the LNG terminal is predicted to have a L_{dn} sound level of about 51.4 dBA at NSA2. This would be below the FERC standard of an L_{dn} of 55 dBA. However, we are recommending that Jordan Cove document that its facilities meet our noise standards by filing the results of a noise survey during operation.

Sound levels from equipment during construction of the Pacific Connector pipeline are predicted to be 95 dBA 50 feet away, and would attenuate to 74 dBA at 300 feet. Pipeline construction activities generally would be limited to daytime hours. Due to the assembly-line nature of pipeline construction, activities in any area could occur intermittently over a period lasting from several weeks to a few months. Noise from HDD drilling activities may be above our standard of 55 dBA at some NSAs without mitigation. To make certain that the mitigation measures implemented at the HDD locations are reducing noise at nearby NSAs, were are recommending that Pacific Connector file the results of noise surveys during the drilling activities.

Pacific Connector would implement mitigation measures to reduce noise from the compressor station. To ensure that actual operational noise is at or below the predicted noise, and that there would be no significant impact to noise quality at the nearest NSAs, we are recommending that Pacific Connector file the results of a noise survey no later than 60 days after the compressor station is placed in service to demonstrate that noise at nearby NSAs does not exceed 55 dBA L_{dn}. If that level is exceeded, Pacific Connector would need to install additional noise controls to meet the level within 1 year of the in-service date.

Effects on Federal Lands

The nearest federal PSD Class I areas to any of the proposed Jordan Cove facilities are more than 100 km away, and impacts from Project air emissions at these locations would be minimal and well within compliance with federal standards. Air pollution regulations treat other (Class II)

federal lands in the same manner as non-federal Class II lands. The nearest federal lands to the Jordan Cove LNG Terminal include the Shorelands SRMA and the ODNRA. Air quality impacts at these locations would be less than the maximum Class II impact.

The pipeline construction corridor would pass closest to the Mountain Lakes Wilderness Class I area; at its closest point it would be only 4.5 miles away. This is within construction spread 4. Potential air quality impacts on Mountain Lakes would decrease as the distance between construction spread activity and Mountain Lakes increases. Emissions would be below applicable screening criteria. Overall, analyses indicate the pipeline would not adversely affect air quality on federal lands.

During pile driving for installation of LNG terminal berth facilities, predicted noise levels at the BLM boat ramp would exceed 55 dBA, and would be noticeable to users of the BLM boat ramp. This impact would be a temporary annoyance during terminal construction. Predicted noise from operation of the LNG terminal would be below 55 dBA at the BLM boat ramp, which would be below a noise level that would interfere or be an annoyance for users of the boat ramp.

During construction of the Pacific Connector pipeline, there would be temporary noise impacts on federal lands crossed by the pipeline or crossed by construction access roads. Construction noise could have localized and temporary impact on recreational users and wildlife within federal lands. During operation of the pipeline, there would be no noise generated from the buried pipeline. Three aboveground MLVs would be located within BLM lands, and sound is sometimes detectable within several feet of MLVs; however, this noise level would not be humanly perceptible beyond the operational right-of-way.

5.1.13 Reliability and Safety

As part of the NEPA review, Commission staff must assess whether the proposed facilities would be able to operate safely and securely. As a result of our technical review of the preliminary engineering design and our recommended mitigation, we believe that the facility design proposed by Jordan Cove includes acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

As a cooperating agency, DOT assisted FERC staff in evaluating whether Jordan Cove’s proposed design would meet the DOT siting requirements. On June 18, 2014, DOT provided a letter to the FERC staff stating that DOT had no objection to Jordan Cove's methodology for determining the single accidental leakage sources for candidate design spills to be used in establishing the Part 193 siting requirements for the proposed LNG liquefaction facilities. Based on the hazardous area calculations we reviewed, we conclude that potential hazards from the siting of the facility at this location would not have a significant impact on public safety. The areas impacted by these design spills also appear to meet the DOT’s exclusion zone requirements by either being within the facility property boundary, within land controlled by Jordan Cove, or over a navigable body of water. If the facility is constructed and becomes operational, the facility would be subject to DOT’s inspection and enforcement program. Final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by DOT staff.

As a cooperating agency, the Coast Guard analyzed the suitability of the waterway for LNG marine traffic. Based on its review and its own independent risk assessment, the Coast Guard

has determined that the waterway could be made suitable for the type and frequency of LNG marine traffic associated with the proposed Jordan Cove LNG facility. This opinion was contingent upon the availability of additional measures necessary to responsibly manage the maritime safety and security risks. If appropriate resources are not in place prior to LNG vessel movement along the waterway, then the Coast Guard would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

Pacific Connector's pipeline would be built and inspected according to DOT standards. These standards ensure pipeline safety.

Effects on Federal Lands

Locating the pipeline in non-populated areas minimizes the chance for unauthorized public access to the right-of-way. Pacific Connector has proposed mitigation measures to protect the public from construction activity. The BLM, Forest Service, and Reclamation can require Pacific Connector to incorporate additional specific public safety measures into the POD as a condition of a Right-of-Way Grant for use of federal lands. Federal land management agencies may also issue temporary closure orders during periods of active construction when necessary to protect public health and safety.

