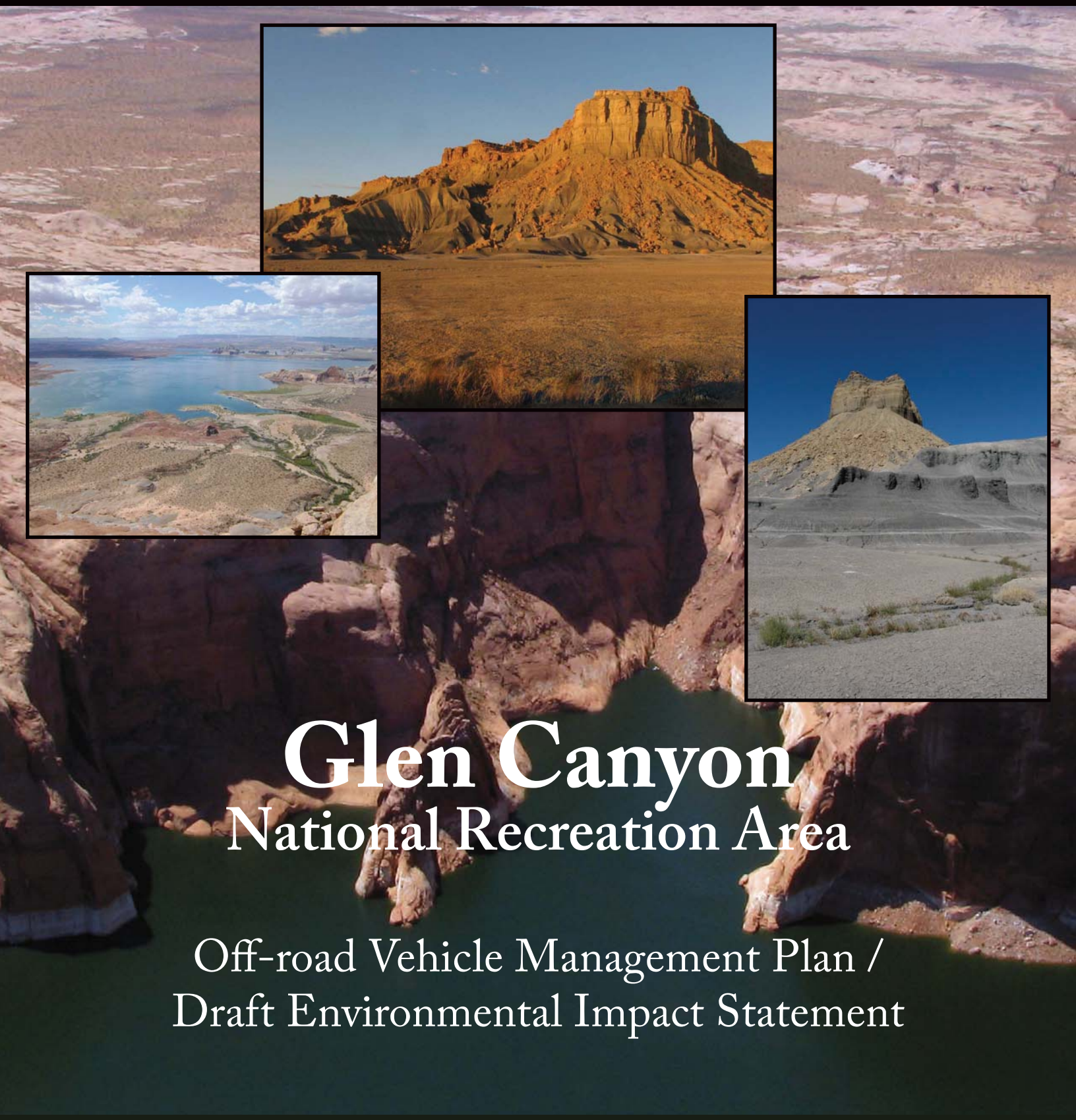
Glen Canyon National Recreation Area
Off-road Vehicle Management Plan /
Draft Environmental Impact Statement
Arizona, Utah

National Park Service
U.S. Department of the Interior



Glen Canyon
National Recreation Area

Off-road Vehicle Management Plan / Draft Environmental Impact Statement

January 2014

UNITED STATES DEPARTMENT OF THE INTERIOR – NATIONAL PARK SERVICE

OFF-ROAD VEHICLE MANAGEMENT PLAN / DRAFT ENVIRONMENTAL IMPACT STATEMENT

Lead Agency: National Park Service (NPS), U.S. Department of the Interior

This *Off-Road Vehicle Management Plan / Environmental Impact Statement* (plan/DEIS) describes five alternatives for managing off-road use and on-road use of off-highway vehicles (OHVs) and street-legal all-terrain vehicles (ATVs) and assesses the impacts that could result from continuing current management (the no-action alternative) or implementation of any of the action alternatives.

The purpose of this plan/DEIS is to evaluate off-road use by conventional and non-conventional motor vehicles and on-road use by non-conventional motor vehicles and to develop management actions that preserve Glen Canyon's scientific, scenic, and historic features; provide for the recreational use and enjoyment of the area; and promote the resources and values for which the area was established as a unit of the national park system. Therefore, a plan is needed for the following reasons:

- To evaluate the impacts associated with allowed but unauthorized off-road use in Glen Canyon and determine what management action should be taken.
- To determine whether NPS will authorize off-road use in accordance with Executive Orders 11644 and 11989 (off-road vehicles (ORVs) on public lands), NPS laws, regulations (36 CFR 4.10), and policies to minimize impacts to Glen Canyon.
- To evaluate the impacts resulting from on-road use by non-conventional motor vehicles in Glen Canyon, and determine what management actions should be taken.
- To address changes in vehicular access at visitor use areas due to fluctuating lake levels.

Under alternative A, the no-action alternative, there would be a continuation of existing management policies and actions related to the use of ORVs in Glen Canyon. This alternative represents no change from the current level of management direction and level of management intensity. This alternative is consistent with the 1979 Glen Canyon General Management Plan, other planning documents, and management policies related to off-road use in Glen Canyon. If the no-action alternative were selected, NPS would be required to promulgate a special regulation to authorize existing ORV routes and areas in compliance with 36 CFR 4.10.

Under alternative B, the remote, undeveloped, and lightly traveled nature that characterizes much of Glen Canyon would be maintained by limiting the operation of motor vehicles only to designated roads. Nearly 669,000 acres of Glen Canyon is classified as "Natural" under Glen Canyon's management zones, where maintaining isolation and natural processes is the primary management objective. There would be no designated ORV routes or areas and existing off-road use areas would be closed and restored to natural conditions.

Under alternative C, ORVs would be managed in a manner that would expand the recreational opportunities in Glen Canyon by increasing the number of ORV routes and areas. Alternative C is designed to enhance the visitor experience by identifying and designating specific areas capable of supporting off-road use and on-road OHV and street-legal ATV use, while prohibiting such uses in areas where natural and cultural resources and visitor experience may be adversely impacted. The isolated and primitive characteristics of the Glen Canyon backcountry would be enhanced by limiting the areas open to off-road use and by prohibiting the operation of OHVs and street-legal ATVs throughout Glen Canyon. These actions are intended to enhance the protection of Glen Canyon resources and values, as well as to promote recreation opportunities that are based on a sense of solitude, remoteness, and natural conditions. Alternative D would reduce the number of available ORV areas.

Under alternative E, the preferred alternative, resources would be protected and the visitor experience enhanced by identifying and designating specific areas capable of supporting off-road use while prohibiting such uses in areas where resources and values may be at risk.

The potential environmental consequences of the alternatives were addressed for geology and soils, vegetation, wildlife and wildlife habitat, special-status species, soundscapes, visitor use and experience, archeological and ethnographic resources, socioeconomics, health and safety, paleontological resources, and wilderness.

The *Off-Road Vehicle Management Plan / Draft Environmental Impact Statement* is available for public and agency review and comment beginning when the U.S. Environmental Protection Agency's Notice of Availability is published in the Federal Register. If you wish to comment on the document, you may mail comments to the name and address listed below or you may post your comments electronically at http://parkplanning.nps.gov/GLCA. Before including your address, telephone number, electronic mail address, or other personal identifying information in your comments, you should be aware that your entire comment (including your personal identifying information) may be made publicly available at any time. While you can ask us in your comments to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. After public review, this document will be revised in response to public comments. A final version of this document will then be released, and a 30-day no-action period will follow. Following the 30-day period, the alternative or actions constituting the approved plan will be documented in a record of decision that will be signed by the Regional Director of the Intermountain Region. For further information regarding this document, please contact:

Glen Canyon National Recreation Area
c/o Superintendent
PO Box 1507
Page, AZ 86040-1507
(928) 608-6200

National Park Service
U.S. Department of the Interior

Glen Canyon National Recreation Area
Arizona and Utah

Glen Canyon National Recreation Area

Off-road Vehicle Management Plan / Draft Environmental Impact Statement

January 2014

EXECUTIVE SUMMARY

This *Glen Canyon National Recreation Area Off-road Vehicle Management Plan / Draft Environmental Impact Statement* (plan/DEIS) analyzes a range of alternatives and actions for managing off-road use of motor vehicles and on-road use of off-highway vehicles (OHVs) and street-legal all-terrain vehicles (ATVs) at Glen Canyon National Recreation Area (Glen Canyon). The plan/DEIS assesses the impacts that could result from continuing current management (the no-action alternative) or implementing any of the four action alternatives.

Upon conclusion of this plan and decision-making process, the alternative selected for implementation will become the Off-road Vehicle (ORV) Management Plan and form the basis for a special regulation to manage any approved off-road use at Glen Canyon. The plan/DEIS would guide management of off-road use at Glen Canyon for the next 10 to 15 years.

***Conventional Motor Vehicle**: A motor vehicle designed primarily for use and operation on streets and highways and is licensed and registered for interstate travel but can be used off-road.*

***ORV**: National Park Service (NPS) defines ORVs broadly as a motorized vehicle (conventional or non-conventional) designed for or capable of cross-country travel on or immediately over natural terrain.*

***OHV**: State law defines these as a non-conventional motor vehicle designed primarily for off-road use.*

***Street-legal ATV**: An ATV that qualifies under the state's motor vehicle and traffic code to be operated on state roads and highways.*

BACKGROUND

Glen Canyon encompasses 1,254,306 acres in northern Arizona and southeastern Utah. Glen Canyon includes portions of Garfield, Kane, San Juan, and Wayne Counties in Utah and Coconino County in Arizona. The southern boundary runs contiguous to the lands of the Navajo Nation. Glen Canyon shares boundaries with other national park system units, including Grand Canyon National Park, Capitol Reef National Park, and Canyonlands National Park. Glen Canyon also encompasses Rainbow Bridge National Monument. Glen Canyon adjoins approximately 9.3 million acres of other federal lands administered by the Bureau of Land Management (BLM), including the Grand Staircase Escalante National Monument, Vermilion Cliffs National Monument, and the Paria Canyon-Vermilion Cliffs Wilderness.

The use of motorized vehicles to reach off-road destinations in Glen Canyon predates the establishment of the recreation area in 1972 (PL 92-593). After Lake Powell began to fill behind the completed Glen Canyon Dam in 1963, the public began driving off-road to access the new lake for recreational activities. This off-road use continued following the establishment of the national recreation area in 1972.

A comprehensive planning process begun by NPS after the establishment of Glen Canyon resulted in the publishing of a general management plan (GMP) in 1979. The GMP designated a system of open roads for vehicle travel and closed several existing unpaved roads in the backcountry. After an evaluation of several alternatives for wilderness suitability under the 1964 Wilderness Act, NPS published a Wilderness Recommendation in 1981 proposing 588,855 acres for designation as wilderness within Glen Canyon.

Following a rapid increase in visitation to Glen Canyon during the 1970s, NPS determined that site-specific planning for off-road use was warranted. Increasing use at shoreline locations was leading to management concerns, including visitor conflicts, safety issues, resource degradation, and unsystematic off-road use. In response, NPS developed a management plan for Lone Rock Beach (1981 *Lone Rock Beach Development Concept Plan and Environmental Assessment*) as well as a management plan for 20 accessible shoreline areas on Lake Powell (1988 *Environmental Assessment and Management/Development Concept Plans for Lake Powell's Accessible Shorelines*). Twelve of the 20 accessible shoreline sites were developed to provide for off-road driving.

In 1986 the Paiute Farms/San Juan Marina Development Concept Plan Environmental Assessment evaluated the development of a marina that was subsequently constructed and then destroyed by a flash flood several years later. Off-road use at this former marina site continues in order to access the San Juan Arm of the Lake Powell at this location. In addition, the 2006 Uplake Development Concept Plan designated an area at the Hite Boat Ramp to continue its use for primitive shoreline camping, which is accessed by off-road use between the public boat launch ramp and the former Hite marina site. An additional area bordering the Navajo Nation, Nokai Canyon, is not authorized for off-road use but is currently being accessed and has not been addressed in past planning efforts.

In 2005, NPS was challenged in federal court over the failure to comply with the executive orders 11644 and 11989 and 36 CFR 4.10(b). Although NPS had implemented ORV management plans for various parts of Glen Canyon in 1981 (Lone Rock Beach) and 1988 (20 accessible shoreline areas on Lake Powell), past planning efforts failed to comply with the CFR requiring promulgation of a special regulation to designate off-road use areas.

Glen Canyon is preparing this plan/DEIS under the terms of the May 12, 2008, settlement agreement between Friends of the Earth, the National Parks Conservation Association, and Wildlands CPR (known collectively as Bluewater Network) and the Department of the Interior and NPS (*Friends of the Earth, Bluewater Network Division, et al. v. United States Department of the Interior, et al.* [Case 1:05-cv-02302-RCL]).

This plan/DEIS addresses the future management of accessible shoreline areas and their suitability for use by conventional motor vehicles, as well as by non-conventional vehicles such as OHVs and street-legal ATVs. This plan/DEIS also evaluates the designation of ORV routes in other areas of Glen Canyon such as at Ferry Swale near Page, AZ. Lastly, this plan/DEIS evaluates the use of OHVs and street-legal ATVs on GMP roads in Glen Canyon.

PURPOSE OF THIS PLAN

The purpose of this plan/DEIS is to evaluate off-road use by conventional and non-conventional motor vehicles and on-road use by non-conventional motor vehicles and develop management actions that preserve Glen Canyon's scientific, scenic, and historic features; provide for the recreational use and enjoyment of the area; and promote the resources and values for which the area was established as a unit of the national park system.

NEED FOR ACTION

A plan/DEIS is needed for the following reasons:

- To evaluate the impacts associated with allowed but unauthorized off-road use in Glen Canyon and determine what management action should be taken.
- To determine whether NPS will authorize off-road use in accordance with Executive Orders 11644 and 11989 ORVs on public lands), NPS laws, regulations (36 CFR 4.10), and policies to minimize impacts to Glen Canyon.

- To evaluate the impacts resulting from on-road use by non-conventional motor vehicles in Glen Canyon and determine what management actions should be taken.
- To address changes in vehicular access at visitor use areas due to fluctuating lake levels.

This plan/DEIS has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500–1508), and NPS Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-Making*.

OBJECTIVES IN TAKING ACTION

The objectives for managing off-road and on-road use of motor vehicles are based on Glen Canyon's enabling legislation and prior planning documents and are compatible with NPS mission and policy guidance. All alternatives considered in this ORV management plan must, to a large degree, accomplish the following objectives:

- Manage authorized vehicle uses to provide safe and healthful opportunities for visitor access and recreation.
- Manage authorized vehicle uses to protect the biological and physical environment, including natural processes and systems.
- Manage authorized vehicle uses to protect cultural resources.
- Establish clear policies to guide authorized vehicle uses.

ISSUES AND IMPACT TOPICS

Glen Canyon staff identified issues associated with implementing an ORV management plan during internal scoping meetings and the public identified issues during the public scoping process at three public meetings. Table ES-1 details the issues that are discussed and analyzed in the plan/DEIS.

TABLE ES-1: ISSUES AND IMPACT TOPICS

ISSUE	REASON FOR ANALYSIS
Geology and Soils	Damage to soils from off-road use includes the destruction of soil stabilizers, soil compaction and reduced rates of water infiltration, accelerated rates of surface water runoff and erosion, accelerated rates of wind erosion, and declines in soil productivity. Cyanobacterial soil crusts stabilize soils, increase water infiltration, and concentrate essential nutrients for vascular plant growth. Damage to these living soil crusts can occur with a single pass of a vehicle.
Vegetation	Off-road use can adversely impact native plants and plant communities directly, by crushing and uprooting of plants, and indirectly, by altering soil properties and by serving as a vector for invasive plant species that replace native vegetation.
Wildlife and Wildlife Habitat	Wildlife is known to be affected by off-road motor vehicle use. Impacts occur in four primary categories: direct mortality, disturbance, noise, and habitat alteration. The most vulnerable species to off-road activity include burrowing species, such as rodents that nest in open sandy sites and whose burrows are easily crushed.

Issue	Reason for Analysis
Special-status Species	A number of federally listed species are likely to occur in the project area and may be affected by management actions. Because this plan/DEIS may affect, but is not likely to adversely affect, listed species, NPS has engaged in consultation with the U.S. Fish and Wildlife Service (USFWS) as required under Section 7 of the Endangered Species Act (16 USC 1536 [a][2]).
Soundscapes	The natural soundscape is considered a resource, and qualifies as an inherent component of "the scenery and the natural and historic objects and the wild life therein" that is protected by the NPS Organic Act. Vehicular noise has the potential to impact other users in these areas. Motor vehicle noise could also discourage wildlife from using these areas or directly impact their ability to hear.
Visitor Use and Experience	The use of motorized vehicles is an integral component of the experience for some visitors and the extent to which this use may be authorized in Glen Canyon could impact the amount and range of recreational opportunities accessible to visitors, especially if certain restrictions or user fees are involved. While off-road use may provide a positive experience for some visitors, this can also conflict with the experiences sought by others.
Cultural Resources	Off-road use has been demonstrated to be a source of direct and indirect damage to cultural resources. Due to the potential for adverse impacts on archeological and ethnographic resources through the adoption of one or more of the action alternatives, these two resources have been assessed for their potential to be affected by the alternatives.
Archeological Resources	Glen Canyon is known to contain archeological resources eligible for inclusion in the National Register of Historic Places; archeological resources do exist in the study area.
Ethnographic Resources	Ethnographic resources that are archeological sites have been documented in association with the accessible lakeshores and within Lone Rock Beach Play Area. Archeological sites have been recorded within and adjacent to the GMP roads. Some of these sites may also be ethnographic resources. One traditional cultural property (TCP) is located within the study area and the Hole-in-the-Rock Road corridor may also meet the criteria for a TCP.
Socioeconomics	The alternatives associated with the management of ORVs at Glen Canyon could have an impact on the socioeconomic environment of the recreation area and the region, including a greater demand for recreation and tourism-related amenities, the potential for increased profitability of commercial services in the area, and the enhancement of local economies.
Health and Safety	NPS recognizes that both the Glen Canyon National Recreation Area resources which attract visitors and some of the specific recreational activities in which visitors participate can present sources of potential hazards. Off-road use is of particular concern regarding visitor health and safety. ATVs in particular have been the subject of actions by the Consumer Product Safety Commission.
Paleontological Resources	All sedimentary rock formations in Glen Canyon hold the potential for fossil discovery. Certain formations are more sensitive than others and warrant special management concern. Some formations contain dinosaur tracks and traces and are targets for illegal collection and trade in the black market.
Wilderness	Approximately 588,855 acres (47%) of Glen Canyon have been proposed for addition to the National Wilderness Preservation System and an additional 48,955 (4%) are identified as potential wilderness. The general policy of NPS is to manage all lands with wilderness characteristics so as not to diminish the wilderness eligibility of these areas.