5.1.14 Cumulative Impacts

Construction of the Project, in addition to other projects within the same watersheds crossed by the pipeline during the same timeframe, would have cumulative impacts on a range of environmental resources, as discussed in section 4.14. We provided information about project-related impacts and mitigation measures for specific environmental resources, and were able to make some general assumptions about other federal projects identified in table 4.14.2.3-1. For the federal projects, there are laws and regulations in place that protect waterbodies and wetlands, threatened and endangered species, and historic properties, and limit impacts from air and noise pollution. Federal land-managing agencies, such as the BLM and Forest Service, have requirements in their LMPs to protect resources on the lands they manage. We do not have good information about potential or foreseeable private projects in the region. For some resources, there are also state laws and regulations that apply to private projects. The analysis area is vast; the 19 watersheds crossed by the Project include more than two million acres. While there would be cumulative impacts on resources when all of the foreseeable projects are combined, the magnitude of that impact would be minimal at the landscape scale. Given the Project BMPs and design features, mitigation measures that would be implemented, federal and state laws and regulations protecting resources, and permitting requirements, we conclude that when added to other past, present, and reasonably foreseeable future actions, the Project would not have significant adverse cumulative impacts on environmental resources within the watersheds crossed by the Pacific Connector pipeline route.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission approves the proposed Projects, we recommend that the Commission's authorizations include the measures recommended below to further mitigate the environmental impacts associated with the construction and operation of the proposed Project.

1. **Jordan Cove Energy Project LP (Jordan Cove) and Pacific Connector Gas Pipeline LP (Pacific Connector)** shall follow the construction procedures and mitigation measures described in their respective applications, supplemental filings (including responses to staff data requests), and as identified in the environmental impact statement (EIS), unless modified by the Order. Jordan Cove and Pacific Connector must:

   a. request any modification to these procedures, measures, or conditions in a filing with the Secretary of the Commission (Secretary);

   b. justify each modification relative to site-specific conditions;

   c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and

   d. receive approval in writing from the Director of the Office of Energy Projects (OEP) **before using that modification**.

2. **For Jordan Cove's liquefied natural gas (LNG) facilities**, the Director of OEP has delegated authority to take all steps necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Project. This authority shall include:

   a. stop-work authority and authority to cease operation; and

   b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the conditions of the Order.

3. **For Pacific Connector's facilities**, the Director of OEP has delegated authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the Project. This authority shall allow:

   a. the modification of conditions of the Order; and

   b. the design and implementation of any additional measures deemed necessary (including stop work authority) to assure continued compliance with the intent of the environmental conditions as well as the avoidance or mitigation of adverse environmental impact resulting from Project construction and operation.

4. **Before any construction of the LNG terminal and the pipeline**, Jordan Cove and Pacific Connector shall each file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, environmental inspectors (EI), and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.

5. The authorized facility locations shall be as shown in the EIS, as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction for the LNG terminal and the pipeline**, Jordan Cove and Pacific Connector shall each

file with the Secretary any revised detailed maps or survey alignment sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these maps/alignment sheets.

Pacific Connector's exercise of eminent domain authority granted under NGA section 7(h) in any condemnation proceedings related to the Order must be consistent with these authorized facilities and locations. Pacific Connector's right of eminent domain granted under NGA section 7(h) does not authorize it to increase the size of its natural gas pipeline or facilities to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

6. Jordan Cove and Pacific Connector shall each file with the Secretary detailed maps or alignment sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, new access roads, and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, and documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   This requirement does not apply to extra workspace allowed by the FERC staff's *Upland Erosion Control, Revegetation, and Maintenance Plan* (*Plan*), minor field realignments per landowner needs, and requirements which do not affect other landowners or sensitive environmental areas such as wetlands.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;

   b. implementation of endangered, threatened, or special concern species mitigation measures;

   c. recommendations by state regulatory authorities; and

   d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

7. **Within 60 days of the acceptance of the Order, and before construction of the LNG terminal and the pipeline begins**, Jordan Cove and Pacific Connector shall each file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. Jordan Cove and Pacific Connector must file revisions to their respective plan as schedules change. The plans shall identify:

   a. how Jordan Cove and Pacific Connector will implement the construction procedures and mitigation measures described in their applications and

supplements (including responses to staff data requests), identified in the EIS, and required by the Order;

b. how Jordan Cove and Pacific Connector would incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to on-site construction and inspection personnel;

c. the number of EIs assigned per spread, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;

e. the location of the environmental compliance training Jordan Cove and Pacific Connector will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel change), with the opportunity for OEP staff to participate in the training sessions;

f. the company personnel (if known) and specific portion of Jordan Cove and Pacific Connector's organization having responsibility for compliance;

g. the procedures (including use of contract penalties) Jordan Cove and Pacific Connector will follow if noncompliance occurs; and

h. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

(1) the completion of all required surveys and reports;

(2) the environmental compliance training of on-site personnel;

(3) the start of construction; and

(4) the start and completion of restoration.

8. Jordan Cove and Pacific Connector shall employ a team of EIs, including at least one EI at the LNG terminal and two or more per pipeline spread. The EIs shall be:

a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorizing documents;

b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 7 above) and any other authorizing document;

c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;

d. a full-time position, separate from all other activity inspectors;

e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

f. responsible for maintaining status reports.