ALTERNATIVES

NPS held seven meetings to inform the public about the preliminary alternatives for the plan/DEIS. The alternatives analyzed in this document are the result of internal and public scoping. These alternatives meet the management objectives of the recreation area while also meeting the overall purpose of and need for the proposed action. Alternative elements that were considered but were not technically or economically feasible, did not meet the purpose of and need for the project, created unnecessary or excessive adverse impacts on resources, and/or conflicted with the overall management of Glen Canyon or its resources were dismissed from further analysis. The elements of all five alternatives, including the no-action alternative, are summarized in table ES-2.

ELEMENTS COMMON TO ALL ALTERNATIVES

The following management actions are common to all alternatives, including the no-action alternative. NPS will implement these actions upon adoption of the final Record of Decision (ROD) regardless of which alternative is selected. Additional details of each element can be found in the plan/DEIS.

- **Clarification of the Management of Glen Canyon Lands below Lake Powell Full Pool:** The Lake Powell shoreline area below full pool (3,700-foot elevation contour) is not open to off-road use unless designated.
- **Motor Vehicle Operator and Equipment Requirements**: All motor vehicle use must comply with state motor vehicle and operator requirements. Operators of conventional and non-conventional motor vehicles are responsible for complying with all applicable NPS and state statutes and regulations pertaining to the lawful operation of motor vehicles in Glen Canyon.
- **Use Area Rules**: All rules applicable to public use, recreation, and travel at Glen Canyon will remain in effect.
- **Administrative Uses and Other Authorized Uses**: Administrative uses will continue, including use by government officials, lease holders, permit holders, or any other individual with authority from NPS to operate at Glen Canyon.
- **NPS Authority to Alter or Adopt State Motor Vehicle Laws:** NPS will review any future change to state law that may affect motor vehicle operation and use in Glen Canyon for conformity with this plan/DEIS. Title 36 CFR 4.2 allows NPS to adopt non-conflicting state laws.

ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (ALTERNATIVES B, C, D, AND E)

The following management actions are common to all action alternatives. NPS would implement these actions upon adoption of the final ROD and subsequent regulation if one of the four action alternatives were selected. Additional details of each element can be found in the plan/DEIS.

- **Designation of Roads Open to OHV and Street-Legal ATV Use:** GMP roads that are identified as either open or closed to OHV and street-legal ATV use would be adequately marked.
- **Communications Strategy:** The multiple government jurisdictions, the transboundary nature of roads, and the lack of active management from NPS has resulted in confusion about which regulations apply throughout Glen Canyon. To address this confusion, a communications strategy would be developed that would include partnerships, web site development, partnerships and informational brochures.
- **Closing Undesignated ORV Routes and Areas and Restoring Them to Natural Conditions**: NPS would close routes and areas not designated for off-road use. NPS may use a number of different techniques to close and restore routes and areas where unauthorized off-road use has occurred.

Measures to Monitor, Avoid, Minimize, or Mitigate Off-Road Motor Vehicle Impacts under alternatives C, D, and E

NPS developed management and mitigation strategies to address the impacts from off-road use as proposed in this plan/DEIS. The objectives are to improve site design and control, reduce incidents of disturbance to lands, restore disturbed areas, track findings and accomplishments, and increase public awareness of the environmental impacts related to off-road use.

ORV Fee Permit System

- Permits would be used to recover NPS costs for managing areas designated for off-road use. Costs include monitoring, signs, education programs, and partnerships, as well as the administrative costs associated with administering the permit system.
- Permits would have an educational component to further reduce visitor use conflicts, prevent resource damage and provide for visitor safety.
- Permits would be required for all off-road travel at accessible shoreline areas, Lone Rock Beach, Lone Rock Beach Play Area, and designated ORV routes in Ferry Swale.
- Permits would be available at designated permit issuing stations and by mail.
- Permits could be revoked for violation of applicable Glen Canyon regulations or terms and conditions of the permit.

Alternative A: No Action

The no-action alternative represents the continuation of existing management policies and actions related to the use of ORVs in Glen Canyon and represents "no change" from the current level of management direction and level of management intensity. This alternative is consistent with the 1979 Glen Canyon GMP and other planning documents and management policies related to off-road use in Glen Canyon. If the no-action alternative were selected, NPS would be required to promulgate a special regulation to authorize existing ORV routes and areas in compliance with 36 CFR 4.10.

Alternative B: No Off-road Use

Under alternative B, the remote, undeveloped, and lightly traveled nature that characterizes much of Glen Canyon would be maintained by limiting the operation of motor vehicles only to designated roads. Nearly 669,000 acres of Glen Canyon is classified as "Natural" under Glen Canyon's management zones, where maintaining isolation and natural processes is the primary management objective. There would be no designated ORV routes or areas and existing off-road use areas would be closed and restored to natural conditions.

Alternative C: Increased Motorized Access

Under alternative C, ORVs would be managed in a manner that would expand the recreational opportunities in Glen Canyon by increasing the number of ORV routes and areas. Alternative C is designed to enhance the visitor experience by identifying and designating specific areas capable of supporting off-road use and on-road OHV and street-legal ATV use, while prohibiting such uses in areas where natural and cultural resources and visitor experience may be adversely impacted.

Alternative D: Decreased Motorized Access

The isolated and primitive characteristics of the Glen Canyon backcountry would be enhanced by limiting the areas open to off-road use and by prohibiting the operation of OHVs and street-legal ATVs throughout Glen Canyon. These actions are intended to enhance the protection of Glen Canyon resources and values, as well as to promote recreation opportunities that are based on a sense of solitude, remoteness, and natural conditions. Alternative D would reduce the number of available ORV areas.

Alternative E: Mixed Use (NPS Preferred Alternative)

Alternative E is designed to protect resources and enhance the visitor experience by identifying and designating specific areas capable of supporting off-road use while prohibiting such uses in areas where resources and values may be at risk.

ENVIRONMENTAL CONSEQUENCES

Impacts of the alternatives were assessed in accordance with Director's Order 12 in terms of their context, duration, and intensity. The analysis provides the public and decision-makers with an understanding of the implications of ORV management actions in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

For each impact topic, methods were identified to assess the change in Glen Canyon National Recreation Area resources that would occur with the implementation of each management alternative. Each management alternative was compared to baseline conditions (Alternative A: No Action) to determine the context, duration, and intensity of resource impacts.

Table ES-3 summarizes the results of the impact analysis for the impact topics that were assessed. The full impact analysis is in "Chapter 4: Environmental Consequences." For all of the alternatives in this plan/DEIS, impacts from operations in the Glen Canyon National Recreation Area would be mitigated to avoid impairment of Glen Canyon National Recreation Area resources and values.

Table ES-2. Alternative Elements Overview

	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Highlights	Off-road use would continue at 15 designated ORV areas. Street-legal ATVs would be authorized for use on GMP roads. No OHVs or street-legal ATVs would be allowed within the Orange Cliffs Special Management Unit (Orange Cliffs Unit). Approximately 53 miles of ORV routes would be designated.	No ORV areas would be designated. Street-legal ATVs would be authorized for use on designated GMP roads. No OHVs or street-legal ATVs would be allowed within the Orange Cliffs Unit. No ORV routes would be designated.	Conventional motor vehicles, OHVs, and street-legal ATVs would be authorized for use at 17 designated ORV areas only by permit, subject to water level closures. OHVs and street-legal ATVs would be authorized for use on all GMP roads to include the Orange Cliffs Unit. Fifteen miles of ORV routes would be designated.	Conventional motor vehicles would be authorized for use at five designated ORV areas (Lone Rock Beach, Hite Boat Ramp, Farley Canyon, Dirty Devil, and Stanton Creek), only by permit, subject to water level closures. No OHVs or street-legal ATVs would be authorized for use in Glen Canyon. No ORV routes would be designated.	Conventional motor vehicles and street-legal ATVs would be authorized for use at 16 areas only by permit, subject to water-level closures. A vehicle-free area would be designated at Lone Rock Beach. Street-legal ATVs would be authorized for use on paved GMP roads. OHVs and street-legal ATVs would also be authorized for use on unpaved GMP roads. No OHVs or street-legal ATVs would be authorized for use in the Orange Cliffs Unit. Fifteen miles of ORV routes would be designated.
Lone Rock Beach	Off-road use by conventional motor vehicles, OHVs, and street-legal ATVs would continue. Utah rules regulating OHVs and street-legal ATVs would remain in effect.	Off-road use by all vehicles would be discontinued and the area would be restored to natural conditions.	Same as alternative A, with additional requirement for an ORV permit.	Off-road use by conventional motor vehicles would be authorized only by permit. No OHVs or street-legal ATVs would be allowed.	Same as alternative C except approximately 20 acres of the beach would be designated as a vehicle-free zone (no vehicles of any type would be allowed in this zone).
Lone Rock Beach Play Area	Off-road use by conventional motor vehicles, OHVs, and street-legal ATVs would continue. Utah rules regulating OHVs and street-legal ATVs would remain in effect.	Off-road use by all vehicles would be discontinued and the area would be restored to natural conditions.	Same as alternative A, with additional requirement for an ORV permit and safety flag.	Same as alternative B.	Same as alternative C.

	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Accessible Shoreline Areas	Off-road use by conventional vehicles only would continue at 13 existing areas (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp), subject to water-level closures.	Off-road use at 15 areas (13 existing areas plus Nokai Canyon and Paiute Farms) would be discontinued and these areas would be restored to natural conditions.	Fifteen areas (13 existing areas plus Nokai Canyon and Paiute Farms) would be authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs, only by permit, subject to water-level closures.	Four areas (Dirty Devil, Farley Canyon, Hite Boat Ramp, and Stanton Creek) would be authorized for use only by conventional motor vehicles, only by permit, subject to water-level closures. Off-road use at eleven areas would be discontinued.	Fourteen areas (12 existing areas plus Nokai Canyon and Paiute Farms) would be authorized for use by conventional motor vehicles and street-legal ATVs, only by permit, subject to water-level closures. Off-road use at Warm Creek would be discontinued.
GMP Roads	Street-legal ATVs would be authorized for use on GMP roads in Glen Canyon with the exception of the Orange Cliffs Unit. Conventional motor vehicles are currently and would continue to be authorized on all GMP roads in Glen Canyon, including the Orange Cliffs Unit.	Same as alternative A.	OHVs and street-legal ATVs would be authorized for use on all GMP roads, including the Orange Cliffs Unit. Conventional motor vehicles are currently and would continue to be authorized on all GMP roads in Glen Canyon, including the Orange Cliffs Unit.	OHVs and street-legal ATVs would not be authorized for use on any GMP roads. Conventional motor vehicles are currently and would continue to be authorized on all GMP roads in Glen Canyon, including the Orange Cliffs Unit.	Street-legal ATVs would be authorized for use on paved GMP roads. OHVs and street-legal ATVs would also be authorized on unpaved GMP roads. No OHVs or street-legal ATVs would be authorized on GMP roads in the Orange Cliffs Unit. Conventional motor vehicles are currently and would continue to be authorized on all GMP roads in Glen Canyon, including the Orange Cliffs Unit.
Ferry Swale	Conventional motor vehicles, OHVs, and street-legal ATVs would be authorized for use on approximately 53 miles of designated ORV routes.	No ORV routes would be designated and existing routes would be restored to natural conditions.	Conventional vehicles, OHVs, and street-legal ATVs would be authorized for use on approximately 15 miles of designated ORV routes by permit. Other existing routes would be restored to natural conditions.	Same as alternative B.	Same as alternative C.

Table ES-3: Environmental Impact Summary by Alternative

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Geology and Soils	Direct adverse impacts from crushing, shearing, compaction, and erosion on 250 acres of soil and geology at Lone Rock Beach; 180 acres at Lone Rock Beach Play Area; approximately 5,900 acres at 13 accessible shorelines; and along approximately 53 miles of ORV routes at Ferry Swale. Approximately 858 acres of low to moderately erodible soils directly disturbed at accessible shoreline areas and approximately 200 acres in Ferry Swale. No impacts on soils from conventional motor vehicle and street-legal ATV use on paved GMP roads; direct impacts on 714 acres of low to moderately erodible soils from compaction and indirect impacts on 3,428 acres of low to moderately erodible soils along unpaved GMP roads.	Beneficial impacts on soils and geology at approximately 250 acres at Lone Rock Beach, 180 acres at Lone Rock Beach Play Area; 7,300 acres at 15 accessible shorelines; and Ferry Swale as a result of discontinuation of off-road use in Glen Canyon. Direct and indirect impacts on soils and geology along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Direct adverse impacts from crushing, shearing, compaction, and erosion on 250 acres of soils and geology at Lone Rock Beach; 180 acres at Lone Rock Beach Play Area; approximately 7,300 acres at 15 accessible shorelines; and along approximately 15 miles of ORV routes at Ferry Swale. Approximately 867 acres of low to moderately erodible soils directly disturbed at accessible shoreline areas and approximately 34 acres in Ferry Swale. Direct and indirect impacts on soils and geology along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to but more intense than alternative A.	Direct adverse impacts from crushing, shearing, compaction, and erosion on 250 acres of soil and geology at Lone Rock Beach; and approximately 1,100 acres at four accessible shorelines. Approximately 138 acres of low to moderately erodible soils directly disturbed at accessible shoreline areas. Beneficial impacts on soils and geology at Lone Rock Beach Play Area, 11 accessible shorelines, and Ferry Swale as a result of discontinuation of off-road use. Direct and indirect impacts on soils and geology along GMP roads from conventional motor vehicle would be similar to but less intense than alternative A.	Direct adverse impacts from crushing, shearing, compaction, and erosion on 250 acres of soil and geology at Lone Rock Beach; 180 acres at Lone Rock Beach Play Area, and approximately 6,000 acres at 14 accessible shorelines; and along approximately 15 miles of ORV routes at Ferry Swales. Beneficial impacts on soils at Warm Creek from discontinuation of off-road use. Approximately 888 acres of low to moderately erodible soils directly disturbed at accessible shoreline areas and approximately 34 acres in Ferry Swale. Direct and indirect impacts on soils and geology along paved GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A and more intense along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs.
Vegetation	Direct adverse impacts on vegetation communities consisting primarily of grasses, weeds, and bushes at Lone Rock Beach and Lone Rock Beach Play Area. Direct impact on vegetation at 13 accessible shorelines consisting primarily of blackbrush (416 acres), sand sagebrush (933 acres), and shadscale (612 acres) –dominant shrub species in upland shrublands of Glen Canyon. No direct impacts on vegetation from conventional motor vehicle and street-legal ATV use along paved GMP roads. Approximately 791 acres of blackbrush and 595 acres of shadscale directly impacted and 3,857 acres of blackbrush and 2,855 acres of shadscale indirectly impacted along unpaved GMP roads. Direct and indirect impacts on vegetation along 53 miles of designated ORV routes – primarily to shadscale and fourwing saltbrush.	Beneficial impacts on vegetation at Lone Rock Beach, Lone Rock Beach Play Area; 15 accessible shorelines; and Ferry Swale from discontinuation of off-road use in Glen Canyon. Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Direct adverse impacts on vegetation communities consisting primarily of grasses, weeds, and bushes at Lone Rock Beach and Lone Rock Beach Play Area. Direct impact on vegetation at 15 accessible shorelines consisting primarily of blackbrush (688 acres), sand sagebrush (933 acres), and shadscale (1,684 acres). Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to but more intense than alternative A. Direct and indirect impacts on vegetation along 15 miles of designated ORV routes – primarily to shadscale.	Direct adverse impacts on vegetation communities consisting primarily of grasses, weeds, and bushes at Lone Rock Beach. Continued direct impacts on vegetation at four accessible shorelines consisting primarily of blackbrush (166 acres) and shadscale (215 acres) –dominant shrub species in upland shrublands of Glen Canyon. Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles would be similar to but less intense than alternative A. No direct or indirect impacts on vegetation at Lone Rock Beach Play Area or Ferry Swale as a result of discontinuation of off-road use.	Direct adverse impacts on vegetation communities consisting primarily of grasses, weeds, and bushes at Lone Rock Beach and Lone Rock Beach Play Area. Direct impact on vegetation at 14 accessible shorelines consisting primarily of blackbrush (688 acres), sand sagebrush (933 acres) and shadscale (1,561 acres). Beneficial impacts on vegetation at Warm Creek from discontinuation of off-road use. Direct and indirect impacts on vegetation along paved GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A and more intense than alternative A along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs. Direct and indirect impacts on vegetation along 15 miles of designated ORV routes – primarily to shadscale.