9. Pacific Connector shall develop and implement an environmental compliance resolution procedure. The procedure shall provide landowners with clear and simple directions for identifying and resolving their environmental mitigation problems/concerns during construction of the Project and restoration of the right-of-way. **Prior to construction**, Pacific Connector shall mail the complaint procedures to each landowner whose property would be crossed or affected by the pipeline.

   a. In its letter to affected landowners, Pacific Connector shall:

      (1) provide a local contact that the landowners shall call first with their concerns; the letter shall indicate how soon a landowner shall expect a response;

      (2) instruct the landowners that, if they are not satisfied with the response, they shall call Pacific Connector's Hotline; the letter shall indicate how soon to expect a response; and

      (3) instruct the landowners that, if they are still not satisfied with the response from Pacific Connector's Hotline, they shall contact the Commission's Landowner Helpline at LandownerHelp@FERC.Gov.

   b. In addition, Pacific Connector shall include in its weekly status report a copy of a table that contains the following information for each problem/concern:

      (1) the identity of the caller and date of the call;

      (2) the location by milepost and identification number from the authorized alignment sheets of the affected property;

      (3) the description of the problem/concern; and

      (4) an explanation of how and when the problem was resolved, will be resolved, or why it has not been resolved.

10. Beginning with the filing of their Implementation Plans, Jordan Cove and Pacific Connector shall file updated status reports with the Secretary **on a monthly basis for the LNG terminal and weekly basis for the pipeline** facilities until all construction and restoration activities are complete. On request, these status reports will also be provided to other federal and state agencies with authorization or permitting responsibilities. Status reports shall include:

    a. an update on Jordan Cove and Pacific Connector's efforts to obtain the necessary federal authorizations;

    b. the construction status of the LNG terminal or pipeline, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;

    c. a listing of all problems encountered and each instance of noncompliance observed by the EI(s) during the reporting period (both for the conditions imposed by the

Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);

d. a description of the corrective actions implemented in response to all instances of noncompliance, and their cost;

e. the effectiveness of all corrective actions implemented;

f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the Order, and the measures taken to satisfy their concerns; and

g. copies of any correspondence received by Jordan Cove or Pacific Connector from other federal, state or local permitting agencies concerning instances of noncompliance, and Jordan Cove and Pacific Connector's response.

11. **Prior to receiving written authorization from the Director of OEP to commence construction of any facilities**, Jordan Cove and Pacific Connector shall each file with the Secretary documentation that each company has received all applicable authorizations required under federal law (or evidence of waiver thereof).

12. Jordan Cove must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the Project facilities**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

13. Jordan Cove and Pacific Connector must each receive written authorization from the Director of OEP **before commencing service** of their respective facilities. Such authorization will only be granted following a determination that the LNG terminal facilities and the pipeline and associated facilities have been constructed in accordance with Commission approval and applicable standards, can be expected to operate safely as designed, and the rehabilitation and restoration of areas disturbed by construction are proceeding satisfactorily.

14. **Within 30 days of placing the authorized facilities in service**, Jordan Cove and Pacific Connector shall each file an affirmative statement with the Secretary, certified by a senior company official:

    a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

    b. identifying which of the conditions of the Order Jordan Cove and Pacific Connector has complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

Recommendations 15 through 19 apply to both the LNG terminal and pipeline, and shall be addressed by Jordan Cove and Pacific Connector <u>prior to the start of construction</u>.

15. Jordan Cove and Pacific Connector **shall not begin construction of their respective facilities** until the companies each file with the Secretary a copy of the Oregon Department of Land Conservation and Development's determination of consistency with the Coastal Zone Management Act. (*EIS section 4.1.1.2*)

16. **Prior to construction,** Jordan Cove and Pacific Connector shall each file with the Secretary a copy of their final *Migratory Bird Conservation Plan*, and documentation that their plans were developed in consultation with the U.S. Department of the Interior Fish and Wildlife Service (FWS). (*EIS section 4.6.1.1*)

17. Jordan Cove and Pacific Connector **shall not construct or use** any of their facilities, including related ancillary areas for staging, storage, temporary work areas, and new or to-be-improved access roads, **until**:

    c. the Commission staff completes formal consultations with the FWS and U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS); and

    d. Jordan Cove and Pacific Connector have received written notification from the Director of OEP that construction and/or implementation of conservation measures may begin. (*EIS section 4.7.5*)

18. Jordan Cove and Pacific Connector **shall not begin construction of facilities and/or use** all staging, storage, or temporary work areas and new or to-be-improved access roads **until**:

    a. Jordan Cove and Pacific Connector each file with the Secretary:

        (1) remaining cultural resources inventory reports for areas not previously surveyed;

        (2) site evaluation and monitoring reports, as necessary;

        (3) avoidance and treatment plans, as required, and a final Historic Properties Management Plan; and

        (4) comments on the cultural resources reports and plans from the Oregon State Historic Preservation Office, applicable federal land managing agencies, and interested Indian tribes.

    b. the FERC amends the Memorandum of Agreement, and affords the Advisory Council on Historic Preservation an opportunity to comment; and

    c. the FERC staff reviews and the Director of OEP approves all cultural resources reports and plans, and notifies Jordan Cove and Pacific Connector in writing that treatment plans may be implemented and/or construction may proceed.

    All materials filed with the Commission containing **location, character, and ownership information** about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "**CONTAINS PRIVILEGED INFORMATION – DO NOT RELEASE**." (*EIS section 4.11.5*)

Recommendations 19 through 31 apply only to the LNG terminal, and shall be addressed by Jordan Cove <u>prior to commencing final design</u>, <u>prior to procurement</u>, <u>prior to the start of construction,</u> and <u>after commencement of service</u>.

19. **Prior to construction,** Jordan Cove shall file with the Secretary a revised *Dredged Material Management Plan*, and documentation that the revised plan was developed in

consultation with the U.S. Army Corps of Engineers (COE) and the U.S. Environmental Protection Agency. The revised plan shall include an analysis of alternative dredged material disposal sites in the region in the event that Sites F and H possess insufficient capacity for materials dredged during Jordan Cove's future operational maintenance activities. *(EIS section 2.1.1.11)*

20. **Prior to construction**, Jordan Cove shall file with the Secretary documentation that it will employ a special inspector during construction to perform duties described in Section 6 of NBSIR84-2833, Data Requirements for the Seismic Review of LNG Facilities. (*EIS section 4.2.1.4*)

21. **Prior to commencing final design of the LNG terminal**, Jordan Cove shall file with the Secretary, stamped and sealed by the professional engineer-of-record registered in Oregon, the following:

    a. final geotechnical investigations necessary to support all final foundation designs in satisfying the criteria stated in the application and subsequent data request responses. These investigations would include how the identified potential zones of liquefaction at the terminal site would be mitigated and the details of the liquefaction mitigation method(s), procedures, plan extent, and verification methods proposed to verify mitigation of liquefaction potential;

    b. detailed calculations of seismic slope stability and lateral movements anticipated after the liquefaction mitigation is implemented to verify the stability of critical structures for the LNG terminal design earthquake motions;

    c. final foundation design recommendations, including foundation design and/or liquefaction mitigation measures for all structures including the LNG storage tanks;

    d. final Seismic Design Criteria for all Seismic Design Category I and II structures, systems, and components that satisfy the criteria stated in the application and subsequent data request responses;

    e. a final list of Seismic Category assignments for all structures, systems, and components; and

    f. final Quality Control and Quality Assurance procedures to be used for design. (*EIS section 4.2.1.4*)

22. **Prior to commencing final design of the LNG storage tanks,** Jordan Cove shall file with the Secretary, stamped and sealed by the professional engineer-of-record registered in Oregon, the following information:

    a. non-linear response history analysis of the LNG tank and isolation system. The analysis would simultaneously include all three components of ground motion. The response spectra of the time history vertical component of motion envelope the site-specific vertical design response spectra developed for the Project facilities. The horizontal components shall be rotated so that one of the components for each set of motions is the maximum component of response at the isolated period of the tank and isolation system;

    b. non-linear analyses for both maximum and minimum design liquid levels of the LNG tanks;

c. separate non-linear analysis to account for variations of design stiffness, minimum values of friction, and other properties as required by Sections 17.5 and 17.2.4.1 of ASCE 7-05; and

d. documentation that the lateral displacement capacity of the seismic isolation bearings is not less than 24 inches. (*EIS section 4.2.1.4*)

23. **Prior to commencing with procurement, fabrication, or construction**, Jordan Cove shall file with the Secretary, stamped and sealed by the professional engineer-of-record registered in Oregon, the following information:

a. final seismic specifications to be used in conjunction with the procuring Seismic Design Category I and II equipment;

b. site preparation drawings and specifications;

c. final and construction documents (drawings, calculations, specifications, etc.) for Seismic Category I and II structures, systems and components including the LNG storage tanks and Seismic Isolation Design Review Report; and

d. final Quality Control and Quality Assurance procedures to be used for procurement, fabrication and construction. (*EIS section 4.2.1.4*)

24. **Prior to construction**, Jordan Cove shall file with the Secretary, for review and approval by the Director of OEP, a plan to protect the four groundwater wells located on Roseburg Forest Products property from physical damage during construction of the LNG terminal. (*EIS section 4.4.1.1*)

25. **Prior to construction,** Jordan Cove shall file with the Secretary its final *Wetland Mitigation Plan*, together with documentation that the plan was developed in consultations with the Oregon Department of State Lands (ODSL), Oregon Department of Environmental Quality (ODEQ), Oregon Department of Fish and Wildlife (ODFW), and the COE. (*EIS section 4.4.3.1*)

26. **Prior to construction,** Jordan Cove shall file with the Secretary its final lighting plan, for review and approval by the Director of OEP, to include measures that would reduce impacts on wildlife, together with documentation that the plan was developed in consultation with appropriate resource agencies, including the FWS, NMFS, and ODFW. (*EIS section 4.6.1.1*)

27. **Prior to construction,** Jordan Cove shall file with the Secretary, for review and approval by the Director of OEP, a *Monitoring and Adaptive Management Plan* to ensure compliance during construction with NMFS underwater noise criteria for the protection of pinnipeds, and documentation that the plan was formulated in consultation with the NMFS. (*EIS section 4.6.2.2*)

28. **Prior to construction,** Jordan Cove shall file with the Secretary a revised *Traffic Impact Analysis*, for review and approval by the Director of OEP, together with documentation that the revised analysis was developed in consultations with the Oregon Department of Transportation (ODOT), Coos County, and the City of North Bend. The revised analysis shall estimate project-related traffic, including cars and buses transporting employees to and from the LNG terminal, truck deliveries to the terminal during construction, and non-work-related weekend traffic from the residents of the North Point Workers Housing

Complex, and assess the impacts that traffic may have on local road users and visitors to the Coos Bay region. In addition, the revised analysis shall incorporate mitigation measures, including, but not limited to, potential improvements to the Parkway, U.S. Highway 101, Ferry Road, and Chappell Parkway. (*EIS section 4.10.1.2*)

29. **Prior to construction,** Jordan Cove shall file with the Secretary the final determinations from the U.S. Department of Transportation Federal Aviation Administration that indicate there will be no hazard to aircraft using the Southwest Oregon Regional Airport, and copies of all studies related to the Project's potential impact on the airport. *(EIS section 4.10.1.4)*