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Wildlife and Wildlife Habitat	Direct adverse impacts on wildlife and wildlife habitat at Lone Rock Beach, Lone Rock Beach Play Area, approximately 5,900 acres at 13 accessible shorelines, and along 53 miles of designated ORV routes in Ferry Swale as a result of disturbance, dust, displacement, vehicle-wildlife collisions, noise, and habitat destruction. Direct and indirect adverse impacts on wildlife along GMP roads from habitat disturbance and reduction, dust, and habitat fragmentation; and to wildlife habitat from erosion and sedimentation and potential for transport of invasive species.	Beneficial impacts on wildlife and wildlife habitat at Lone Rock Beach, Lone Rock Beach Play Area, 15 accessible shorelines, and Ferry Swale from discontinuation of off-road use. Direct and indirect impacts on wildlife and wildlife habitat along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Direct adverse impacts on wildlife and wildlife habitat at Lone Rock Beach, Lone Rock Beach Play Area, approximately 7,300 acres at 15 accessible shorelines, and concentrated along 15 miles of designated ORV routes in Ferry Swale as a result of disturbance, displacement, vehicle-wildlife collisions, noise, and habitat destruction. Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to but more intense than alternative A.	Direct adverse impacts on wildlife and wildlife habitat at Lone Rock Beach and at approximately 1,100 acres at four accessible shorelines as a result of disturbance, displacement, vehicle-wildlife collisions, noise, and habitat destruction. Beneficial impacts on wildlife and wildlife habitat at 11 accessible shorelines and Ferry Swale as a result of discontinuation of off-road use. Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles would be similar to but less intense than alternative A.	Direct adverse impacts on wildlife and wildlife habitat at Lone Rock Beach, Lone Rock Beach Play Area, and approximately 6,000 acres at 14 accessible shorelines as a result of disturbance, displacement, vehicle-wildlife collisions, noise, and habitat destruction. Beneficial impacts on wildlife and wildlife habitat at Warm Creek as a result of discontinuation of off-road use. Impacts at Ferry Swale would be the same as alternative C. Direct and indirect impacts on wildlife and wildlife habit along paved GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A and more intense than alternative A along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs.
Special-status Species	Adverse impacts on special-status species at Lone Rock Beach, Lone Rock Beach Play Area, 13 accessible shorelines, and along 53 miles of designated ORV routes in Ferry Swale as a result of habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement. Adverse impacts on special-status species along GMP roads from habitat disturbance and reduction, dust, and habitat fragmentation; and to their habitat from erosion and sedimentation, and potential for transport of invasive species. Alternative A may affect, but is not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions.	Beneficial impacts on special-status species at Lone Rock Beach, Lone Rock Beach Play Area, 15 accessible shorelines, and Ferry Swale as a result of discontinuation of off-road use. Impacts on special-status species along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A. Alternative B may affect, but is not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally-listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions	Adverse impacts on special-status species at Lone Rock Beach, Lone Rock Beach Play Area, 15 accessible shorelines, and along 15 miles of designated ORV routes Ferry Swale as a result of habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement. Impacts on special-status species along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to but more intense as alternative A. Alternative C may affect, but is not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally-listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions	Adverse impacts on special-status species at Lone Rock Beach and four accessible shorelines as a result of habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement. Beneficial impacts on special-status species at Lone Rock Beach Play Area and Ferry Swale plus 11 accessible shorelines as a result of discontinuation of off-road use. Impacts on special-status species along GMP roads from conventional motor vehicles would be similar to but potentially less intense than alternative A. Alternative D may affect, but is not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions.	Adverse impacts on special-status species at Lone Rock Beach, Lone Rock Beach Play Area, and 14 accessible shorelines as a result of habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement. Beneficial impacts on special-status species at Warm Creek as a result of discontinuation of off-road use. Impacts at Ferry Swale would be the same as alternative C. Impacts on special-status species along paved GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A and more intense along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs. Alternative E may affect, but are not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Soundscapes	Direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs total 362,269 acres of land (28.88% of the Glen Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur.	Direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs total 351,408 acres of land (28.02% of the Glen Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially decreased through implementation of the 96-dBA limit on OHVs and street-legal ATVs (80,906 fewer acres within the direct impact noise effect zone or 21.57% of Glen Canyon).	Direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs total 479,270 acres of land (38.21% of the Glen Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially increased through implementation of the 96-dBA limit on OHVs and street-legal ATVs (101,715 fewer acres within the direct impact noise effect zone or 30.10% of Glen Canyon land area).	Direct impacts as a result of noise generated from conventional motor vehicles total 6,351 acres of land (0.51% of the Glenn Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to conventional vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would not be affected by the 96-dBA limit because no OHV or street-legal ATV use would be allowed (the limit only applies to OHVs and street-legal ATVs).	Direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs total 373,135 acres of land (28.75% of the Glen Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially increased through implementation of the 96-dBA limit on OHVs and street-legal ATVs (82,190 fewer acres within the direct impact noise effect zone or 23.20% of Glen Canyon).
Visitor Use and Experience	Current visitor use patterns would continue at Lone Rock Beach, Lone Rock Beach Play Area, and 13 accessible shorelines. Some visitor experience could be diminished at Lone Rock Beach, Lone Rock Beach Play Area, and Ferry Swale as a result of noise and air emissions produced by OHVs and street-legal ATVs. No measurable changes are expected on visitors using conventional motor vehicles or street-legal ATVs on GMP roads. Visitors seeking a quiet, backcountry experience may be adversely impacted by the noise street-legal ATVs produce in the more remote areas of Glen Canyon.	Visitor use patterns would be considerably impacted at Lone Rock Beach, Lone Rock Beach Play Area, 15 accessible shorelines, and Ferry Swale due to the discontinuation of off-road use. Although visitors would not be able to engage in off-road use in these areas, they would still be able to access the sites by parking at the end of the road and walking to the site. Impacts on visitor use and experience from conventional motor vehicles and street-legal ATVs on GMP roads would be the same as alternative A.	Impacts on visitor use and experience at Lone Rock Beach and Lone Rock Beach Play Area would be similar to alternative A, but with an additional small adverse impact on visitor experience with the requirement to obtain a permit. An increase in number of accessible shorelines and authorization of OHVs and street-legal ATVs for use at accessible shorelines, in addition to conventional motor vehicles, would increase the areas available for OHVs and street-legal ATV opportunities and provide a beneficial impact for these users. Expansion and authorization of OHV and street-legal ATV use at accessible shorelines could result in adverse impacts on visitors seeking a quieter experience as a result of increase in noise and air emissions from OHVs and street-legal ATVs. Impacts on visitor use and experience from conventional motor vehicles, OHVs, and street-legal ATVs on GMP roads would be similar to but more intense and widespread than alternative A.	Impacts on visitor use and experience at Lone Rock Beach would be similar to alternative A, but with an additional small adverse impact on visitor experience with the requirement to obtain a permit. Visitor use patterns would be considerably impacted at Lone Rock Beach Play Area and Ferry Swale as a result of discontinuation of off-road use in these areas, resulting in severe adverse impacts. Four accessible shoreline areas would remain available for use by conventional motor vehicles, but depending on the level of use, visitors may experience a negative impact from increased crowding. However, generally, visitor experience at these shoreline areas would not be noticeably impacted and overall visitor use patterns would not likely change because two of the four accessible shorelines already experience high visitation comparable to other accessible shorelines. Visitor use patterns would change substantially as access by OHVs or street-legal ATVs within Glen Canyon would not be authorized.	Impacts on visitor use and experience at Lone Rock Beach, Lone Rock Beach Play Area, and Ferry Swale would be similar to alternative C. An increase in number of accessible shorelines and authorization of street-legal ATVs for use at accessible shorelines, in addition to conventional motor vehicles, would increase the areas available for street-legal ATV opportunities and provide a beneficial impact for those users. Expansion and authorization of street-legal ATV use at accessible shorelines could result in adverse impacts on visitors seeking a quieter experience as a result of increase in noise and air emissions from street-legal ATVs. Impacts on visitor use and experience from conventional motor vehicles and street-legal ATVs on paved GMP roads would be the same as alternative A and more intense and widespread from on unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs.
Archeology	Direct adverse impacts on archeological resources could involve 3 not evaluated sites in Lone Rock Beach Play Area; 3 eligible sites and 2 not evaluated sites at accessible shorelines; and 6 eligible sites and 3 not evaluated sites in Ferry Swale. Indirect impacts on archeological resources could involve 3 not evaluated sites at Lone Rock Beach; 1 not evaluated site at Lone Rock Beach Play Area; and 19 eligible sites and 37 not evaluated sites at accessible shorelines; and 17 eligible sites and 6 not evaluated sites along GMP roads.	Indirect adverse impacts on archeological resources could involve 17 eligible sites and 6 not evaluated sites along GMP roads.	Direct adverse impacts on archeological resources could involve 3 not evaluated sites in Lone Rock Beach Play Area; 6 eligible sites and 4 not evaluated sites at accessible shorelines; and 6 eligible sites and 3 not evaluated sites in Ferry Swale. Indirect impacts on archeological resources could involve 3 not evaluated sites at Lone Rock Beach; 1 not evaluated site at Lone Rock Beach Play Area; and 19 eligible sites and 37 not evaluated sites at accessible shorelines; and 39 eligible sites and 23 not evaluated sites along GMP roads.	Indirect impacts on archeological resources could involve 3 not evaluated sites at Lone Rock Beach; 8 eligible sites and 5 not evaluated sites at accessible shorelines; and no eligible sites or not evaluated sites along GMP roads.	Direct adverse impacts on archeological resources could involve 3 not evaluated sites in Lone Rock Beach Play Area; 6 eligible sites and 2 not evaluated sites at accessible shorelines; and 6 eligible sites and 3 not evaluated sites in Ferry Swale. Indirect impacts on archeological resources could involve 3 not evaluated sites at Lone Rock Beach; 1 not evaluated site at Lone Rock Beach Play Area; and 19 eligible and 37 not evaluated sites at accessible shorelines; and 17 eligible sites and 6 not evaluated sites along GMP roads.

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Ethnographic Resources	Beneficial impact as a result of continued access to the Hole-in-the Rock traditional cultural property (TCP) site by members of The Church of Jesus Christ of Latter-day Saints for permitted activities. Potential for indirect adverse impacts on the Hole-in-the-Rock and potentially National Register-eligible Hole-in-the-Rock landscape TCP as a result of conventional motor vehicles and street-legal ATVs allowed on the Hole-in-the-Rock Road (an unpaved GMP road).	Impacts would be the same as alternative A.	Increased beneficial impacts for members of The Church of Jesus Christ of Latter-day Saints as a result of continued and increased access (by conventional motor vehicles, OHVs, and street-legal ATVs on Hole-in-the-Rock Road) to the Hole-in-the Rock TCP site for permitted activities. Increased potential for indirect adverse impacts on the Hole-in-the-Rock and potentially National Register-eligible Hole-in-the-Rock landscape TCP as a result of conventional motor vehicles, OHVs, and street-legal ATVs allowed on the Hole-in-the-Rock Road.	Decreased beneficial impacts for members of The Church of Jesus Christ of Latter-day Saints as a result of continued but decreased access (only by conventional motor vehicles on Hole-in-the-Rock Road) to the Hole-in-the Rock TCP site for permitted activities. Decreased potential for indirect adverse impacts on the Hole-in-the-Rock and potentially National Register eligible Hole-in-the-Rock landscape TCP as a result of reduction in the type of motor vehicles (conventional motor vehicles only) allowed on the Hole-in-the-Rock Road.	Impacts would be the same as alternative C, as the Hole-in-the-Rock would be accessed by conventional motor vehicles, OHVs, and street-legal ATVs.
Socioeconomics	The current level of visitation at Glen Canyon is expected to continue. Visitation and use of Lone Rock Beach, Lone Rock Beach Play Area, 13 accessible shorelines, and Ferry Swale is expected to continue, beneficially contributing to local economies and supporting jobs, income, and gross regional product. The ability to continue to ride conventional motor vehicles and street-legal ATVs on GMP roads would likely have a minimal impact on socioeconomic resources. Use of 53 miles of designated ORV routes in Ferry Swale would have limited impacts on socioeconomic resources.	Potential adverse impacts would occur with decreased visitor spending as a result of discontinuation of off-road use within Glen Canyon. Impacts on socioeconomic resources from use of GMP roads by conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Visitation and use of Lone Rock Beach and Lone Rock Beach Play Area would remain similar to alternative A, beneficially contributing to local economies and supporting jobs, income, and gross regional product; although a permit system may discourage a small amount of visitation to these sites. Additional opportunities for OHV and street-legal ATV use at the 15 accessible shorelines and on GMP roads could also contribute to the local economy. Because off-road use has been rapidly increasing in Utah and Arizona, allowing OHVs and street-legal ATVs at accessible shorelines could result in increased visitation to these areas. Beneficial impacts on socioeconomic resources from use of GMP roads and 15 miles of designated ORV routes in Ferry Swale by conventional motor vehicles, OHVs, and street-legal ATVs would be limited.	Prohibition of OHV and street-legal ATVs within Glen Canyon would lead to decreased visitation by these types of vehicles at Lone Rock Beach and Lone Rock Beach Play Area, although this portion of visitation is very small. Visitation overall within Glen Canyon would be expected to slightly decrease, with slight adverse effects on local economies. The loss of visitation at 11 accessible shoreline areas where off-road use would be discontinued would adversely impact local economies (assumed to equal the total visitation at Stanton Creek – approximately 14,000 annual visitors) with a potential loss of $2.3 million in visitor spending and 28 jobs. These economic impacts would account for a very small portion of the employment and economic activity in the study area. Impacts on socioeconomic resources from use of GMP roads by conventional motor vehicles would be limited.	Impacts on socioeconomic resources would be expected to be the similar to those described under alternative C, where visitation and visitor spending associated with users at Lone Rock Beach, Lone Rock Beach Play Area, and Ferry Swale would continue to beneficially contribute and support local economies. Additional opportunities would beneficially contribute to local economies as a result of expanded street-legal ATV use at the 14 accessible shorelines and OHV uses on unpaved GMP roads. Because off-road use has been rapidly increasing in Utah and Arizona, allowing street-legal ATVs at accessible shorelines could result in increased visitation to these areas. However, it is expected that beneficial effects on local economies would be limited.
Health and Safety	Adverse impacts on health and safety as conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to operate together at Lone Rock Beach, Lone Rock Beach Play Area, along 53 miles of designated ORV routes at Ferry Swale.	Beneficial impacts on health and safety of conventional motor vehicle users, OHV users, and street-legal ATV users, as off-road use would be eliminated from Lone Rock Beach, Lone Rock Beach Play Area, all accessible shorelines areas, and Ferry Swale.	Adverse impacts on health and safety as conventional motor vehicles, OHVs and street-legal ATVs would be allowed to operate together at Lone Rock Beach, Lone Rock Beach Play Area, at 15 accessible shorelines, along GMP roads, and along 15 miles of designated ORV routes at Ferry Swale. Additional requirement for ORV permit and flag at Lone Rock Beach Play Area would provide some beneficial impacts.	Beneficial impacts on health and safety of conventional vehicle users, OHV users, and street-legal ATV users, as off-road use would be eliminated from Lone Rock Beach Play Area and Ferry Swale. Additional beneficial impacts as a result of only conventional vehicles authorized for use within Glen Canyon – at Lone Rock Beach and four authorized accessible shorelines.	Adverse impacts for health and safety as conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to operate together at Lone Rock Beach, Lone Rock Beach Play Area, along unpaved GMP roads, and along 15 miles of designated ORV routes at Ferry Swale. Additional requirement for ORV permit and flag at Lone Rock Beach Play Area would provide some beneficial impacts, similar to alternative C.

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Paleontological Resources	Adverse impacts on paleontological resources stemming from erosion as a result of motor vehicle use on 250 acres Lone Rock Beach, 180 acres at Lone Rock Beach Play Area, approximately 5,900 acres at 13 accessible shorelines, and along approximately 53 miles of ORV routes at Ferry Swale. Approximately 1,057 acres of geologic formation with varying degrees of trace paleontological resources (including Organ Rock, Moenkopi, Chinle, Tropic Shale, and Carmel Formations) directly disturbed at accessible shoreline areas and approximately 155 acres in Ferry Swale. No direct impacts on paleontological resources from conventional motor vehicle and street-legal ATV use on paved GMP roads; direct impacts on approximately 2,000 acres and indirect impacts on approximately 5,400 acres of geologic formations with potential for paleontological resources along unpaved GMP roads.	Beneficial impacts on paleontological resources at approximately 250 acres at Lone Rock Beach, 180 acres at Lone Rock Beach Play Area, 7,300 acres at 15 accessible shorelines, and Ferry Swale from discontinuation of off-road use in Glen Canyon. Direct and indirect impacts on paleontological resources along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Adverse impacts on paleontological resources stemming from erosion as a result of motor vehicle use on 250 acres Lone Rock Beach, 180 acres at Lone Rock Beach Play Area, approximately 7,300 acres at 15 accessible shorelines, and along approximately 15 miles of ORV routes at Ferry Swale. Approximately 1,152 acres of geologic formation with varying degrees of trace paleontological resources (including Organ Rock, Moenkopi, Chinle, Tropic Shale, and Carmel Formations) directly disturbed at accessible shoreline areas and approximately 11 acres in Ferry Swale. Direct and indirect impacts on paleontological resources along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to alternative A.	Adverse impacts on paleontological resources stemming from erosion as a result of motor vehicle use on 250 acres Lone Rock Beach and approximately 1,100 acres at 4 accessible shorelines. Approximately 230 acres of geologic formation with varying degrees of trace paleontological resources (including Organ Rock, Moenkopi, Chinle, Tropic Shale, and Carmel Formations) directly disturbed at accessible shoreline areas. No direct or indirect impacts at Lone Rock Beach Play Area, 11 accessible shorelines and Ferry Swale from discontinuation of off-road use in those areas. Impacts on paleontological resources along GMP roads from conventional motor vehicles, would be similar to alternative A.	Adverse impacts on paleontological resources stemming from erosion as a result of motor vehicle use on 250 acres Lone Rock Beach, 180 acres at Lone Rock Beach Play Area, approximately 6,000 acres at 14 accessible shorelines, and along approximately 15 miles of ORV routes at Ferry Swale. Beneficial impacts on paleontological resources at Warm Creek from discontinuation of off-road use. Approximately 1,074 acres of geologic formation with varying degrees of trace paleontological resources (including Organ Rock, Moenkopi, Chinle, Tropic Shale, and Carmel Formations) directly disturbed at accessible shoreline areas and approximately 11 acres in Ferry Swale. Impacts on paleontological resources along paved GMP roads from conventional motor vehicles, and street-legal ATVs and along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to alternative A.
Wilderness	Without the 96-dBA limit, 16.13% of proposed wilderness areas would be directly impacted by motor vehicle noise.	With the 96-dBA limit, 10.63% of proposed wilderness areas would be directly impacted by motor vehicle noise.	With the 96-dBA limit, 17.15% of proposed wilderness areas would be directly impacted by motor vehicle noise.	With (and without the 96-dBA limit) 0.11% of proposed wilderness areas would be directly impacted by motor vehicle noise. The degree and geographic extent of impacts on soundscapes and thus wilderness would not be affected by the 96-dBA limit because no OHV or street-legal ATV use would be allowed (the limit only applies to OHVs and street-legal ATVs).	With the 96-dBA limit, 10.74% of proposed wilderness areas would be directly impacted by motor vehicle noise.