30. **Prior to construction**, Jordan Cove shall file with the Secretary a copy of its final Memorandum of Understanding (MOU) with interested Indian tribes. The MOU shall outline procedures for future archaeological test excavations and monitoring at the LNG terminal facilities, and include the participation of representatives from interested Indian tribes. (*EIS section 4.11.1.2*)

31. Jordan Cove shall file with the Secretary a full load noise survey for the LNG terminal **no later than 60 days after placing the plant into service**. If a full load noise survey is not possible, Jordan Cove shall file an interim survey at the maximum possible operation **within 60 days of placing the LNG terminal into service** and **file the full operational surveys within 6 months**. If the noise attributable to the operation of all the equipment of the LNG terminal at full operation exceeds 55 A-weighted decibels (dBA) day-night sound levels (L_{dn}) at any nearby noise sensitive areas (NSAs), Jordan Cove shall install additional noise controls to meet the level **within 6 months of the in-service date**. Jordan Cove shall confirm compliance with this requirement by filing a second full power noise survey with the Secretary **no later than 60 days after it installs the additional noise controls**. (*EIS section 4.12.2.4*)

Recommendations 32 through 46 apply only to the pipeline, and shall be addressed by Pacific Connector <u>prior to the start of construction</u>, <u>during construction</u>, and <u>after commencement of service</u>.

32. **Prior to construction,** Pacific Connector shall incorporate the Shasta View Irrigation District (SVID) Alternative into its proposed pipeline route between about mileposts (MP) 218 and 228, unless it files with the Secretary a mutually agreeable plan for crossing the SVID features that addresses concerns to the satisfaction of the U.S. Department of the Interior Bureau of Reclamation. *(EIS section 3.4.2.13)*

33. **Prior to construction**, Pacific Connector shall file with the Secretary, stamped and sealed by the professional engineer-of-record registered in Oregon, the final monitoring protocols and/or mitigation measures for all landslide areas that were not accessible during previous studies, to evaluate slope stability conditions. (*EIS section 4.2.2.2*)

34. **Prior to construction**, Pacific Connector shall file with the Secretary, for review and approval by the Director of OEP, a revised *Groundwater Supply Monitoring and Mitigation Plan* that identifies the location by MP of all wells, springs, and seeps within 150 feet of the construction right-of-way, including direction and distance (in feet) from the pipeline centerline, and outlines measures that would be implemented to avoid or reduce impacts on those features. (*EIS section 4.4.1.2*)

35. **Prior to construction,** Pacific Connector shall file with the Secretary a revised *Integrated Pest Management Plan* that addresses U.S. Department of the Interior Bureau of Land

Management (BLM) and U.S. Department of Agriculture Forest Service (Forest Service) requirements related to monitoring of invasive plant species on federally managed lands, and documentation that the revised plan was found acceptable by the BLM and Forest Service. (*EIS section 4.5.1.3*)

36. **Prior to construction,** Pacific Connector shall file with the Secretary, for review and approval by the Director of OEP, a Project-specific *Aquatic Species Nuisance Treatment Plan*, and documentation that the plan was developed in consultation with ODFW and appropriate resource agencies. *(EIS section 4.6.2.3)*

37. **Prior to construction**, Pacific Connector shall file with the Secretary, for review and approval by the Director of OEP, a plan to avoid both direct and indirect impacts on vernal pool fairy shrimp habitat at the proposed Burrill Lumber Yard and the pipeline route between MPs 145.3 and 145.4. (*EIS section 4.7.1.5*)

38. **Prior to construction,** Pacific Connector shall file with the Secretary any new survey results for federally listed threatened and endangered plants, for review and approval by the Director of OEP, and documentation that the survey reports were also provided to the FWS and the Oregon Department of Agriculture. If newly identified federally listed threatened and endangered plant species will be affected, Pacific Connector shall also file measures it will implement to avoid, reduce, or mitigate those impacts. (*EIS section 4.7.1.6*)

39. **Prior to construction**, Pacific Connector shall file with the Secretary a pipeline route realignment to create a buffer distance to avoid impacts on BLM and Forest Service sensitive fungi at MP 61.3, and documentation of BLM and Forest Service approval of this route modification. *(EIS section 4.7.4.3)*

40. **Prior to construction**, Pacific Connector shall file with the Secretary documentation of consultations with the Oregon International Port of Coos Bay, Coos County, City of North Bend, Oregon Department of Parks and Recreation, Oregon Department of State Lands, the Coos Regional Trails Partnership, and other interested parties regarding potential impacts on the Haynes Inlet Water Trail and users of the boat ramp along North Bay Drive. The documentation shall include their comments on Pacific Connector's *Recreation Management Plan*. (*EIS section 4.8.1.2*)

41. **Prior to construction**, Pacific Connector shall file with the Secretary a revised *Recreation Management Plan, Aesthetics Management Plan, and Leave Tree Protection Plan* that address the Forest Service requirements for the pipeline crossing of the Pacific Crest Trail near MP 167.8, and documentation that the revised plans were found acceptable by the Forest Service. *(EIS section 4.8.1.2)*

42. **Prior to construction**, Pacific Connector shall file with the Secretary a plan that outlines measures to avoid, minimize, or mitigate impacts on commercial oyster beds in the vicinity of the crossing of Haynes Inlet between about MPs 1.7 and 4.1, for review and approval of the Director of OEP, and documentation that the plan was developed in consultations with Clausen Oysters and other commercial oyster growing companies in that portion of Coos Bay. (*EIS section 4.9.2.8*)