Contents

Chapter 1: Purpose of and Need for Action 1
Purpose of this Plan 1
Need for Action 1
Objectives in Taking Action 1
Terminology 2
Project Study Area 6
Purpose and Significance of Glen Canyon National Recreation Area 7
Motor Vehicle Use Within Glen Canyon 8
Motor Vehicle Regulations Within Glen Canyon 9
Scope of the Plan/DEIS 10
Scoping and Public Participation 10
Impact Topics Identified for Further Analysis 11
Geology and Soils 12
Vegetation 12
Wildlife and Wildlife Habitat 12
Special-status Species 13
Soundscapes 13
Visitor Use and Experience 14
Cultural Resources 14
Socioeconomics 16
Health and Safety 16
Paleontological Resources 16
Wilderness 17
Impact Topics Dismissed from Further Analysis 17
Water Resources 17
Fish and Fish Habitat 17
Air Quality 18
Cultural Resources 19
Geohazards 20
Energy Requirements and Conservation Potential 20
Climate Change 20
Natural or Depletable Resources 21
Floodplains and Wetlands 21
Environmental Justice 22
Prime and Unique Agricultural Lands 23
Indian Trust Resources 23
Biospheres and Other Ecologically Critical Areas 23
Glen Canyon National Recreation Area Management and Operations 24
Related Laws, Policies, Regulations, and Plans 24
Executive Orders 11644 and 11989: Off-road Vehicles on Public Lands 24
Code of Federal Regulations, Title 36, Section 4.10: Travel on Park Roads and Designated Routes 25
National Parks Omnibus Management Act of 1998 25

NPS Organic Act, as Amended 25
Redwood National Park Expansion Act of 1978, as Amended 26
National Environmental Policy Act of 1969, as Amended 26
National Historic Preservation Act of 1966, as Amended 26
NPS *Management Policies 2006* 26
Endangered Species Act of 1973, as Amended 27
Executive Order 13112, Invasive Species 27
Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds 27
NPS Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making and Handbook 28
Director's Order 28: Cultural Resource Management 28
Director's Order 77: Natural Resource Protection 28
Related Plans and Policies for Glen Canyon National Recreation Area 28
Glen Canyon National Recreation Area General Management Plan (1979) 28
Glen Canyon Wilderness Recommendation (1980) 29
Glen Canyon Development Concept Plans / Environmental Assessments 29
Resources Management Plan, Cultural Component, Glen Canyon National Recreation Area (1987) 30
Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan / Environmental Assessment (1995/1993) 31
Grazing Component of the General Management Plan (1999) 31
Glen Canyon National Recreation Area, Archeological Resources Protection Plan (2002) 31
Personal Watercraft EIS (2003) 32
OHV Interim Management Plans at Lone Rock Beach and at Accessible Shorelines (2007) 32
Garfield County General Management Plan Resource Management Section (2007) 32
San Juan County Travel Plan (2013) 32
Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road (2012) 32
Superintendent's Compendium (2013) 33

Chapter 2: Alternatives 35
Introduction 35
Alternatives Development Process 36
Elements Common to All Alternatives 36
Clarification of the Management of Glen Canyon Lands below Lake Powell Full Pool 36
Conventional Motor Vehicle Operator Requirements 37
Use Area Rules 37
Administrative Uses and Other Authorized Uses 37
Elements Common to all Action Alternatives (Alternatives B, C, D, and E) 37
Designation of Roads Open to OHV and Street-Legal ATV Use 38
Communications Strategy 38
Motor Vehicle Operator and Equipment Requirements 38
Closing Undesignated Off-road Vehicle Routes and Restoring Them to Natural Conditions 40

Measures to Monitor, Avoid, Minimize, or Mitigate Off-RoAD Vehicle Impacts Under Alternatives C, D, and E 40
Monitoring and Mitigation 40
Temporary Closures 43
Alternatives 43
Alternative A: No Action 43
Alternative B: No Off-road Use 53
Project Components under Alternative B 53
Alternative C: Increased Motorized Access 57
Alternative D: Decreased Motorized Access 63
Alternative E: Mixed Use (NPS Preferred Alternative) 67
Alternatives Eliminated from Further Consideration 73
Adopting Equipment/Operator Regulations for ATVs on Glen Canyon Roads in an NPS Special Regulation 73
Development of Additional All-terrain Vehicle / Off-road Vehicle Areas 74
RS 2477 Rights-of-Way 74
Inclusion of a Wilderness Baseline Inventory in the ORV Plan 75
Designation of Certain New ORV Routes 75
Changes to the Road System 75
How the Alternatives Meet Project Objectives 76
Consistency with the Purposes of NEPA 76
Environmentally Preferable Alternative 79
National Park Service Preferred Alternative 79
Environmental Impacts Summary 80
Chapter 3: Affected Environment 87
Introduction 87
General Project Setting 87
Management Zoning 88
Geology and Soils 92
Geology 92
Soils 93
Vegetation 98
Upland Shrubland 103
Riparian Shrublands 103
Upland Woodlands 104
Riparian Woodlands 104
Vegetation in Accessible Shoreline Areas 106
Vegetation Along Paved and Unpaved GMP Roads 106
Vegetation in Ferry Swale 106
Wildlife and Wildlife Habitat 106
Mammals 107
Reptiles and Amphibians 108
Birds 109

Special-status Species 110
Species-specific Information 116
Critical Habitat 129
Soundscapes 130
Soundscape Terminology 130
Existing Sound Levels 132
Visitor Use and Experience 140
Recreational Area Road System 141
Off-road Vehicle Recreation Trends 142
Off-road Use at Glen Canyon 143
Recreational Opportunities in Glen Canyon 143
Cultural Resources 172
Archeological Resources 172
Ethnographic Resources 183
Socioeconomics 185
Socioeconomic Area of Consideration 185
Demographics 186
Arizona 186
Utah 188
Employment 190
Unemployment 193
Economic Contributions to Local Economies 193
Economic Contributions of Travel and Tourism Activities 193
Economic Contributions of Glen Canyon National Recreation Area 194
Economic Contributions of Off-road Vehicle Recreation 196
Health and Safety 197
All-terrain Vehicle–related Injuries and Fatalities 197
Off-road Vehicle–related Accidents and Injuries at Glen Canyon 199
Compliance with Glen Canyon Recreation Area Rules and Regulations 199
Paleontological Resources 200
Protection of Fossil Resources 200
Paleontological Resources at Off-road Vehicle–accessible Shorelines 201
Hermosa Group: Honaker Trail Formation (Middle-Late Pennsylvanian) 202
Cutler Group: Halgaito Formation / Rico Formation / Elephant Canyon Formation (Late Pennsylvanian–Early Permian) 202
Cutler Group: Cedar Mesa Sandstone (Early Permian) 202
Moenkopi Formation (Early-Middle Triassic) 203
Chinle Formation (Late Triassic) 203
Glen Canyon Group: Wingate Sandstone (Late Triassic–Early Jurassic) 204
Glen Canyon Group: Kayenta Formation (Early Jurassic) 204
Glen Canyon Group: Navajo Sandstone (Early-Middle Jurassic) 205
San Rafael Group: Page Sandstone (Middle Jurassic) 205
San Rafael Group: Entrada Sandstone (Middle Jurassic) 205
Morrison Formation (Late Jurassic) 206

Dakota Formation (Late Cretaceous) 207
Tropic Shale (Late Cretaceous) 207
Straight Cliffs Formation (Late Cretaceous) 207
Quaternary Rocks and Sediments (Pleistocene-Holocene) 208
Wilderness 209
Chapter 4: Environmental Consequences 211
Introduction 211
Impact Assessment Methodology and Assumptions 211
General Analysis Method 211
Assumptions 211
Cumulative Impacts Analysis Method 213
Glen Canyon Plans, Policies, and Actions 225
Projects throughout Glen Canyon 226
Other Activities within Glen Canyon 226
Other Federal Agency Plans, Policies, and Actions 227
Other State and Local Planning Documents, Policies, Actions 230
Geology and Soils 231
Guiding Regulations and Policies 231
Methodology and Assumptions 231
Alternative A: No Action 231
Alternative B: No Off-road Use 237
Alternative C: Increased Motorized Access 238
Alternative D: Decreased Motorized Access 240
Alternative E: Mixed Use 241
Conclusion 243
Vegetation 245
Guiding Regulations and Policies 245
Methodology and Assumptions 246
Alternative A: No Action 246
Alternative B: No Off-road Use 251
Alternative C: Increased Motorized Access 252
Alternative D: Decreased Motorized Access 254
Alternative E: Mixed Use 255
Conclusion 257
Wildlife and Wildlife Habitat 259
Guiding Regulation and Policies 259
Methodology and Assumptions 259
Alternative A: No Action 260
Alternative B: No Off-road Use 267
Alternative C: Increased Motorized Access 268
Alternative D: Decreased Motorized Access 270
Alternative E: Mixed Use 271
Conclusion 273

Special-status Species 274
Guiding Regulations and Policies 274
Methodology and Assumptions 274
Alternative A: No Action 278
Alternative B: No Off-road Use 289
Alternative C: Increased Motorized Access 292
Alternative D: Decreased Motorized Access 296
Alternative E: Mixed Use 299
Conclusion 301
Soundscapes 303
Guiding Regulations and Policies 303
Methodology and Assumptions 303
Alternative A: No Action 307
Alternative B: No Off-road Use 315
Alternative C: Increased Motorized Access 321
Alternative D: Decreased Motorized Access 327
Alternative E: Mixed use 333
Conclusion 339
Visitor Use and Experience 341
Guiding Regulations and Policies 341
Methodology and Assumptions 342
Alternative A: No Action 342
Alternative B: No Off-road Use 345
Alternative C: Increased Motorized Access 347
Alternative D: Decreased Motorized Access 349
Alternative E: Mixed Use 350
Conclusion 351
Cultural Resources 354
Guiding Regulations and Policies 354
Methodology and Assumptions 355
Archeology 356
Conclusion 367
Ethnographic Resources 369
Alternative A: No Action 370
Alternative B: No Off-road Use 370
Alternative C: Increased Motorized Access 370
Alternative D: Decreased Motorized Access 371
Alternative E: Mixed Use 371
Conclusion 371
Socioeconomics 372
Guiding Regulations and Policies 372
Methodology and Assumptions 372
Alternative A: No Action 374
Alternative B: No Off-road Use 377

Alternative C: Increased Motorized Access 379
Alternative D: Decreased Motorized Access 381
Alternative E: Mixed Use 383
Conclusion 384
Health and Safety 386
Guiding Regulations and Policies 386
Methodology and Assumptions 386
Alternative A: No Action 386
Alternative B: No Off-road Use 390
Alternative C: Increased Motorized Access 391
Alternative D: Decreased Motorized Access 393
Alternative E: Mixed Use 394
Conclusion 395
Paleontological Resources 396
Guiding Regulations and Policies 396
Methodology and Assumptions 396
Alternative A: No Action 397
Alternative B: No Off-road Use 400
Alternative C: Increased Motorized Access 401
Alternative D: Decreased Motorized Access 403
Alternative E: Mixed Use 404
Conclusion 405
Wilderness 410
Guiding Regulations and Policies 410
Methodology and Assumptions 411
Alternative A: No Action 413
Alternative B: No Off-road Use 421
Alternative C: Increased Motorized Access 427
Alternative D: Decreased Motorized Access 433
Alternative E: Mixed Use 439
Conclusion 445
Unavoidable Adverse Impacts 446
Alternative A: No Action 446
Alternative B: No Off-road Use 447
Alternative C: Increased Motorized Access 447
Alternative D: Decreased Motorized Access 447
Alternative E: Mixed Use (Preferred Alternative) 448
Irreversible or Irretrievable Commitments of Resources 448
Alternative A: No Action 449
Alternative B: No Off-road Use 449
Alternative C: Increased Motorized Access 449
Alternative D: Decreased Motorized Access 449
Alternative E: Mixed Use (Preferred Alternative) 449

Chapter 5: Consultation and Coordination 451
History of Public Involvement 451
The Scoping Process 451
Internal Scoping 451
Public Scoping 452
Public Scoping on the Preliminary Range of Alternatives 452
Agency Consultation 454
Endangered Species Act Consultation 454
Tribal Consultation 455
National Historic Preservation Act Consultation 456
List of Recipients of the Draft Plan / Environmental Impact Statement 459
Federal Agencies 459
Congressional Delegates 459
State and Local Governments 459
Associated Native American Groups 460
Other Organizations and Businesses 460
List of Preparers and Consultants 462
References 467
Glossary 495
Index 499

Appendices

Appendix A: Letters of Consultation and Coordination
Appendix B: Glen Canyon National Recreation Area Management and Operations

Figures

Figure 1: Glen Canyon National Recreation Area 3
Figure 2: Relationship between Types of Motor Vehicles Used within the Plan/DEIS 6
Figure 3: Alternative A: No Action 49
Figure 4: Designated ORV Routes in Ferry Swale: Alternative A 51
Figure 5: Alternative B: No Off-road Use 55
Figure 6: Alternative C: Increased Motorized Access 59
Figure 7: Designated ORV Routes in Ferry Swale: Alternative C 61
Figure 8: Alternative D: Decreased Motorized Access 65
Figure 9: Alternative E: Mixed Use (NPS Preferred Alternative) 69
Figure 10: Designated ORV Routes in Ferry Swale: Alternative E 71
Figure 11: Management Zones 89
Figure 12: Soils in the Project Area, Glen Canyon National Recreation Area 99
Figure 13: Vegetation of Glen Canyon National Recreation Area 101
Figure 14: Lone Rock Beach Acoustic Monitoring Sites 132
Figure 15: Acoustical Measurement Locations 135
Figure 16: Annual Visitation 1992–2011 141
Figure 17: OHV Use in Adjacent BLM Lands 145
Figure 18: Glen Canyon Recreation Area Regions 147
Figure 19: Ferry Swale–Vermilion Cliffs Region 149
Figure 20: Warm Creek to Grand Bench Region 151
Figure 21: Smoky Hollow 153
Figure 22: Lone Rock Beach 155
Figure 23: Crosby Canyon 156
Figure 24: Escalante Region 157
Figure 25: Wilson Mesa Region 161
Figure 26: Paiute Canyon 163
Figure 27: Hite Region 165
Figure 28: Orange Cliffs Region 169
Figure 29: Orange Cliffs Road 171
Figure 30: Reduction in Listening Area 306
Figure 31a: Direct Impacts on the Soundscape from Alternative A 311
Figure 31b: Cumulative Impacts on the Soundscape from Alternative A 313
Figure 32a: Direct Impacts on the Soundscape from Alternative B 317
Figure 32b: Cumulative Impacts on the Soundscape from Alternative B 319
Figure 33a: Direct Impacts on the Soundscape from Alternative C 323
Figure 33b: Cumulative Impacts on the Soundscape from Alternative C 325
Figure 34a: Direct Impacts on the Soundscape from Alternative D 329
Figure 34b: Cumulative Impacts on the Soundscape from Alternative D 331
Figure 35a: Direct Impacts on the Soundscape from Alternative E 335
Figure 35b: Cumulative Impacts on the Soundscape from Alternative E 337
Figure 36a: Direct Impacts on Wilderness from Alternative A 417
Figure 36b: Cumulative Impacts on Wilderness from Alternative A 419
Figure 37a: Direct Impacts on Wilderness from Alternative B 423
Figure 37b: Cumulative Impacts on Wilderness from Alternative B 425
Figure 38a: Direct Impacts on Wilderness from Alternative C 429
Figure 38b: Cumulative Impacts on Wilderness from Alternative C 431
Figure 39a: Direct Impacts on Wilderness from Alternative D 435
Figure 39b: Cumulative Impacts on Wilderness from Alternative D 437
Figure 40a: Direct Impacts on Wilderness from Alternative E 441
Figure 40b: Cumulative Impacts on Wilderness from Alternative E 443

Tables

Table 1: Off-highway Vehicle Operator and Equipment Requirements (2011) for Utah and Arizona 39
Table 2: Potential Indicators for Monitoring and Management Actions 41
Table 3: Alternatives Overview Matrix 44
Table 4: Environmental Impact Summary by Alternative 81
Table 5: Bat Species Observed at Four Riparian Areas in Glen Canyon National Recreation Area 108
Table 6: Special-status Species at Glen Canyon National Recreation Area 111
Table 7: Sound Pressure Levels Measured in National Parks 131
Table 8: Acoustic Measurement Locations 134
Table 9: Natural Ambient Sound Levels (L_{nat}), Day and Night, Summer and Winter, 2010 137
Table 10: Existing Ambient Sound Levels (L_{50}), Day and Night, Summer and Winter, 2010 137
Table 11: Common Sound Sources and Percentage of Time Audible in Developed / High-use Areas and Backcountry / Low-use Areas, Summer and Winter Seasons 138
Table 12: Classification (High Use or Low Use) of Measurement Location by Season 139
Table 13: Noise-free Interval Metrics (Mean), Day and Night Periods, in Low-use Backcountry Areas 139
Table 14: National Register of Historic Places Listed Properties 173
Table 15: Glen Canyon Regional Archaic Chronology 175
Table 16: Previously Identified Grazing Land Sites by Ecozone 177
Table 17: NAU Site Inventory 1984–1987 Site Density Values 178
Table 18: National Register Status of Archeological Sites in ORV Areas 178
Table 19: Demographic Characteristics for the Study Area 187
Table 20: Employment by Industry in the Study Area (2009) 191
Table 21: Unemployment Rates (Percent of Labor Force) 193
Table 22: 2006 Direct Travel and Tourism Impacts—Visitor Spending in the Study Area 194
Table 23: 2010 Glen Canyon National Recreation Area Payroll Spending Impacts 195
Table 24: Total Visitor Spending and Impacts 195
Table 25: Reported All-terrain Vehicle–related Fatalities in Arizona and Utah (January 1, 1982–December 31, 2011) 198
Table 26: Annual Estimates of All-terrain Vehicle–Related Emergency Department–Treated Injuries (January 1, 2001–December 31, 2011) 198
Table 27: Actions That Contribute to Cumulative Impacts 214
Table 28: Soils at Locations of Interest in Glen Canyon National Recreation Area 233
Table 29: Comparison of Impacts on Soils across Alternatives* 243
Table 30: Summary of Impacts on Vegetation Communities* 257
Table 31: Potential Impacts on Special-status Species at Glen Canyon National Recreation Area 275
Table 32: Reduction in Listening Area and Alerting Distance Due to Increases in Ambient Levels 305
Table 33: Acreage of Glen Canyon with 50% Reduction in Listening Area Due to Motorized Vehicles, with and without 96 dBA Limit 339
Table 34: Number of Locations and Acres of Authorized Off-Road Use, including Accessible Shorelines, Lone Rock Beach, and Lone Rock Beach Play Area 352
Table 35: Miles of Paved and Unpaved GMP Roads with Authorized Off-Road Use 352
Table 36: Miles of Designated ORV Routes in Ferry Swale 352
Table 37: Comparison of Impacts on Archeological Resources across Alternatives 368
Table 38: Comparison of Impacts on Paleontological across Alternatives 406
Table 39: Acres of Wilderness in Glen Canyon that Would be Impacted by Noise from Motorized Vehicles, with and without the 96-dBA Limit 445

Acronyms

ATV	all-terrain vehicle
BLM	Bureau of Land Management
BP	before present
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CRMP	Cultural Resources Management Plan
DCP/EA	development concept plan / environmental assessment
DOT	Department of Transportation
EA	environmental assessment
EA/DCP	environmental assessment/development concept plan
EIS	environmental impact statement
EPA	Environmental Protection Agency
FONSI	Finding of No Significant Impact
GHG	greenhouse gas
GIS	geographic information system
GMP	General Management Plan
IDT	Interdisciplinary Team
mph	miles per hour
NAAQS	National Ambient Air Quality Standards
NAU	Northern Arizona University
NEPA	National Environmental Policy Act
NFI	noise-free interval
NHPA	National Historic Preservation Act
NPS	National Park Service
OHV	off-highway vehicle
ORV	off-road vehicle
PEPC	Planning, Environment, and Public Comment
plan/DEIS	Off-Road Vehicle Management Plan/Draft Environmental Impact Statement
ROD	Record of Decision
RV	recreational vehicle
SHPO	State Historic Preservation Office (or officer)
TCP	traditional cultural property
THPO	Tribal Historic Preservation Office
USFWS	U.S. Fish and Wildlife Service

Chapter 1 Purpose of and Need for Action

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

This "Purpose of and Need for Action" chapter explains what this Off-road Vehicle Management Plan / Draft Environmental Impact Statement (plan/DEIS) intends to accomplish and why the National Park Service (NPS) is taking action at this time. The plan/DEIS presents four action alternatives for managing off-road use and on-road use of off-highway vehicles (OHVs) and street-legal all-terrain vehicles (ATVs) and assesses the impacts that could result from continuing current management (the no-action alternative) or implementation of any of the action alternatives. The range of alternatives evaluated includes one alternative prohibiting all off-road use in Glen Canyon National Recreation Area (Glen Canyon). If at the conclusion of this plan/DEIS and decision-making process the alternative selected for implementation includes authorizing off-road use, then this plan/DEIS will become the Off-road Vehicle (ORV) Management Plan and form the basis for a special regulation to manage off-road use at Glen Canyon. The plan/DEIS would guide management of off-road use at Glen Canyon for the next 10 to 15 years.

If at the conclusion of this plan/DEIS and decision-making process the alternative selected for implementation includes authorizing off-road use, then this plan/DEIS will become the ORV Management Plan and form the basis for a special regulation that is required to authorize off-road use at the Glen Canyon.

PURPOSE OF THIS PLAN

The purpose of this plan/DEIS is to evaluate off-road use by conventional and non-conventional motor vehicles and on-road use by non-conventional motor vehicles and develop management actions that preserve Glen Canyon's scientific, scenic, and historic features; provide for the recreational use and enjoyment of the area; and promote the resources and values for which the area was established as a unit of the national park system.