43. **Prior to construction,** Pacific Connector shall file with the Secretary a revised *Transportation Management Plan for Non-Federal Lands* for review and approval by the Director of OEP together with documentation that it consulted with ODOT and the counties

crossed by the pipeline route regarding project-related impacts on non-federal roads. (*EIS section 4.10.2.3*)

44. **Prior to construction**, Pacific Connector shall file with the Secretary documentation of meetings with the Cow Creek Tribe and the Klamath Tribes, and copies of any agreements reached with the tribes. (*EIS section 4.11.1.2*)

45. Pacific Connector shall include in its **weekly construction status reports** (see condition 10 above) the following information for the horizontal directional drills and direct pipe entry points of the Coos River, South Umpqua River, Roque River, and Klamath River:

    a. noise measurements from the nearest NSA, obtained at **the start of drilling operations**;

    b. noise mitigation Pacific Connector implemented at **the start of drilling operations**; and

    c. any additional mitigation measures that Pacific Connector would implement if the initial noise measurements attributable to drilling operations exceeded an L_{dn} of 55 dBA at the nearest NSA. (*EIS section 4.12.2.4*)

46. Pacific Connector shall file a noise survey with the Secretary **no later than 60 days after placing the Klamath Compressor Station in service**. If a full load condition noise survey is not possible, Pacific Connector shall provide an interim survey at the maximum possible horsepower load and provide the full load survey **within 6 months**. If the noise attributable to the operation of all of the equipment at the Klamath Compressor Station under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Pacific Connector shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. Pacific Connector shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (*EIS section 4.12.2.4*)

The following measures shall apply to the Jordan Cove Project. Information pertaining to these specific recommendations shall be filed with the Secretary for review and written approval by the Director of OEP either: <u>prior to initial site preparation</u>; <u>prior to construction of final design</u>; <u>prior to commissioning</u>; <u>prior to introduction of hazardous fluids</u>; or <u>prior to commencement of service</u>, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, shall be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶ 31,228 (2006). Information pertaining to items such as offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements will be subject to public disclosure. All information shall be filed <u>a minimum of 30 days</u> before approval to proceed is required.

47. **Prior to initial site preparation,** Jordan Cove shall file an overall project schedule, which includes the proposed design stages of the commission plan. (*EIS section 4.13.3*)

48. **Prior to initial site preparation**, Jordan Cove shall provide procedures for controlling access during construction. (*EIS section 4.13.3*)

49. **Prior to initial site preparation**, Jordan Cove shall file the quality assurance and quality control procedures for construction activities. (*EIS section 4.13.3*)

50. **Prior to initial site preparation**, Jordan Cove shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems. (*EIS section 4.13.3*)

51. **Prior to initial site preparation,** Jordan Cove shall file with the Secretary for review and approval by the Director of OEP, concurrence with the U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) that the ethylene vapor cloud explosions due to releases from design spills comply with 49 CFR Part 193. (*EIS section 4.13.5*)

52. **Prior to initial site preparation,** Jordan Cove shall file with the Secretary for review and approval by the Director of OEP, concurrence with the PHMSA that the jet fires due to releases from design spills comply with 49 CFR Part 193. (*EIS section 4.13.5*)

53. **Prior to initial site preparation**, Jordan Cove shall file with the Secretary concurrence from PHMSA that the Safety Zone Easement Option language satisfies the exclusion zone requirements of 49 CFR 193.2059. This information shall be filed **a minimum of 30 days before approval to proceed is requested**. (*EIS section 4.13.5.3*)

54. **Prior to initial site preparation**, Jordan Cove shall file with the Secretary, for review and written approval by the Director of OEP, an Emergency Response Plan. The Emergency Response Plan shall include evacuation procedures. Jordan Cove shall coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state, county, and local law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with state and local emergency response agencies;

    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

    c. procedures for notifying residents and recreational users within areas of potential hazard;

    d. evacuation routes/methods for residents and other public use areas that are within any transient hazard areas along the route of the LNG marine traffic;

    e. locations of permanent sirens and other warning devices; and

    f. an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.

    The Emergency Response Plan shall include consideration of a tsunami event. Jordan Cove shall notify the FERC staff of all planning meetings in advance and shall report progress on the development of its Emergency Response Plan at **3-month intervals**. (*EIS section 4.13.7*)

55. **Prior to initial site preparation**, Jordan Cove shall file with the Secretary, for review by the Director of OEP, a Cost-Sharing Plan to be included in its Emergency Response Plan. The Cost-Sharing Plan shall identify the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies.

In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Jordan Cove shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its Cost-Sharing Plan at **3-month intervals**. (*EIS section 4.13.7*)

56. The **final design** shall include an analysis of the structural integrity of the outer containment of the full containment storage tanks when exposed to a roof tank top fire or adjacent tank top fire. (*EIS section 4.13.3*)

57. **Prior to construction of the final design,** Jordan Cove shall file with the Secretary, for review and written approval by the Director of OEP, the details of the vapor barriers as well as procedures to maintain and inspect the vapor barriers provided to meet the siting provisions of 49 CFR 193.2059. This information shall be filed **a minimum of 30 days before approval to proceed is requested**. (*EIS section 4.13.5.3*)

58. **Prior to construction of the final design,** Jordan Cove shall file with the Secretary, for review and approval by the Director of OEP, information/revisions pertaining to Jordan Cove's response numbers 17(b), 17(d), 27, 43, 46, 59, 61, 66, 91, 95, 103, 111, and 112 of its October 3, 2013 filing, which indicated features to be included or considered in the final design. (*EIS section 4.13.3*)

59. The **final design** shall vent the seal gas from the pressure regulator and bursting disc to the flare, and the seal gas drum drain shall be piped to a safe location for containment instead of draining to grade. (*EIS section 4.13.3*)

60. The **final design** shall specify the operating temperature of the hot gas injection nozzle to Refrigerant Suction Drum, 30-V-0101, consistent with the design temperature of the first stage refrigerant compressor discharge. (*EIS section 4.13.3*)

61. The **final design** shall provide provisions for the future installation of LNG transfer pumps for the BOG Compressor Suction Drums. (*EIS section 4.13.3*)

62. The **final design** of the electrical seal interface between a flammable fluid and electrical cable shall comply with the requirements of National Fire Protection Association (NFPA) 59A (2001 edition), Section 7. (*EIS section 4.13.3*)

63. The **final design** of the Marine Area and the Process Area Impoundment Basins shall include low temperature detectors that shutdown and prevent the start-up of the storm water pumps. (*EIS section 4.13.3*)

64. The **final design** shall include procedures that require the equipment to be completely shut down and depressurized during maintenance. (*EIS section 4.13.3*)

65. The **final design** shall provide coarse mesh strainers in the bottom outlet piping of the adsorbers to prevent support material and molecular sieve migrating from the Mole Sieve Gas Dehydrators to the piping system and switching valves. (*EIS section 4.13.3*)

66. The **final design** shall provide drainage piping to the flare system from the Heavies Separator bottom outlet piping upstream of the shutoff valve. (*EIS section 4.13.3*)

67. The **final design** shall include a flow transmitter with low flow alarm in the cooling water inlet line to each refrigerant compressor motor cooling system. (*EIS section 4.13.3*)

68. The **final design** shall include a plant-wide shutdown initiated by low instrument air pressure. The setting shall be above the minimum required to maintain stable operation. (*EIS section 4.13.3*)

69. The **final design** shall provide provisions for the future installation of transfer pumps for the Flare Knockout (KO) Drums. (*EIS section 4.13.3*)

70. The **final design** shall consider design features necessary to prevent liquid from the flare KO drums overflowing into the flare piping system in the event of releases into these drums when they are operating with high liquid levels, or when a plant shutdown has been initiated by high-high liquid level in a flare KO drum. (*EIS section 4.13.3*)

71. The **final design** shall include change logs that list and explain any changes made from the Front-End Engineering Design provided in Jordan Cove's application and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings. (*EIS section 4.13.3*)

72. The **final design** shall provide up-to-date Process Flow Diagrams with heat and material balances and piping and instrumentation diagrams (P&IDs), which include the following information:

    a. equipment tag number, name, size, duty, capacity, and design conditions;

    b. equipment insulation type and thickness;

    c. storage tank pipe penetration size and nozzle schedule;

    d. valve high pressure side and internal and external vent locations;

    e. piping with line number, piping class specification, size, and insulation type and thickness;

    f. piping specification breaks and insulation limits;

    g. all control and manual valves numbered;

    h. relief valves with set points; and

    i. drawing revision number and date. *(EIS section 4.13.3)*

73. The **final design** shall provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications. (*EIS section 4.13.3*)

74. The **final design** shall include three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion. (*EIS section 4.13.3*)

75. The **final design** shall provide complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment. (*EIS section 4.13.3*)

76. The **final design** shall provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list shall include the equipment tag number, type, capacity, equipment

covered, discharge rate, and automatic and manual remote signals initiating discharge of the units. (*EIS section 4.13.3*)

77. The **final design** shall provide facility plans and drawings that show the location of the firewater and foam systems. Drawings shall clearly show: firewater and foam piping; post indicator valves; and the location, and area covered by, each monitor, hydrant, deluge system, foam system, water-mist system, and sprinkler. The drawings shall also include piping and instrumentation diagrams of the firewater and foam system. (*EIS section 4.13.3*)

78. The **final design** shall include an updated fire protection evaluation of the facilities carried out in accordance with the requirements of NFPA 59A 2001, chapter 9.1.2 as required by 49 CFR Part 193. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. (*EIS section 4.13.3*)

79. The **final design** shall demonstrate that for hazardous fluids, piping and piping nipples 2 inches or less in diameter are to be no less than schedule 160 for carbon steel and no less than schedule 80 for stainless steel, and are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators. (*EIS section 4.13.3*)

80. The **final design** shall include drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A. (*EIS section 4.13.3*)

81. The **final design** shall provide an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that shall continuously monitor for the presence of a flammable fluid; shall alarm the hazardous condition; and shall shutdown the appropriate systems. (*EIS section 4.13.3*)

82. The **final design** shall provide electrical area classification drawings. (*EIS section 4.13.3*)

83. The **final design** shall provide spill containment system drawings with dimensions and slopes of curbing, trenches, and impoundments. (*EIS section 4.13.3*)

84. The **final design** of the hazard detectors shall account for the calibration gas when determining the lower flammability limit set points for methane, propane, ethylene, and isopentane. Include a list of alarm and shutdown set points for each flammable gas detector. (*EIS section 4.13.3*)

85. The **final design** of the hazard detectors shall account for the calibration gas when determining the toxic concentration set points for hydrogen sulfide, benzene, toluene, ethylbenzene, and xylene. Include a list of alarm and shutdown set points for each toxic gas detector. (*EIS section 4.13.3*)