NEED FOR ACTION

A plan/DEIS is needed for the following reasons:

- To evaluate the impacts associated with allowed but unauthorized off-road use in Glen Canyon and determine what management action should be taken.
- To determine whether NPS will authorize off-road use in accordance with Executive Orders 11644 and 11989 (off-road vehicles on public lands), NPS laws, regulations (36 CFR 4.10), and policies to minimize impacts to Glen Canyon.
- To evaluate the impacts resulting from on-road use by non-conventional motor vehicles in Glen Canyon, and determine what management actions should be taken.
- To address changes in vehicular access at visitor use areas due to fluctuating lake levels.

This plan/DEIS has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500–1508) and NPS Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-Making (NPS 2011a).

OBJECTIVES IN TAKING ACTION

Objectives are specific goals that help define what each alternative must achieve for the plan/DEIS to be considered a success. Each alternative was evaluated against the objectives to ensure that the alternative satisfies the purpose of

this plan and resolves the need for action as stated above. The objectives for managing off-road use are based on Glen Canyon's enabling legislation and prior planning documents and are compatible with NPS mission and policy guidance. All alternatives considered in this ORV management plan must, to a large degree, accomplish the following objectives:

- Manage authorized vehicle uses to provide safe and healthful opportunities for visitor access and recreation.
- Manage authorized vehicle uses to protect the biological and physical environment, including natural processes and systems.
- Manage authorized vehicle uses to protect cultural resources.
- Establish clear policies to guide authorized vehicle uses.

TERMINOLOGY

Vehicle technology is changing rapidly; state vehicle codes likewise can alter the definition of a vehicle. As such, NPS desires to maintain flexibility in its approach to managing vehicle types so that management can remain responsive to future changes in recreation technologies, legal codes, production standards, and other factors beyond the control of this plan/DEIS. The following definitions explain the terms commonly used throughout this plan/DEIS.

Park Road: NPS defines a park road as the main-traveled surface of a roadway open to motor vehicles, owned, controlled or otherwise administered by NPS (36 CFR 1.4), see also Park Road Standards (NPS 1984).

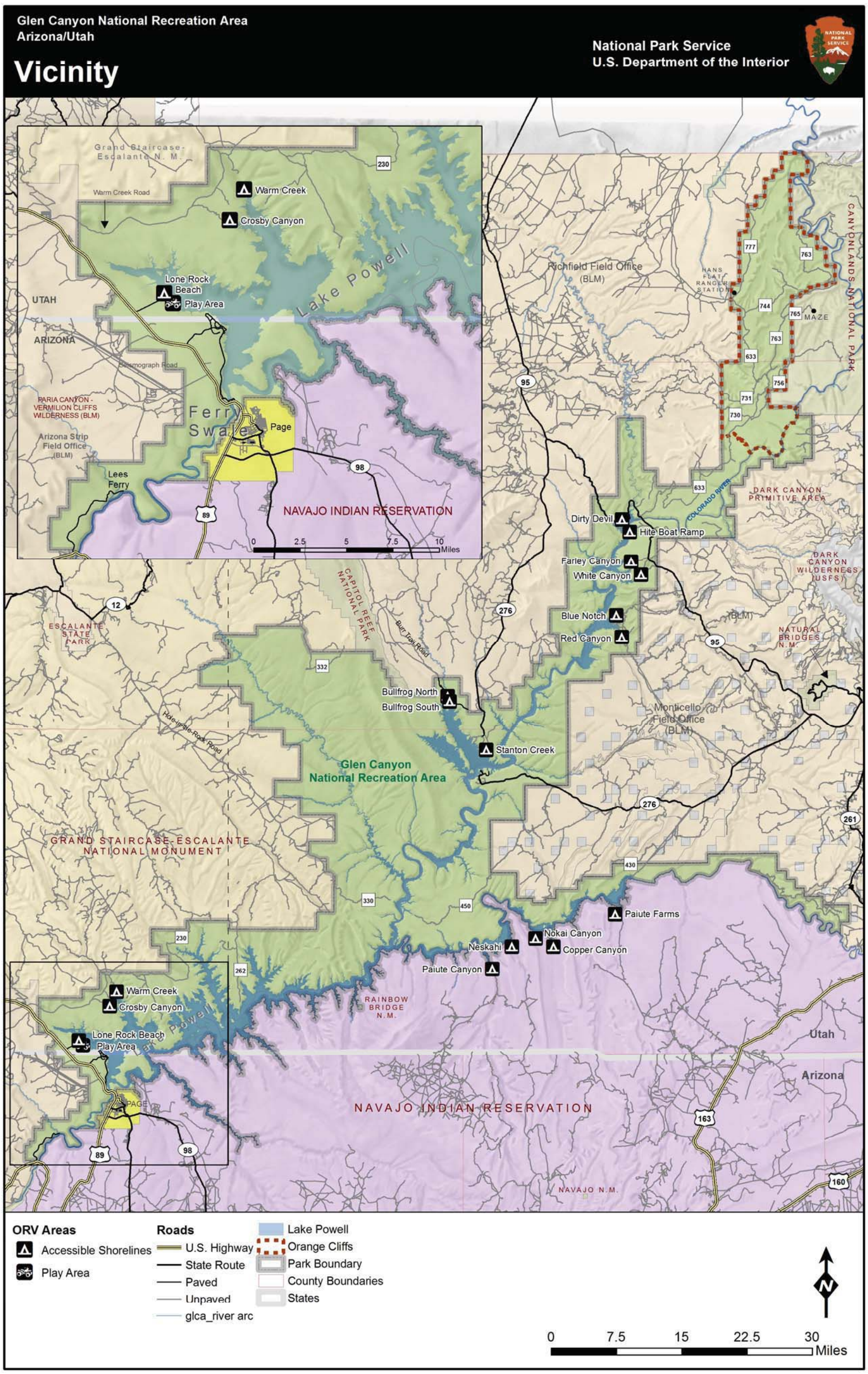
General Management Plan (GMP) Road: Roads (paved and unpaved) open to motor vehicle travel as designated in the Glen Canyon 1979 General Management Plan (figure 1). All other roads are closed to public motor vehicle travel. Park roads in Glen Canyon are the same as GMP roads.

Off-road Use: The terms "off-road use or off-road travel" refers to the driving of any motor vehicle off of paved or unpaved roads. Operating a motor vehicle off of park roads or parking areas within the National Park System is illegal unless it is authorized by a special regulation.

Motor Vehicle: NPS defines a motor vehicle as every vehicle that is self-propelled and every vehicle that is propelled by electric power, but not operated on rails or upon water, except a snowmobile and a motorized wheelchair (36 CFR 1.4).

Off-road Vehicle (ORV): NPS defines ORVs broadly as "any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain" (Executive Order 11644). Because the federal definition is so broad, the term "ORV" is not sufficient to describe the full scope of management activities in this plan/DEIS. This plan/DEIS distinguishes between conventional motor vehicles (e.g., automobiles, trucks, cars, and other vehicles that are licensed and registered for interstate travel), and non-conventional motor vehicles (e.g., all-terrain vehicles (ATVs), dirt bikes, sand rails, side-by-sides, dune buggies, etc.), which generally are not licensed for interstate travel.

Conventional Motor Vehicle: The term "conventional motor vehicle" is used throughout this plan/DEIS to distinguish motor vehicles designed primarily for use and operation on streets and highways and are licensed and registered for interstate travel but can be used off-road, from non-conventional vehicles primarily designed for off-road use. Automobiles, vans, highway motorcycles, sport utility vehicles, recreational vehicles (RVs), pickup trucks, or buses for which the primary purpose of manufacture is transportation and/or commerce are examples of conventional motor vehicles. Conventional motor vehicles do not include OHVs, ATVs, or snowmobiles.



*Note: additional road segments may exist but may not be depicted on the map due to scale.

FIGURE 1: GLEN CANYON NATIONAL RECREATION AREA

Non-conventional Motor Vehicle: The term "non-conventional motor vehicle" is used throughout this plan/DEIS to distinguish ATVs, OHVs, dirt bikes, sand rails, side-by-sides, dune buggies, and other vehicles primarily designed for off-road use from conventional motor vehicles. When necessary to distinguish a road or area designated for a specific category of motor vehicles, non-conventional motor vehicles are further divided into two categories: OHVs and street-legal ATVs. Snowmobiles are not included in this term.

Off-highway Vehicle (OHV): NPS has no definition of OHVs in the federal code. Glen Canyon overlaps two state jurisdictions (Arizona and Utah) with distinct vehicle codes that define OHV operator and vehicle requirements; see the "Conventional Motor Vehicle Operator Requirements" section in "Chapter 2: Alternatives." In Utah, Utah State Park regulations define OHVs as follows:

> (1) "Off-highway vehicle" means any snowmobile, all-terrain type I vehicle, all-terrain type II vehicle, or motorcycle. (this plan/DEIS would not authorize snowmobile use at Glen Canyon)
>
> (2) "All-terrain type I vehicle" means any motor vehicle 52 inches or less in width, having an un-laden dry weight of 1500 pounds or less, traveling on three or more low pressure tires, having a seat designed to be straddled by the operator, and designed for or capable of travel over unimproved terrain. (effective July 1, 2009)
>
> (3)(a) "All-terrain type II vehicle" means any other motor vehicle, not defined in Subsection (2), (10), or (21), designed for or capable of travel over unimproved terrain.
>
> (3)(b) "All-terrain type II vehicle" does not include golf carts, any vehicle designed to carry a disabled person, any vehicle not specifically designed for recreational use, or farm tractors as defined under Section 41-1a-102.

The Arizona Game and Fish Department and Arizona State Parks define OHVs as follows:

> (1) A motorized vehicle when operated primarily off of highways on land, water, snow, ice or other natural terrain or on a combination of land, water, snow, ice or other natural terrain. (this plan/DEIS would not authorize snowmobile use at Glen Canyon)
>
> (2) Includes a two-wheel, three-wheel or four-wheel vehicle, motorcycle, four-wheel drive vehicle, dune buggy, amphibious vehicle, ground effects or air cushion vehicle, and any other means of land transportation deriving motive power from a source other than muscle or wind.
>
> (3) Does not include a vehicle that is either designed primarily for travel on, over or in the water, or used in installation, inspection, maintenance, repair or related activities involving facilities for the provision of utility or railroad service.

Street-legal All-terrain Vehicle (ATV): NPS has no definition of ATVs in the federal code. Glen Canyon overlaps two state jurisdictions (Arizona and Utah) with distinct vehicle codes. In Utah, ATVs are legal to operate on a road or highway, with the exception of an interstate freeway[1] or a limited access highway, if they meet the "street-legal" definition under the Utah state motor vehicle and traffic code, currently described at UCA 41-6a-1509, "Street-legal all-terrain vehicle — Operation on highways — Registration and licensing requirements — Equipment requirements."

---

[1] Freeways are controlled-access highways that are part of the U.S. Interstate system as provided in the Federal Aid Highway Act of 1956 (Public Law 84-627) and any supplemental acts or amendments.

In Arizona, ATVs are legal to operate on a road or highway if they meet the "street-legal" definition under the Arizona state motor vehicle and traffic code, currently described at ARS 28-1171–1181 (Article 20 - Off-highway Vehicles). Street-legal ATVs must comply with the same requirements as a road motorcycle for registration, titling, odometer statement, vehicle identification number, license plates, registration fees, and county motor vehicle emissions inspection and maintenance programs. Street-legal ATVs must also comply with the same requirements as conventional motor vehicles for motor vehicle insurance and safety inspection requirements.

Figure 2 shows the relationship between conventional and non-conventional vehicles and OHVs and street-legal ATVs that guides the use of these terms for the purposes of this plan.

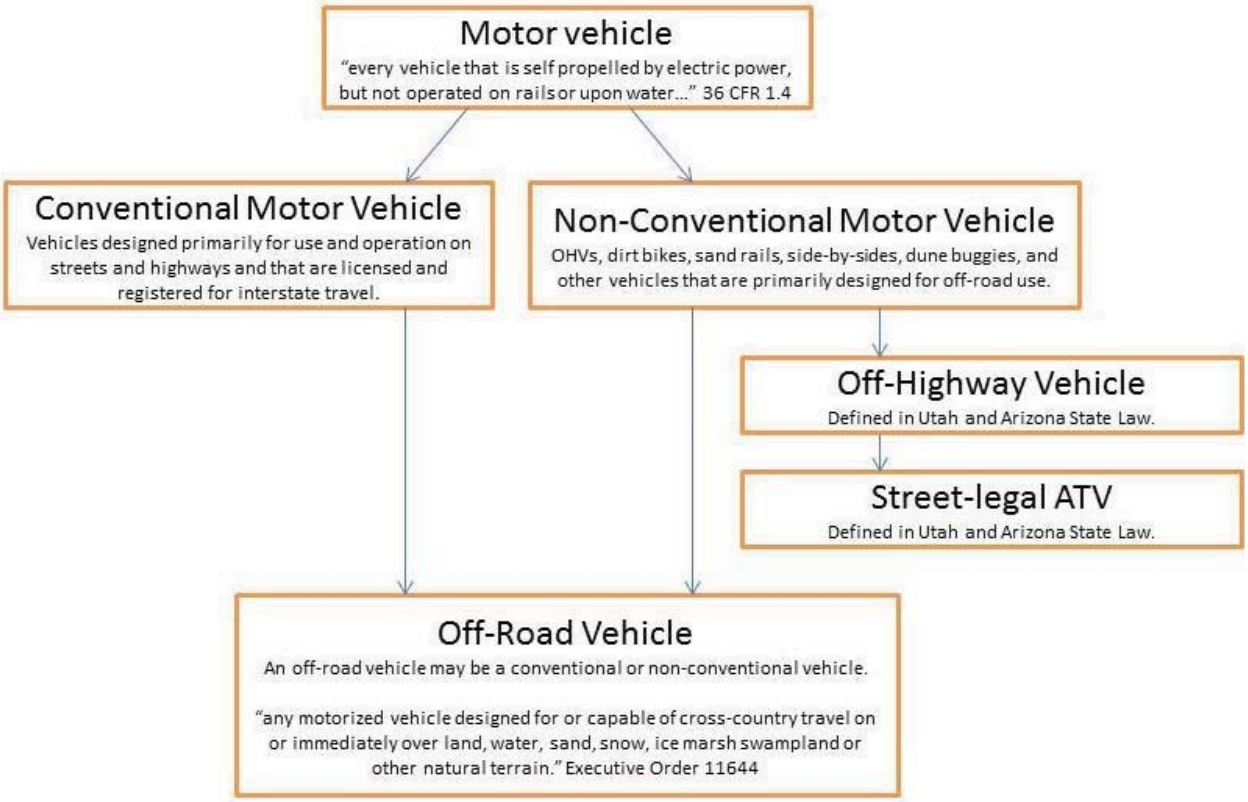


FIGURE 2: RELATIONSHIP BETWEEN TYPES OF MOTOR VEHICLES USED WITHIN THE PLAN/DEIS

Off-road Vehicle (ORV) Area: NPS has no definition of ORV areas in the federal code. This plan/DEIS uses the term "ORV area" as referenced in 36 CFR 4.10 to describe an area designated for off-road use.

Off-road Vehicle (ORV) Route: NPS has no definition of ORV routes in the federal code. This plan/DEIS uses the term "ORV route" as referenced in 36 CFR 4.10 to describe a specific linear corridor designated for off-road motor vehicle travel between identified points or locations.

PROJECT STUDY AREA

The geographic study area for this plan/DEIS is Glen Canyon National in Utah and Arizona (figure 1), unless otherwise noted under each resource topic.

Glen Canyon encompasses 1,254,306 acres in northern Arizona and southeastern Utah (figure 1). Glen Canyon includes portions of Garfield, Kane, San Juan, and Wayne Counties in Utah and Coconino County in Arizona. The

southern boundary runs contiguous to the lands of the Navajo Nation. Glen Canyon adjoins approximately 9.3 million acres of other federal lands administered by the Bureau of Land Management (BLM), including the Grand Staircase-Escalante National Monument, Vermilion Cliffs National Monument, and the Paria Canyon / Vermilion Cliffs Wilderness.

The principal feature of Glen Canyon is Lake Powell, a 186-mile-long reservoir formed behind the 710-foot-high Glen Canyon Dam on the Colorado River. Glen Canyon also possesses significant backcountry resources of outstanding scenic, scientific, and historic interest. The area is characterized by Colorado Plateau physiography: widespread layers of sedimentary rock, gigantic cliffs, towering buttes, and a multitude of canyons that carry many of the "glens," or seeps and drip gardens, for which Glen Canyon is named. Natural forces and time have conspired to create numerous alcoves, arches, and natural bridges. In this vast landscape is a fragile but complex ecosystem that, although sparse-looking, supports a wealth of plant and animal communities adapted to the arid to semi-arid environment. Glen Canyon has been home to people for thousands of years, from the archaic and prehistoric Indian cultures that roamed and lived in the canyons to more recent explorers and wanderers.

Although Glen Canyon was not established as a unit of the national park system until 1972, portions of Glen Canyon have been administered for public uses by NPS since 1958. The Glen Canyon Recreation Area, as it was then known, encompassed approximately 1,196,500 acres of lands with restricted public entry under the Colorado River Storage Project Act of 1956 (Public Law [PL] 84-485) or from a land exchange with the Navajo Nation under the Navajo Land Exchange Act of 1958 (PL 85-868). Additional acreage, including sections of the Escalante region, continued to be added or acquired as the area was developed as Glen Canyon National Recreation Area under PL 92-593 in 1972.

PURPOSE AND SIGNIFICANCE OF GLEN CANYON NATIONAL RECREATION AREA

While all parks are governed by the principles of the NPS Organic Act, each individual park is established to fulfill specific purposes based on the area's unique and nationally significant resources. The specific purposes outlined in the enabling legislation form the foundation for each park's GMP, which serves as the broad, long-term umbrella plan for managing the park.

Glen Canyon was established in 1972 by act of Congress (PL 92-593) to "provide for the public outdoor recreation use and enjoyment of Lake Powell and lands adjacent thereto in the states of Arizona and Utah and to preserve the scenic, scientific, and historic features contributing to the public enjoyment of the area"(16 USC 460dd).

The act states that "the Secretary shall administer, protect, and develop the recreation area in accordance with the provisions of the act of August 25, 1916 (NPS Organic Act), as amended and supplemented, and with any other statutory authority available to him for the conservation and management of natural resources" (16 USC 460dd-3).

The primary objective for Glen Canyon, as established in the GMP, is "to manage the recreation area so that it provides maximal recreational enjoyment to the American public and their guests" (NPS 1979). As stated in the GMP and Glen Canyon's strategic plan (NPS 2007e), Glen Canyon is important for the following reasons:

- Glen Canyon offers a tremendous diversity of both water- and land-based recreational opportunities.
- Glen Canyon contains Lake Powell, the second-largest human-made lake in North America, which provides both a unique opportunity to recreate in a natural environment and a transportation corridor to remote backcountry areas of Glen Canyon.

The primary objective for Glen Canyon is "to manage the recreation area so that it provides maximal recreational enjoyment to the American public and their guests" (NPS 1979).

- Glen Canyon is in the heart of the Colorado Plateau region, which offers a unique combination of water and desert environments. It offers a natural diversity of rugged water- and wind-carved canyons, buttes, mesas, and other outstanding physiographic features.
- The climate and physical features of Glen Canyon have created local environments favorable to the preservation of scientifically valuable objects, sites, populations, habitats, or communities that are important in and of themselves, or provided opportunities to add to our understanding of past or ongoing events.
- Evidence of 11,000 years of human occupation and use of resources in Glen Canyon provides a continuing story of the prehistoric, historic, and present-day affiliation of humans and their environment.
- Glen Canyon constitutes a substantial part of the outstanding public lands of the Colorado Plateau.

The objectives and goals for management of Glen Canyon stated in the enabling legislation and GMP will help provide context for the future management of ORVs.

Motor Vehicle Use Within Glen Canyon

Glen Canyon allows for a variety of recreational opportunities, including off-road use and on-road use by motor vehicles. The use of motorized vehicles to reach off-road destinations in Glen Canyon predates the establishment of the recreation area. After Lake Powell began to fill behind the completed Glen Canyon Dam in 1963, the public began driving off-road to access the new lake for recreational activities. This off-road use continued following the establishment of the national recreation area in 1972.

Following a rapid increase in visitation during the 1970s, NPS determined that site-specific planning for off-road use was warranted. Increasing use at shoreline locations was leading to management concerns, including visitor conflicts, safety issues, resource degradation, and indiscriminate off-road use. In response, NPS developed a management plan for Lone Rock Beach (NPS 1981) as well as a management plan for 20 accessible shoreline areas on Lake Powell (NPS 1988). Twelve of the 20 accessible shoreline sites were developed to provide for off-road driving.

ORV Tracks at Warm Creek Area

A comprehensive planning process begun by NPS after the establishment of Glen Canyon resulted in the publishing of a General Management Plan (GMP) in 1979. The GMP designated a system of open roads for vehicle travel and closed several existing unpaved roads in the backcountry. After an evaluation of several alternatives for wilderness suitability under the 1964 Wilderness Act, NPS published a Wilderness Recommendation in 1980 proposing 588,855 acres for designation as wilderness within Glen Canyon.

In 1986, a Paiute Farms / San Juan Marina Development Concept Plan Environmental Assessment (NPS 1986) evaluated the development of a marina which was subsequently constructed and then destroyed by a flash flood several years later. Off-road use at this former marina site continues in order to access the San Juan Arm of

Lake Powell at this location. In addition the 2006 Uplake Development Concept Plan (NPS 2006b) designated an area at the Hite Boat Ramp to continue its use for primitive shoreline camping, which is accessed by off-road use between the public boat launch ramp and the former Hite marina site. An additional area bordering the Navajo Nation, Nokai Canyon, is not authorized for off-road use but is currently being accessed and has not been addressed in past planning efforts.

Glen Canyon's planning efforts reflected national trends. By 1972, the widespread popularity and uncontrolled off-road use had led to the first of two executive orders seeking to unify federal policies toward the management of off-road use on federal lands.

Executive Order 11644, "Use of Off-road Vehicles on the Public Lands," issued in 1972 and amended by Executive Order 11989 in 1977, requires federal agencies that allow off-road use to designate specific areas and routes on public lands where the use may be permitted. Executive Order 11644 was issued in response to the widespread and rapidly increasing off-road use on public lands "often for legitimate purposes but also in frequent conflict with wise land and resource management practices, environmental values, and other types of recreational activity."

Title 36 of the Code of Federal Regulations, Part 4, contains regulations regarding vehicles and traffic safety on NPS lands and Section 4.10 requires that "routes and areas designated for off-road use shall be promulgated as special regulations" and that the designation of routes and areas "shall comply with §1.5 of this chapter and [Executive Order] 11644" (37 Federal Register [FR] 2887). ORV routes and areas may be designated only in national recreation areas, national seashores, national lakeshores, and national preserves.

In 2005, NPS was challenged in federal court over the failure to comply with the executive orders 11644 and 11989 and 36 CFR 4.10[b]. Although NPS had implemented ORV management plans for various parts of Glen Canyon in 1981 (Lone Rock Beach) and 1988 (20 accessible shoreline areas on Lake Powell), past planning efforts failed to comply with the CFR requiring promulgation of a special regulation to designate off-road use areas.

Glen Canyon is preparing this plan/DEIS under the terms of the May 12, 2008, settlement agreement between the Plaintiffs and the Department of the Interior and NPS (Friends of the Earth, Bluewater Network Division, et al. v. United States Department of the Interior, et al. [Case 1:05-cv-02302-RCL]).

Motor Vehicle Regulations Within Glen Canyon

NPS regulations that govern traffic on park roads include a provision at 36 CFR 4.2, which states, "Unless specifically addressed by regulations in this chapter, traffic and the use of vehicles within a park area are governed by State law. State law that is now or may later be in effect is adopted and made a part of the regulations in this part." Under this federal regulation, NPS adopts non-conflicting Utah traffic code to govern the use of vehicles on GMP roads within the Utah portion of Glen Canyon. Non-conflicting Arizona traffic code is adopted for GMP roads within the Arizona portion of Glen Canyon.

On March 13, 2008, the Governor of Utah signed into law Senate bill 181. The effect of this public law was to amend the Utah traffic code to authorize a new class of vehicle, known as "street-legal ATVs" (Utah Code 41-6a-1509) effective October 1, 2008. Because this plan/DEIS was underway at that time, Glen Canyon has allowed ATVs that comply with Utah code and meet the street-legal requirements to be operated on GMP roads in Glen Canyon, subject to the same rules that apply to conventional motor vehicles, as an interim measure.

Similar motor vehicle and operator requirements exist in Arizona for those operating motor vehicles, including ATVs. In order for ATVs to meet the street-legal definition under the Arizona state motor vehicle and traffic code, they must adhere to the requirements currently described at ARS 28-1171 to 1181, Off Highway Vehicles. This section of the code describes the requirements and conditions under which ATVs may be classified as "street-legal," or legal to operate on a road or highway in the state of Arizona.

Under Utah traffic code (UCA 41-22-10.1) the controlling agency is provided the opportunity to designate the areas that are open for OHV use and to post or mark those areas appropriately. Under the 1972 enabling legislation for Glen Canyon, the U.S. Congress designated NPS as the controlling federal agency. County ordinances promulgated under this statute would not apply within Glen Canyon.

NPS may supplement state vehicle codes to resolve visitor safety and/or resource protection concerns that cannot be satisfied on a servicewide basis by applying and enforcing state vehicle code provisions. This plan/DEIS will evaluate whether that is necessary for the use of non-conventional motor vehicles on GMP roads.

NPS may supplement state vehicle codes to resolve visitor safety and/or resource protection concerns that cannot be satisfied on a servicewide basis by applying and enforcing state vehicle code provisions.

SCOPE OF THE PLAN/DEIS

The scope of the plan/DEIS is determined by the purpose of and need for action and is used to identify those management alternatives that directly address the established purpose of and need for action.

This scope includes the evaluation of locations currently where off-road use is allowed at Glen Canyon. Off-road use is currently allowed but not authorized at Lone Rock Beach, Lone Rock Beach Play Area, and the 13 designated accessible shorelines. Nokai Canyon and Paiute Farms are shoreline areas that are not currently officially authorized for off-road use but are being accessed by vehicles. ORV routes in the Ferry Swale area will also be evaluated.

The plan/DEIS also will evaluate the on-road use of OHVs and street-legal ATVs on paved and unpaved GMP roads. The on-road legal use of conventional motor vehicles currently authorized on GMP roads will not be evaluated in this plan/DEIS because there would be no change in management of conventional motor vehicles on any GMP roads.

Activities beyond the scope of this plan/DEIS include a reevaluation of Glen Canyon's designated road system (e.g., opening, closing, or altering any road segments). Authorized roads for Glen Canyon are identified in the Glen Canyon GMP (NPS 1979). All roads, routes, trails, or paths in Glen Canyon not designated as open under the GMP are closed to any motorized travel. Closures are enforced under existing federal regulations. Any changes to the road network would need to be considered as part of a larger planning context. This plan/DEIS is not to be considered a travel management plan as is sometimes developed by other neighboring federal agencies.

It is beyond the scope of this document to recognize or reject Revised Statute (R.S.) 2477 assertions. This 1866 statute allowed the creation of a right-of-way across unreserved federal land without notification to or approval from the federal government as long as the requirements of the statute were met. Nothing in this document is intended to provide evidence bearing on or addressing the validity of any R.S. 2477 assertion that may be made in the future. No regulations, either to assert or recognize R.S. 2477 rights-of-way, currently exist and NPS has no policy regarding this matter. At the time of preparation of this plan/DEIS, the State of Utah and its counties have filed several lawsuits seeking to quiet title on rights-of-way that are claimed on multiple roads within Glen Canyon. To the extent that valid rights-of-way have been adjudicated or will be adjudicated in the future, they are still subject to reasonable NPS regulations concerning travel on GMP roads.

SCOPING AND PUBLIC PARTICIPATION

Public scoping began on August 31, 2007, with the publication of the notice of intent in the Federal Register (72 FR 50393–50394). The intent of public scoping was to collect public input on issues that require study and alternatives to be considered related to the management of off-road use and on-road use of non-conventional vehicles at Glen Canyon. NPS hosted three public scoping meetings in September 2007: September 5 in Escalante, Utah; September

20 in Page, Arizona; and September 24 in Monticello, Utah. Approximately 60 individuals participated in the public meetings. In addition, the public submitted comments online, via U.S. mail, and by hand-delivered comments to Glen Canyon's headquarters. NPS received a total of 2,759 comments by the close of public scoping on October 1, 2007.

NPS used public scoping to identify issues that were important to consider during the environmental analysis. Issues are defined as general questions, problems, or opportunities regarding the relationship between current and possible future actions to manage off-road and on-road use by non-conventional vehicles and the effect of these actions on natural, cultural, and socioeconomic resources. The following statements generalize the themes that were raised by NPS and other agencies, by local and state governments, and by the public during scoping:

- Off-road use and on-road use by non-conventional vehicles should be evaluated and managed in the context of the resources and values for which Glen Canyon was established.
- Rules and regulations for off-road use and on-road use of non-conventional vehicles should be clarified to provide better information and education regarding these uses, including clear identification of use areas.
- Off-road use and on-road use by non-conventional vehicles should be balanced with other recreational opportunities and should be managed in the context of local and regional recreational resources outside Glen Canyon's boundaries.
- Off-road use and on-road use by non-conventional vehicles should be managed in a manner consistent with NPS resource protection mandates.
- NPS should work closely with the public, local governments, and other state and federal agencies, and should be open and inclusive when making management decisions.

As a result of the public and agency comments received in 2007, NPS developed preliminary alternatives for managing off-road use at Glen Canyon. These preliminary alternatives were published and distributed to the public for a second public comment period in November 2010.

Seven public meetings were held in Utah and Arizona from November 1 through November 9, 2010, with the public comment period ending on November 24, 2010. At the end of the preliminary alternatives public comment period, a total of 557 pieces of correspondence were received, containing 1,858 comments. The majority of the comments received were regarding "new alternative elements," followed by "purpose and need: land management laws and executive orders," "affected environment: wilderness," and those stating support of off-road use in Glen Canyon.

IMPACT TOPICS IDENTIFIED FOR FURTHER ANALYSIS

Following internal and public scoping, the issues that were deemed pertinent to the environmental analysis were refined into impact topics. Impact topics are used to measure the degree (context, intensity, duration, and timing) to which a proposed alternative could impact natural, cultural, or socioeconomic resources, as well as visitor experience and Glen Canyon operations. These impact topics form the scientific and analytical basis for the comparison between alternatives in "Chapter 4: Environmental Consequences" and are described in detail in "Chapter 3: Affected Environment." Those impact topics determined to not have substantial consequences were dismissed from further analysis.

Geology and Soils

The physical impacts on desert soils at Glen Canyon from off-road use have been well documented. Damage to soils from off-road use includes destruction of soil stabilizers (e.g., macrofloral elements [plants], microfloral elements [lichen, fungal, and algal crusts], and inorganic elements [soil crusts]), soil compaction and reduced rates of water infiltration, accelerated rates of surface water runoff and erosion, accelerated rates of wind erosion, and declines in soil productivity. Damage to desert soils can result from a single pass of a vehicle. In the deserts of the Colorado Plateau, cyanobacterial soil crusts can account for 70% of the living soil cover. The functions of these living soil crusts include stabilizing soils, improving soil structure to increase water infiltration, and concentrating essential nutrients for vascular plant growth. Such soils are an integral part of the desert ecosystem, but they are highly susceptible to disturbance and damage by vehicles and may require hundreds of years or more for full recovery. Understanding these impacts is important because the physical and chemical properties of desert soils play a significant role in ecological processes. Because soils have the potential to be impacted by off-road use and by the adoption of the alternatives under consideration, geology and soils was carried forward for evaluation as an impact topic.

ORV Tracks at Alstrom Point

Vegetation

Off-road use can adversely impact native plants and plant communities at Glen Canyon directly, by crushing and uprooting of plants, and indirectly, by altering soil properties and by carrying and dispersing invasive plant seeds that replace native vegetation. Native vegetation is important for many reasons, including wildlife habitat and water quality protection.

Some slopes and heavily used areas designated for off-road use at Glen Canyon are completely denuded of native vegetation, except for partial areas inhabited by sagebrush. Some species, such as snakeweed, dicoria, and ragweed, have accommodated off-road use and are common throughout Glen Canyon. Most species are capable of recovering from direct contact with ORVs; however, blackbrush does not reestablish after elimination of the species.

Invasive plants pose a threat to native biodiversity, including to native plant populations. Executive Order 13112, “Invasive Species” (1999), directs federal agencies to prevent the introduction of invasive species, and not to take actions that the agency believes are likely to cause or promote the introduction or spread of invasive species. Glen Canyon has an active and ongoing program to control invasive plant species.

Because vegetation and plant communities have the potential to be affected through the adoption of one or more of the alternatives proposed, vegetation was carried forward for analysis in this plan/DEIS.

Wildlife and Wildlife Habitat

NPS is directed to maintain all animals native to park ecosystems. Wildlife is known to be affected by recreational activities, including off-road use, at Glen Canyon. Impacts occur in four primary categories: direct mortality,

disturbance, noise, and habitat. The most vulnerable species to off-road activity at Glen Canyon include burrowing species, such as kangaroo rats, and other rodents that nest in open sandy sites and whose burrows are easily crushed. In addition to vehicles crushing habitat, engine noise can deafen a kangaroo rat and virtually eliminate its defensive hearing. Bighorn sheep are also known to be intolerant of noise and off-road activities, and can abandon areas where such activity is common. Because wildlife and wildlife habitat has the potential to be impacted by the adoption of the alternatives under consideration, wildlife and wildlife habitat was carried forward for analysis in this plan/DEIS.

SPECIAL-STATUS SPECIES

NPS has a positive responsibility to meet its obligations under the NPS Organic Act and the federal Endangered Species Act of 1973 to conserve listed species and prevent detrimental effects to listed, threatened, or candidate species as a result of any proposed action. A number of federally listed species are likely to occur in the project area (such as the southwestern willow flycatcher [*Empidonax traillii extimus*], the California condor [*Gymnogyps californianus*], and the Mexican spotted owl [*Strix occidentalis lucida*]) and therefore may be affected by management actions. If this plan/DEIS indicates that there may be an adverse effect on any listed species, NPS will engage in consultation with the U.S. Fish and Wildlife Service (USFWS) as required under Section 7 of the Endangered Species Act (16 USC 1536 [a][2]).

Glen Canyon region is home to approximately 31 wildlife species of concern.

Pursuant to Utah Division of Wildlife Resources Administrative Rule R657-48, wildlife species that are federally listed, that are candidates for federal listing, or for which a conservation agreement is in place automatically qualify for the Utah Sensitive Species List. In addition to these species, the list includes "wildlife species of concern," which are species for which credible scientific evidence exists to substantiate a threat to continued population viability. According to Utah Division of Wildlife Resources data, the Glen Canyon region is home to approximately 31 wildlife species of concern. Because special-status species, along with threatened and endangered species, have the potential to be impacted by the adoption of the alternatives under consideration, special-status species was carried forward for analysis in this plan/DEIS.

SOUNDSCAPES

Part of the NPS mission is to preserve, to the greatest extent possible, the natural soundscape of a park, and to protect this natural soundscape from unacceptable impacts (NPS 2006a, Section 4.9). Section 8.2.3 of NPS *Management Policies 2006* directs park managers to evaluate motorized vehicle use for impacts on park resources and values, particularly the natural soundscape. Impacts related to soundscapes could occur on or near where off-road use is allowed. A wide variety of off-road use occurs at Glen Canyon, each emitting various levels of noise. Off-road use can generate noise that has the potential to impact other users in these areas, such as those camping, enjoying a picnic with their families, or participating in other activities. Such noise could also discourage wildlife from using these areas. Because soundscapes have the potential to be impacted through the adoption of one or more of the alternatives proposed in this plan/DEIS, soundscapes was considered as an impact topic.

Visitor Use and Experience

Visitors at Glen Canyon

The use of motorized vehicles to reach off-road destinations around Lake Powell predates the establishment of the recreation area. After Lake Powell began to fill behind the completed Glen Canyon Dam in 1963, the public began driving off-road to access the new lake for recreational activities. This off-road use continued following the establishment of the national recreation area in 1972. Today, the area is still popular with off-road enthusiasts and OHV users. Because off-road use, as well as on-road street-legal ATV use, at Glen Canyon is an integral component of the experience for some visitors, visitors may be affected by potential vehicle management actions, especially if certain restrictions or user fees are involved. While off-road use may provide a positive experience for some visitors, it can also intrude on the experiences sought by others, resulting in recreation conflict. In addition, the extent to which this use may be authorized in Glen Canyon could impact the amount and range of recreational opportunities available to visitors.

Because visitor use and experience have the potential to be impacted through the adoption of one or more of the alternatives proposed in this plan/DEIS, visitor use and experience was considered as an impact topic.

Cultural Resources

The cultural resource management policies of NPS derive from a suite of historic preservation, environmental, and other laws, proclamations, executive orders, and regulations. Cultural resources are aspects of a cultural system that are valued by or significantly representative of a culture or that contain significant information about a culture. These resources are typically tangible entities but may include cultural practices. Cultural resources include archeological resources, cultural landscapes, historic/prehistoric structures, ethnographic resources, and museum collections (prehistoric and historic objects, artifacts, works of art, archival documents, and natural history specimens). Section 106 of the National Historic Preservation Act of 1966 (NHPA) (16 USC 470 et seq.) specifically directs each federal agency to consider the effects of their undertakings on these cultural resources eligible for or listed in the National Register of Historic Places (national register).

Due to the potential for adverse impacts on archeological and ethnographic resources through the adoption of one or more of the action alternatives, archeological and ethnographic resources have been assessed for their potential to be affected by the alternatives. The other three cultural resource categories (cultural landscapes, historic/prehistoric structures, and museum collections) have been dismissed as impact topics for reasons stated in the next section.

Archeological Resources: The Archeological Resource Protection Act of 1979 (14 USC 470bb) and NPS *Management Policies 2006* (NPS 2006a) define archeological resources as any material remains or physical evidence of past human life or activities that are of archeological interest and are capable of revealing scientific or humanistic information through archeological research. Glen Canyon is known to contain archeological resources eligible for inclusion in the national register; archeological resources do exist within the study area.