86. The **final design** shall provide an analysis of the localized hazards to operators from a potential liquid nitrogen release and shall also provide consideration of any mitigation that may be prudent. (*EIS section 4.13.3*)

87. The **final design** shall include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of

recommendations, and actions taken on the recommendations, shall be filed. (*EIS section 4.13.3*)

88. The **final design** shall include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and setpoints. (*EIS section 4.13.3*)

89. The **final design** shall include a drawing showing the location of the emergency shutdown (ESD) buttons. ESD buttons shall be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency. (*EIS section 4.13.3*)

90. The **final design** shall specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System/Safety Instrumented System. (*EIS section 4.13.3*)

91. The **final design** shall include a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193, and shall provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing. (*EIS section 4.13.3*)

92. The **final design** shall include the sizing basis and capacity for the final design of pressure and vacuum relief valves for major process equipment, vessels, storage tanks, as well as vent stacks. (*EIS section 4.13.3*)

93. The **final design** shall provide the procedures for pressure/leak tests which address the requirements of American Society of Mechanical Engineers (ASME) VIII and ASME B31.3. (*EIS section 4.13.3*)

94. The **Prior to construction of the final design**, Jordan Cove shall file with the Secretary for review and approval by the Director of OEP, certification that the final design is consistent with the information provided to DOT as described in the design spill determination letter dated June 18, 2014 (Accession Number 20140619-4001). In the event that any modifications to the design alters the candidate design spills on which the 49 CFR Part 193 siting analysis was based, Jordan Cove shall consult with DOT on any actions necessary to comply with Part 193. (*EIS section 4.13.5.2*)

95. **Prior to construction of the final design,** Jordan Cove shall file with the Secretary for review and approval by the Director of OEP, an evaluation that demonstrate flammable vapor clouds would be prevented from dispersing under the elevated LNG storage tanks or the LNG storage tanks would be able to withstand the overpressure due to ignition of design spills. This information shall be filed a minimum of 30 days before approval to proceed is requested. (*EIS section 4.13.5.4*)

96. **Prior to construction of the final design,** Jordan Cove shall file with the Secretary, for review and approval by the Director of OEP, details of the LNG storage tank structural design that demonstrate the tanks can withstand overpressures from ignition of design spills. This information shall be filed a minimum of 30 days before approval to proceed is requested. (*EIS section 4.13.5.4*)

97. **Prior to commissioning**, Jordan Cove shall file plans and detailed procedures for: testing the integrity of on-site mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. (*EIS section 4.13.3*)

98. **Prior to commissioning**, Jordan Cove shall provide a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids; and during commissioning and startup. Jordan Cove shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup would be issued. (*EIS section 4.13.3*)

99. **Prior to commissioning**, Jordan Cove shall provide results of the LNG storage tank hydrostatic test and foundation settlement results. At a minimum, foundation settlement results shall be provided thereafter annually. (*EIS section 4.13.3*)

100. **Prior to commissioning**, Jordan Cove shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. (*EIS section 4.13.3*)

101. **Prior to commissioning**, Jordan Cove shall file a tabulated list and drawings of the proposed hand-held fire extinguishers. The list shall include the equipment tag number, extinguishing agent type, capacity, number, and location. The drawings shall show the extinguishing agent type, capacity, and tag number of all hand-held fire extinguishers. (*EIS section 4.13.3*)

102. **Prior to commissioning**, Jordan Cove shall file the operation and maintenance procedures and manuals, as well as safety procedures. (*EIS section 4.13.3*)

103. **Prior to commissioning**, Jordan Cove shall maintain a detailed training log to demonstrate that operating staff has completed the required training. (*EIS section 4.13.3*)

104. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s). (*EIS section 4.13.3*)

105. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system. (*EIS section 4.13.3*)

106. **Prior to commencement of service**, Jordan Cove shall develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Jordan Cove staff. (*EIS section 4.13.3*)

107. **Prior to commencement of service**, Jordan Cove shall label piping with fluid service and direction of flow in the field in addition to the pipe labeling requirements of NFPA 59A. (*EIS section 4.13.3*)

108. **Prior to commencement of service,** Jordan Cove shall notify FERC staff of any proposed developments on the security plan of the facility. (*EIS section 4.13.3*)

109. **Prior to commencement of service**, progress on the construction of the proposed systems shall be reported in **monthly** reports filed with the Secretary. Details shall include a summary of activities, problems encountered, contractor non-conformance/deficiency

logs, remedial actions taken, and current project schedule. Problems of significant magnitude shall be reported to the FERC **within 24 hours**. (*EIS section 4.13.3*)

110. **Prior to commencement of service**, Jordan Cove shall receive written authorization from the Director of OEP. Prior to issuing such authorization, the Director of OEP will consult with the Coast Guard COTP to confirm that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Jordan Cove or other appropriate parties. (*EIS section 4.13.6.6*)

In addition, we recommend that the following measures shall apply throughout the life of the Jordan Cove facilities:

111. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or more frequently as circumstances indicate. **Prior to each FERC staff technical review and site inspection**, Jordan Cove shall respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted. (*EIS section 4.13.3*)

112. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also shall be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility. (*EIS section 4.13.3*)

113. In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action shall be specified. (*EIS section 4.13.3*)

114. Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g.,

attempts to enter site, suspicious activities) shall be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:

a. fire;

b. explosion;

c. estimated property damage of $50,000 or more;

d. death or personal injury necessitating in-patient hospitalization;

e. release of hazardous fluids for five minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident. (*EIS section 4.13.3*)