Ethnographic Resources: NPS defines "ethnographic resources" as "objects and places, including sites, structures, landscapes, and natural resources, with traditional cultural meaning and value to associated peoples" (NPS 2006a). Research and consultation with associated people identifies and explains the places and things they find culturally meaningful.

Ethnographic resources eligible for the national register are called traditional cultural properties (TCPs). TCPs are defined by NPS as "a property associated with cultural practices, beliefs, the sense of purpose, or existence of a living community that is rooted in that community's history or is important in maintaining its cultural identity and development as an ethnically distinctive people" (NPS 2006a).

Ethnographic resources exist within the study area. Ethnographic resources include archeological sites made by indigenous peoples. American Indian archeological sites known and likely to occur within the study area include Paleoindian, Archaic, Ancestral Puebloan, Paiute and Ute sites, as well as Navajo sites. The Pueblo of Zuni and the Hopi Tribe both passed resolutions declaring their relationships with the people who lived during the Paleoindian and Archaic periods. Paleoindian and Archaic period sites, therefore, become ethnographic resources. The Hopi Tribe also claims association with any Ancestral Puebloan sites. The Pueblo of Zuni claims association with Fremont Period sites. Therefore, the sites are ethnographic resources because of the significance of those sites within the cultural traditions and histories of the Hopi Tribe and Pueblo of Zuni. Any archeological sites associated with Navajo inhabitance of the area are also ethnographic resources. Any Numic or Paiute or Ute sites would similarly be regarded as ethnographic resources by contemporary Paiute and Ute tribes and bands.

Ethnographic resources that are archeological sites have been documented in association with the accessible lakeshores and within Lone Rock Beach Play Area. Cultural resources that combine the attributes of ethnographic and archeological sites have been recorded in the areas proposed for designated ORV routes at Ferry Swale. Consultation with tribes and the State Historic Preservation Officer (SHPO) are ongoing over these resources. Archeological sites have been recorded within and adjacent to the GMP roads. Some of these sites may also be ethnographic resources.

Ethnographic Resources that are or have the Potential to be Traditional Cultural Properties: Four historic properties potentially eligible to the national register as TCPs lie adjacent to, but are not within, the study area. They include (1) Rainbow Bridge within Rainbow Bridge National Monument; (2) the Colorado River inclusive of what is now Lake Powell; (3) an archeological site associated within the Wahweap governmental housing complex near the Lakeshore Drive Access Road; and (4) a location in association with the Halls Crossing Access Road. Rainbow Bridge is considered significant to the histories and on-going traditions of five tribes associated with Glen Canyon/ Rainbow Bridge National Monument. These tribes include the Kaibab Paiute Tribe, San Juan Southern Paiute Tribe, Navajo Nation, Hopi Tribe, and White Mesa Ute of the Ute Mountain Ute Tribe. The Colorado River within the jurisdiction of Glen Canyon, and adjacent to various accessible lakeshores, is regarded as a TCP by the Kaibab Band of Paiute Indians, the Navajo Nation, the Pueblo of Zuni, and the Hopi Tribe. The Colorado River has been and remains a significant place within the histories and cultures of these tribes.

One historic property potentially eligible to be a TCP is located within the study area. The Hole-in-the-Rock Road corridor is significant to members of the Church of Jesus Christ of Latter-day Saints as a location associated with their pioneer history, and it continues to be important in the maintenance of their on-going communal identity and in their development as an ethnically distinctive group. The significance of the corridor is documented in the 2011 Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road (NPS 2011c). In consulting on the 2011 Programmatic Environmental Assessment for Organized Group Activities along the Hole-in-the-Rock Road, the Church of Jesus Christ of Latter-day Saints community was a proponent for increased use by organized groups; they do not view pedestrian and vehicular use as having more than minor impacts.

Socioeconomics

The social and economic environment of a region is characterized by its demographic composition, the structure and size of its economy, and the types and levels of public services available to its citizens. Glen Canyon provides recreation, quality of life, and other amenities to regional visitors and residents. Glen Canyon lies in five counties: Coconino County, Arizona; and Garfield, Kane, San Juan, and Wayne Counties, Utah. NPS evaluated the socioeconomic environment in the five counties surrounding Glen Canyon and determined that the labor market for this region should include additional counties where residents live and commute to jobs in the counties that encompass Glen Canyon. The socioeconomic study area therefore includes eight counties, accounting for over 60% of the labor force for the five-county region that encompasses Glen Canyon National Recreation Area. This socioeconomic study area includes Coconino County in Arizona, as well as the following Utah counties: Garfield, Iron, Kane, San Juan, Sevier, Wayne, and Washington. These eight counties form the economic region of influence and define the geographic area in which the predominant social and economic impacts from the proposed alternatives are likely to take place.

The alternatives associated with the management of ORVs at Glen Canyon could have an impact on the socioeconomic environment of Glen Canyon and the region, including a greater demand for recreation and tourism-related amenities, the potential for increased profitability of commercial services in the area, and the enhancement of local economies.

The CEQ requires NPS to consider the effects of actions on the quality, growth, expansion, and use of outlying and gateway communities (40 CFR 1502.16). Because the local economy could be impacted through the adoption of one or more of the alternatives proposed in this plan/DEIS, socioeconomics is considered as an impact topic.

Health and Safety

CEQ regulations (40 CFR 1508.27) require NPS to consider the effects of proposed actions on visitor health and safety. NPS strives to provide a safe and healthful environment for visitors. NPS recognizes that both the Glen Canyon National Recreation Area resources which attract visitors, and some of the specific recreational activities in which visitors participate can present sources of potential hazards (e.g., use of conventional vehicles and ATVs together on GMP roads). Off-road use is a particular concern for visitor health and safety. ATVs in particular have been the subject of actions by the Consumer Product Safety Commission. Because health and safety of visitors and employees could be impacted through adoption of one or more of the alternatives proposed in this plan/DEIS, health and safety is considered as an impact topic.

Paleontological Resources

Paleontological resources (fossils, trackways, and associated data) represent a significant record of information and evidence about past life. Management of paleontological resources follows federal laws, regulations, and policies as embodied in NPS *Management Policies 2006* Section 4.8.2.1 (NPS 2006a). This section requires NPS managers to protect and preserve for educational and scientific purposes all paleontological resources, including both organic and mineralized remains in body or trace form. NPS is directed by the Paleontological Resources Preservation Act of 2009 (Title VI, PL 111-11) and 36 CFR 2, which contains penalties for those who would possess, destroy, remove, or otherwise damage paleontological resources.

All sedimentary rock formations in Glen Canyon hold the potential for fossil discovery. Certain formations are more sensitive than others and warrant special management concern. These include the Chinle and Morrison Formations, the Tropic Shale, and the Quaternary Deposits. The Moenkopi, Navajo, and Entrada Formations are also known to be high in tracks and traces, are subject to natural erosion and are targets for illegal collection and trade in the black market.

Because paleontological resources could be impacted (through soil erosion and/or collection) by the adoption of one or more of the alternatives proposed in this plan/DEIS, paleontological resources are considered as an impact topic.

WILDERNESS

NPS has proposed 588,855 acres or 47% of the lands in Glen Canyon as suitable for addition to the National Wilderness Preservation System and an additional 48,955 (4%) as potential wilderness (NPS 1980). The general policy of NPS is to manage all lands with wilderness characteristics, including recommended and potential wilderness areas, in expectation of eventual wilderness designation (NPS 2006a, 6.3.1). As such, management will take no action that would diminish the wilderness eligibility of these areas. Due to the proximity of unpaved GMP roads to proposed wilderness, wilderness is evaluated as an impact topic.

IMPACT TOPICS DISMISSED FROM FURTHER ANALYSIS

WATER RESOURCES

An objective of the Glen Canyon GMP is "to encourage the maintenance of high water quality in all bodies and sources of water and to perpetuate the natural flow of free water" (NPS 1979). Glen Canyon accomplishes this objective through education, visitor rules, enforcement of regulations, well-maintained facilities, and an active water quality monitoring program. Under the 1996 Strategic Plan to Protect Water Quality (NPS 1996a), an agreement with the Arizona and Utah Departments of Environmental Quality, Glen Canyon monitors the public health risk to recreational users in Lake Powell by monitoring for E. coli (*Escherichia coli*), an indicator of fecal contamination. Each year, samples are collected from the lake and analyzed under a beach monitoring program. Glen Canyon maintains two laboratories that are certified as environmental testing laboratories by the Utah Department of Health. Areas that pose an unacceptable public health risk are closed to swimming. Currently, 100% of surface water resources meet state- and U.S. Environmental Protection Agency (EPA)-approved water quality standards. Human waste management has been an issue in the past; NPS has in place stringent visitor use rules to mitigate this potential problem at Glen Canyon. These use rules apply to all accessible shoreline locations in Glen Canyon.

The two potential impacts on water resources from off-road use are disturbance and pollution. Disturbance occurs as off-road use breaks down stream banks, compacts soils, and damages riparian vegetation, all of which can lead to erosion and siltation; however, no off-road use is occurring in riparian areas of Glen Canyon. Pollution may occur if motorized vehicles leak or otherwise discharge oil or gasoline, or if increased public use due to off-road access leads to problems with human waste management.

Due to the ephemeral nature of the streams in off-road use areas and the overall arid climate, disturbance and the resulting erosion has not been an identified problem at Glen Canyon. Localized events may lead to increased turbidity of lake waters, which can cause decreased sunlight penetration, temperature variations, and the introduction of sediment; however, these impacts would be short term and localized, and would not cause a threat to water quality. Because impacts on water quality in Glen Canyon from the alternatives proposed would be minimal, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

FISH AND FISH HABITAT

As discussed above, impacts to water quality in Glen Canyon from the alternatives proposed would be minor. Therefore, it is expected that there would not be a substantial indirect impact to fish or its habitat, including species of special concern. Fish species of special concern occurring in Glen Canyon are found in the Colorado River itself and not within any of the areas considered within the scope of this plan/DEIS. Additionally, impacts to sport

fishery are not expected as a result of implementation of this plan/DEIS. As a result, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

Air Quality

The EPA, the Arizona Department of Environmental Quality, and the Utah Department of Environmental Quality regulate air quality in Glen Canyon National Recreation Area through the implementation of the Clean Air Act. The EPA has established primary and secondary National Ambient Air Quality Standards for six criteria pollutants: carbon monoxide, nitrogen dioxide, particulate matter, ozone, sulfur dioxide, and lead. In addition to the National Ambient Air Quality Standards, the Clean Air Act contains a "Prevention of Significant Deterioration" title (42 USC 7470–7492) to place ceilings on additional amounts of pollution over baseline levels based on an area's classification. The program outlines three types of airshed classification areas: Class I, Class II, and Class III. Glen Canyon is classified as a Class II area. Currently, Glen Canyon is located in a designated EPA air quality attainment area, which means air quality standards are being met. Neighboring national park units, including Capitol Reef, Canyonlands, and Grand Canyon National Parks, are Class I areas.

Off-road use can have an adverse impact on ambient air quality through its destabilizing effects on soils and through mobile source emissions. Additionally, impacts of fugitive dust due to off-road activity can be problematic.

In considering whether to analyze the impacts of each alternative on air quality in detail, NPS relied on current and predicted use numbers as well as data collected for the Cape Hatteras National Seashore Off-road Vehicle Management Plan / Environmental Impact Statement. An air quality analysis was completed at Cape Hatteras National Seashore on the impacts of conventional vehicles driving off-road. NPS air quality experts have suggested that the study is similar enough on which to reasonably rely for this plan/DEIS. The analysis demonstrated that off-road driving had minimal impact on air quality. That analysis assumed significantly more conventional vehicles driving off-road than numbers of vehicles that would be allowed to drive off-road under any of the alternatives in this plan. Additionally, almost all off-road driving at Glen Canyon involves driving to a destination and parking rather than driving and touring as is the case at Cape Hatteras National Seashore. The off-road driving/ touring at Lone Rock Beach Play Area and in the Ferry Swale area is likely so limited it will have minimal impacts on air quality.

A review of OHV use numbers for Lone Rock Beach and Lone Rock Beach Play Area over the last five years revealed numbers too low to meaningfully model. The only alternative that could see an increase in OHV use at accessible shorelines would be alternative C, because OHVs will not be permitted off-road on shorelines in the other alternatives, including no action. Though OHV use is likely to increase under alternative C, Glen Canyon does not anticipate a significant increase in OHVs driving off-road.

Dust can also be a concern with off-road driving of both conventional and non-conventional motor vehicles. One cacti species (*Pediocactus bradyi*) found in Glen Canyon is especially susceptible to dust. However, according to a recent survey, this species does not occur within any of the areas in which OHV use currently occurs or is being contemplated. Further, since off-road use under this plan would be primarily for reaching shoreline destinations and then parking, we anticipate that dust will be minimal.

On-road OHV use, both legal and illegal, is currently limited. Under several of the alternatives, including the preferred alternative, OHV use would likely increase on GMP roads, but Glen Canyon does not anticipate a huge influx in numbers so as to cause anything more than a negligible change in air quality. OHV use on GMP roads will likely be widely dispersed and infrequent as many GMP roads (particularly unpaved) are not hospitable to driving long distances using OHVs.

Finally, NPS recognizes the importance of addressing air quality long before exceeding National Ambient Air Quality Standards or endangering the Class II designation. Because of this, we have included monitoring air quality

in our monitoring and mitigation framework. If use numbers become such that we see changes to air quality, Glen Canyon will institute closures or use limitations.

Cultural Resources

Cultural Landscapes: NPS defines "cultural landscapes" as features humans construct when inhabiting an area. They can be cattle ranches, formal gardens, and cemeteries. They reflect human adaptation and use of natural resources. The character of a cultural landscape is defined by physical materials, such as roads, buildings, walls, and vegetation, and by uses that reflect cultural values and traditions. An example of a cultural landscape in Glen Canyon is the Church of Jesus Christ of Latter-day Saints settlement at Lees Ferry/Lonely Dell National Historic District.

There are no documented cultural landscapes within the study area. However, Glen Canyon recognizes that portion of the Hole-in-the-Rock Road within Glen Canyon that extends to the Hole-in-the-Rock as an undocumented cultural landscape. The Trail and the Hole are currently listed in the national register. NPS is currently pursuing funding to document of the Hole-in-the-Rock area as a cultural landscape and TCP. This effort could be considered a potential mitigation to any effects resulting from the proposed action on the Hole-in-the-Rock Road.

Nevertheless, the impacts from the proposed alternatives to the road corridor associated with the Hole-in-the-Rock Expedition Trail would be minor. Vehicular road traffic remains on the existing road corridor. Archeological sites in association with the road corridor, and that also include historic campsites associated with the expedition, were surveyed for the 2011 Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road (NPS 2011c). In all alternatives, impacts to archeological resources from increased vehicular and pedestrian use by organized groups would be minimal.

Historic and Prehistoric Structures: No known or documented prehistoric or historic structures exist within the study area. NPS defines a structure as those consciously created to serve some human activity (NPS 1998). An "historic structure" is generally of Euroamerican origin, but could have been created by American Indians. Historic structures can include log cabins, hogans, brush structures, other buildings, dams, canals, and fences. "Prehistoric structures" are made by American Indians and can include masonry structures built by indigenous farming communities who inhabited Glen Canyon. Although not within the study area, examples include Three Roof Ruin and Defiance House, which were built by ancestors to contemporary Puebloans.

Because no known or documented historic or prehistoric structures exist within the study area, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

Museum Collections: As defined at 36 CFR 79, "Curation of Federally Owned and Administered Archeological Collections," and NPS *Management Policies 2006* (NPS 2006a), museum collections refer to material remains that are excavated or removed during a survey, excavation, or other study of a cultural resource, including associated records. Should the archeological inventory associated with this plan/DEIS produce collections, these collections would be deposited in an institution with adequate long-term curatorial capabilities. In this case, any collections would be accessioned into NPS museum collections. However, no artifacts were collected during archeological surveys of the study area (Bryce 2010; Caldwell 2011). Because adverse impacts on museum collections resulting from the archeological inventory of the project area would be avoided through compliance with relevant policies and guidance, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

GEOHAZARDS

Sand deposits and landslides can threaten the safety of visitors. Active and stabilized dunes and deposits of blown sand are extensively distributed throughout Glen Canyon and can present a formidable impediment to overland travel. GMP roads have been temporarily closed due to rock slides, and roads through bentonitic clay deposits can become hazardous when wet.

The most dangerous geohazard is associated with the fall of large slabs of Wingate and Navajo Sandstone anywhere along the lake. Large slabs can be released along near-vertical joints and topple suddenly into the water. The increased risk of geological hazards related to this plan/DEIS would not be detectable. Therefore, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

This topic involves assessing energy requirements and the potential for energy conservation associated with the various alternatives, but is most relevant to facility construction projects. Glen Canyon would continue to operate under the wise energy use guidelines and requirements stated in NPS *Management Policies 2006*; Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance" of October 5, 2009; and Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management" of January 26, 2007.

The CEQ requires NPS to consider the impact of proposed actions on energy requirements, energy conservation, and sustainability (40 CFR 1502.16). Actions proposed under the alternatives would not have a substantial impact on energy use and conservation; therefore, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

CLIMATE CHANGE

Climate change refers to any significant changes in average climatic conditions (such as mean temperature, precipitation, or wind) or variability (such as seasonality and storm frequency) lasting for an extended period (decades or longer). Recent reports by the U.S. Climate Change Science Program, the National Academy of Sciences, and the United Nations Intergovernmental Panel on Climate Change provide evidence that climate change is occurring as a result of rising greenhouse gas (GHG) emissions and could accelerate in the coming decades. Activities such as fossil fuel combustion, deforestation, and other changes in land use are resulting in the accumulation of trace GHGs such as water vapor, carbon dioxide, methane, nitrous oxide, ozone, and several hydrocarbons and chlorofluorocarbons.

While climate change is a global phenomenon, it manifests differently depending on regional and local factors. General changes that are expected to occur in the future as a result of climate change include hotter, drier summers; warmer winters; warmer water; higher ocean levels; more severe wildfires; degraded air quality; more heavy downpours and flooding; and increased drought. Climate change is a far-reaching, long-term issue that could affect Glen Canyon and its resources, visitors, and management. Although some effects of climate change are considered known or likely to occur, many potential impacts are unknown. Much depends on the rate at which the temperature would continue to rise and whether global GHG emissions can be reduced or mitigated. Climate change science is a rapidly advancing field and new information is being collected and released continually.

To date, no national standards have been established regarding GHG emissions, nor has the Environmental Protection Agency (EPA) established criteria or thresholds for GHG emissions applicable to transportation projects. On April 2, 2007, the Supreme Court issued a decision in Massachusetts et al. v. Environmental Protection Agency et al. 549 U.S. 497 (2007) that the EPA does have authority under the Clean Air Act to establish motor vehicle emissions standards for CO_2 emissions. In response to the Court's decision, EPA issued an endangerment

and cause or contribute finding for six GHGs under Section 202(a) of the Clean Air Act on December 7, 2009. The endangerment finding states that current and projected GHG concentrations in the atmosphere threaten the public health and welfare. The cause or contribute finding states that certain GHG emissions from motor vehicles contribute to the atmospheric concentrations of GHGs and to climate change.

NPS has released draft interim guidance on considering climate change in its NEPA process (NPS 2009a). When considering climate change, two key questions should be addressed: (1) What is the contribution of the proposed project to climate change, as indicated by GHG emissions associated with the project? and (2) What is the impact of climate change on park resources, and specifically the resources that will be impacted by the project?

On February 18, 2010, the CEQ released a draft guidance document addressing how the effects of climate change and GHG emissions should be analyzed under NEPA. The Draft Guidance addresses when and how to evaluate both the GHG emissions from proposed actions and the potential impacts of climate change on proposed actions. The Draft Guidance recommends 25,000 metric tons of direct CO_2-equivelent emissions per year as an indicator for when a quantitative GHG emissions analysis may be appropriate to include in NEPA documents. The Draft Guidance is still under review and subject to substantial change depending on the comments received.

Climate change is inherently a global issue. The sources of GHG emissions that scientists believe are causing the current change in climate are from all over the world, and climate change does not easily lend itself to an analysis at a local level. While off-road driving contributes to mobile source emissions and particulate matter, any effects of GHG emissions from the proposed alternatives on climate change would not be discernible at a regional scale. Further, nothing in NEPA explicitly requires an analysis of GHGs at the project level and no national standards have been established. This impact topic was therefore dismissed and not carried forward for analysis in this plan/DEIS.

Natural or Depletable Resources

Management actions proposed under the alternatives would not have detectable impacts on the long-term enhancement or productivity of the land or natural and depletable resources in Glen Canyon (per the CEQ impact requirement [40 CFR 1501.16]). Therefore, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

Floodplains and Wetlands

Executive Order 11988, “Floodplain Management,” requires an examination of impacts on floodplains and the potential risk involved in placing facilities in floodplains. NPS *Management Policies 2006*, Section 4.6.4, “Floodplains,” and NPS Director’s Order 77-2: Floodplain Management Guidelines (NPS 2006a, 2003) provide guidelines on developments proposed in floodplains. The proposed alternatives in this plan/DEIS do not consider any new development or construction in a floodplain; therefore, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

Executive Order 11990, “Protection of Wetlands,” requires federal agencies to avoid adversely affecting wetlands, where possible. NPS policies for wetlands, as stated in NPS *Management Policies 2006* and Director’s Order 77-1: Wetlands Protection (NPS 2006a, 2002a), strive to prevent the loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. For regulatory purposes under the Clean Water Act, the term “wetlands” means “those areas that are inundated or saturated by surface or ground water 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.”

Under Director's Order 77-1: Wetland Protection (NPS 2002a), NPS classifies wetlands according to the USFWS Classification of Wetlands and Deepwater Habitats of the United States, hereafter referred to as the Cowardin Classification System (Cowardin et al. 1979). Under the Cowardin Classification System wetlands have at least one of the following attributes:

- at least periodically, the habitat supports predominantly hydrophytic vegetation (wetland vegetation)
- the substrate is predominantly undrained hydric soil
- the substrate is non-soil and is saturated with water, or is covered by shallow water at some time during the growing season

The Lake Powell shoreline has at least one of these attributes, and is considered a lacustrine wetland. The boundary of the lacustrine wetland is generally decided by the location of the ordinary high water mark (or "full pool" of 3,700-foot elevation, in the case of Lake Powell). Beachfronts of lakes may be considered wetlands if they are hydrologically influenced by the normal ebb and flow of the lake's ordinary high water mark. Because the ordinary high water mark of Lake Powell is fairly static and does not change on a daily or monthly basis, the beachfront is not considered a wetland. This impact topic was therefore dismissed and not carried forward for analysis in this plan/DEIS.

Environmental Justice

Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low Income Populations" (1994), requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. The executive order further stipulates that the agencies conduct their programs and activities in a manner that does not have the effect of excluding people from participating in, or denying people the benefits of these programs and activities, or subjecting people to discrimination because of their race, color, or national origin.

Evaluating whether a proposed action has the potential to have disproportionately high and adverse impacts on minority and/or low-income populations typically involves identifying any potential high and adverse environmental or human health impacts, identifying any minority or low-income communities in the potential high and adverse impact areas, and examining the spatial distribution of any minority or low-income communities to determine whether they would be disproportionately affected by these impacts.

Guidelines provided by the CEQ (1997) and EPA (1998) indicate that a minority community may be defined where either the minority population comprises more than 50% of the total population or the minority population of the affected area is meaningfully greater than the minority population in the general population of an appropriate benchmark region used for comparison. 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 1997).

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% of residents are below the poverty level.

There are certainly low-income and minority populations adjacent to the recreation in the study area, in particular, a significant population of American Indians due to Glen Canyon's proximity to the Navajo Indian Reservation. ORV management is not likely to disproportionately affect low income or minority populations. The accessible shorelines with the closest proximity to the Navajo Indian Reservation include Paiute Canyon, Neskahi, Copper Canyon, Nokai Canyon, and Paiute Farms, and they receive very little current use due to their remote character and poor access. Currently, Nokai Canyon and Paiute Farms are officially closed but do receive some limited use. These accessible shorelines, along with ten or six additional accessible shoreline sites would be closed under alternatives B and D, respectively. Therefore, impacts would be expected to be negligible to potential environmental justice populations and would not fall disproportionately on these populations since there is very limited use of these sites currently. Under these alternatives, closures at Lone Rock Beach and Lone Rock Beach Play Area may adversely affect the City of Page through decreased visitation and visitor spending. Since the Navajo Indian Reservation surrounds Page, it is likely that residents of the Reservation would also be adversely affected by these decreases in visitation and visitor spending. However, these impacts are not expected to disproportionately affect these populations.

Alternatives C and E would officially open Paiute Farms and Nokai Canyon accessible shorelines, which are currently closed. Additionally, ATVs would be allowed by permit at all the open accessible shorelines as well as all of those closest to the reservation under these alternatives. Fees proposed as part of ORV permits for these areas would be required. Again, a number of other accessible shoreline sites in additional to those with close proximity to the Navajo Indian Reservation would remain open under these alternatives. Impacts to potential environmental justice populations are therefore expected to be minimal and not disproportionate to these populations. Therefore, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

Prime and Unique Agricultural Lands

Under the Farmland Protection Policy Act of 1981 NPS seeks to minimize the unnecessary or irreversible conversion of farmland to nonagricultural uses. No unique or prime farmlands exist in Glen Canyon. The proposed alternatives would not result in the conversion of farmlands. Therefore, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

Indian Trust Resources

Indian Trust assets are assets that the United States holds and administers for Indian Tribes. The federal Indian Trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native Tribes. NPS consulted with the affiliated Tribal governments to determine whether any Trust resources could be affected by the management of off-road use at Glen Canyon. Following consultation, NPS has determined that there are no Indian Trust resources in the area that would be affected by off-road use. This impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

Biospheres and Other Ecologically Critical Areas

CEQ regulations require NPS to review actions for effects on ecologically critical areas, including wild and scenic rivers and national natural landmarks, or other unique natural features as referenced in 40 CFR 1508.27. The areas of Glen Canyon that would be affected by off-road use do not contain ecologically critical areas, wild and scenic rivers, or other unique natural resources. Therefore, this impact topic was dismissed and not carried forward for analysis in this plan/DEIS.

Glen Canyon National Recreation Area Management and Operations

NPS manages natural and cultural resources, public recreation, and associated facilities in Glen Canyon. The superintendent has overall authority and uses six divisions for managing the park unit: Science and Resource Management, Visitor and Resource Protection, Facility Management, Administration, Business Management, and Interpretation, Education and Partnerships. In addition to numerous other responsibilities, Glen Canyon staff are charged with enforcing closures, monitoring motorized vehicle use for general violations, and providing interpretive and educational information to visitors. Alternatives considered in this plan/DEIS could have an impact on Glen Canyon operations, including law enforcement patrols, costs and maintenance associated with infrastructure and facilities, printing costs for the publication of new route maps and brochures, and costs associated with natural and cultural resource management, mitigation, and monitoring. However, impacts associated with Glen Canyon operations are likely to be minor and have not been carried forward for analysis. Appendix B describes costs and staff operation needs for each alternative.

RELATED LAWS, POLICIES, REGULATIONS, AND PLANS

Glen Canyon as a national recreation area is managed much like any other NPS unit. For the most part, the same management policies, regulations, and laws apply at Glen Canyon as all other national park system units.

NPS operates under a number of legal and administrative authorities that guide management decisions affecting park resources and recreational opportunities. Several resource-specific laws and policies are described in the "Impact Topics Identified for Further Analysis" section. The principal laws and policies that govern the management of park units are described below. Any actions evaluated in this plan/DEIS that affect the management of Glen Canyon will be analyzed in the context of these laws, policies, and plans.

Executive Orders 11644 and 11989: Off-road Vehicles on Public Lands

On February 8, 1972, President Richard Nixon issued Executive Order 11644, Use of Off-road Vehicles on the Public Lands, as amended by Executive Order 11989, to "establish policies and provide for procedures that will ensure the use of ORVs on public lands will be controlled and directed so as to protect the resources of those lands, to promote the safety of all users of those lands, and to minimize conflicts among the various uses of those lands."

The executive order directs agencies to develop and issue regulations and administrative instructions to designate the specific areas and trails on public lands on which off-road use may and may not be allowed. The location of off-road use areas and trails shall

- minimize damage to soil, watershed, vegetation, or other resources of the public lands
- minimize harassment of wildlife or significant disruption of wildlife habitats
- minimize conflicts between off-road use and other existing or proposed recreational uses of the same on neighboring public lands, and ensure the compatibility of such uses with existing conditions in populated areas, taking into account noise and other factors
- ensure that areas and trails shall not be located in officially designated wilderness areas or primitive areas but shall be located in areas of the national park system, natural areas, or national wildlife refuges and game ranges only if the respective agency head determines that off-road use in such locations will not adversely affect their natural, esthetic, or scenic values.

Executive Order 11989 amended Executive Order 11644 as follows:

> Section 1. Clause (B) of Section 2 (3) of Executive Order No. 11644, setting forth an exclusion from the definition of off-road vehicles, is amended to read "(B) any fire, military, emergency or law enforcement vehicle when used for emergency purposes, and any combat or combat support vehicle when used for national defense purposes, and".
>
> Sec. 2. Add the following new Section to Executive Order No. 11644:
>
> "Sec. 9. Special Protection of the Public lands.
>
> (a) Notwithstanding the provisions of Section 3 of this Order; the respective-agency-head shall, whenever he determines that the-use of off-road vehicles will cause or is causing considerable adverse effects on the soil, vegetation, wildlife, wildlife habitat or cultural or historic resources of particular areas or trails of the public lands immediately close such areas or trails to the type of off-road vehicle causing such effects, until such time as he determines that such adverse effects have been eliminated and that measures have been implemented to prevent future recurrence."
>
> (b) Each respective agency head is authorized to adopt the policy that portions of the public lands within his jurisdiction shall be closed to use by off-road vehicles except those areas or trails which are suitable and specifically designated as open to such use pursuant to Section 3 of this order."

Code of Federal Regulations, Title 36, Section 4.10: Travel on Park Roads and Designated Routes

This CFR section states, "Operating a motor vehicle is prohibited except on park roads, in parking areas and on routes and areas designated for off-road motor vehicle use." Additionally, routes and areas designated for off-road use shall be promulgated as special regulations, with designations complying with Executive Order 11644 and 36 CFR 4.10. Routes and areas may be designated only in national recreation areas, national seashores, national lakeshores, and national preserves. This plan/DEIS and possible special regulation will be in compliance with 36 CFR 4.10.

National Parks Omnibus Management Act of 1998

Both the National Parks Omnibus Management Act of 1998 (16 USC 5901 et seq.) and NEPA are fundamental to NPS park management decisions. Both acts provide direction for articulating and connecting the ultimate resource management decision to the analysis of impacts, using appropriate technical and scientific information. Both also recognize that such data may not be readily available and provide options for resource impact analysis in this case.

NPS Organic Act, as Amended

By enacting the Organic Act of 1916, Congress directed the U.S. Department of the Interior and NPS to manage units of the national park system "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1). The 1978 Redwood Amendment (see below) reiterates this mandate by stating that NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC 1 a-1). Congress intended the language of the Redwood Amendment to reiterate the provisions of the Organic Act, not to create a substantively different management

standard. The House Committee report described the Redwood Amendment as a "declaration by Congress" that the promotion and regulation of the national park system is to be consistent with the Organic Act. The Senate Committee report stated that under the Redwood Amendment, "The Secretary has an absolute duty, which is not to be compromised, to fulfill the mandate of the 1916 Act to take whatever actions and seek whatever relief as will safeguard the units of the national park system." Although the Organic Act and the Redwood Amendment use different wording ("unimpaired" and "derogation") to describe what NPS must avoid, both acts define a single standard for the management of the national park system—not two different standards. For simplicity, NPS *Management Policies 2006* uses "impairment," not both statutory phrases, to refer to that single standard.

Despite these mandates, the Organic Act and its amendments afford NPS latitude when making resource decisions to allow appropriate visitor use while preserving resources. By these acts Congress "empowered [NPS] with the authority to determine what uses of park resources are proper and what proportion of the park's resources are available for each use" (Bicycle Trails Council of Marin v. Babbitt, 82 F.3d 1445, 1453 [9th Cir. 1996]).

Pursuant to the NPS Guidance for Non-Impairment Determinations and NPS NEPA Process (NPS 2011e), a non-impairment determination for the selected alternative will be appended to the Record of Decision (ROD).

Redwood National Park Expansion Act of 1978, as Amended

Reasserting the system-wide standard of protection established by Congress in the original Organic Act, the Redwood Amendment stated:

> The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress (PL 95-250, 16 USC 1a-1).

National Environmental Policy Act of 1969, as Amended

NEPA is implemented through regulations of the CEQ (40 CFR 1500–1508). NPS has in turn adopted procedures to comply with NEPA and the CEQ regulations, as found in Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making, (NPS 2011a) and its accompanying handbook (NPS 2001). Section 102 (2)(C) of NEPA requires that an EIS be prepared for proposed major federal actions that may significantly affect the quality of the human environment.

National Historic Preservation Act of 1966, as Amended

Section 106 of this act requires federal agencies to consider the effects of their undertakings on properties listed or potentially eligible for listing in the National Register of Historic Places. All actions affecting Glen Canyon's historic, archeological, and cultural resources must comply with this legislation.

NPS *Management Policies 2006*

NPS *Management Policies 2006* addresses management of ORVs in Section 8.2.3.1, "Motorized Off-road Vehicle Use." This section (NPS 2006a, 104) states:

> Off-road motor vehicle use in national park units is governed by Executive Order 11644 (Use of Off-road Vehicles on the Public Lands, as amended by Executive Order 11989), which defines off-road vehicles as "any motorized vehicle designed for or capable of cross-country travel on or immediately over, land, water, sand, snow, ice, marsh, swampland, or other natural terrain"

(except any registered motorboat or any vehicle used for emergency purposes). Unless otherwise provided by statute, any time there is a proposal to allow a motor vehicle meeting this description to be used in a park, the provisions of the executive order must be applied.

In accordance with 36 CFR 4.10(b), routes and areas may be designated only in national recreation areas, national seashores, national lakeshores, and national preserves, and only by special regulation. In accordance with the executive order, they may be allowed only in locations where there will be no adverse impacts on the area's natural, cultural, scenic, and esthetic values, and in consideration of other existing or proposed recreational uses. The criteria for new uses, appropriate uses, and unacceptable impacts listed in Sections 8.1 and 8.2 must also be applied to determine whether off-road vehicle use may be allowed. As required by the executive order and the Organic Act, superintendents must immediately close a designated off-road vehicle route whenever the use is causing or will cause unacceptable impacts on the soil, vegetation, wildlife, wildlife habitat, or cultural and historic resources.

NPS administrative off-road motor vehicle use will be limited to what is necessary to manage the public use of designated off-road vehicle routes and areas; to conduct emergency operations; and to accomplish essential maintenance, construction, and resource protection activities that cannot be accomplished reasonably by other means.

Management policies relating to resource protection and wilderness management were considered in developing this plan/DEIS. Section 4.4.2.3 also applies, which requires protection for federal listed species and state listed species to the extent possible.

Endangered Species Act of 1973, as Amended

This act requires all federal agencies to consult with the Secretary of the Interior on all projects and proposals with the potential to impact federally endangered or threatened plants and animals. It also requires federal agencies to use their authority in furtherance of the purposes of the Endangered Species Act by carrying out programs for the conservation of endangered and threatened species. Federal agencies are also responsible for ensuring that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat.

Executive Order 13112, Invasive Species

This executive order requires NPS to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

Migratory birds are of great ecological and economic value to this country and to other countries. They contribute to biological diversity and bring tremendous enjoyment to millions of people who study, watch, feed, or hunt these birds throughout the United States and other countries. The United States has recognized the critical importance of this shared resource by ratifying international, bilateral conventions for the conservation of migratory birds. Such conventions include the Convention for the Protection of Migratory Birds—Great Britain on behalf of Canada 1916, the Convention for the Protection of Migratory Birds and Game Mammals—Mexico 1936, the Convention for the Protection of Birds and Their Environment—Japan 1972, and the Convention for the Conservation of Migratory Birds and Their Environment—Union of Soviet Socialist Republics 1978. These migratory bird

conventions impose substantive obligations on the United States for the conservation of migratory birds and their habitats, and through the Migratory Bird Treaty Act, the United States has implemented these migratory bird conventions with respect to the United States. This executive order directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act.

NPS Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making and Handbook

Director's Order 12 (NPS 2011a) and its accompanying handbook (NPS 2001) lay the groundwork for how NPS complies with NEPA. Director's Order 12 and handbook set forth a planning process for incorporating scientific and technical information and establishing a solid administrative record for NPS projects. Director's Order 12 requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

Director's Order 28: Cultural Resource Management

Director's Order 28 sets forth the guidelines for management of cultural resources, including cultural landscapes, archeological resources, historic and prehistoric structures, museum objects, and ethnographic resources. This order calls for NPS to protect and manage cultural resources in its custody through effective research, planning, and stewardship in accordance with the policies and principles contained in NPS *Management Policies 2006*.

Director's Order 77: Natural Resource Protection

Director's Order 77 (NPS 1991a) addresses natural resource protection, with specific guidance provided in Reference Manual 77: Natural Resource Management (NPS 1991b). The reference manual offers comprehensive guidance to NPS employees responsible for managing, conserving, and protecting the natural resources found in national park system units. The reference manual serves as the primary guidance on natural resource management in units of the national park system. Reference manual chapters that are particularly relevant to this plan/DEIS include endangered, threatened, and rare species management; geologic resources management; native animal management; shoreline management; vegetation management; special use permitting; wetland protection (Director's Order 77-1); and floodplain management (Director's Order 77-2).

RELATED PLANS AND POLICIES FOR GLEN CANYON NATIONAL RECREATION AREA

Glen Canyon National Recreation Area General Management Plan (1979)

The GMP for Glen Canyon National Recreation Area was adopted in 1979. The GMP evaluated the enabling legislation and specifically looked at constraints on and obligations for the management and use of Glen Canyon. The GMP identified four management zones and identified management strategies for resource protection and visitor use in these zones. The GMP also identified roads that would remain open for public use and travel. The GMP was completed after extensive public involvement, with an administrative record that includes 827 pages of transcripts and 1,581 written comments received.

Glen Canyon Wilderness Recommendation (1980)

NPS recommended the designation of 588,855 acres within Glen Canyon as wilderness by an act of Congress (NPS 1980). The recommendation was based upon careful studies of the roadless areas, management considerations, the views presented at public hearings, and written responses received on the preliminary environmental assessment on the wilderness study report; the draft environmental statement on the preliminary wilderness proposal and alternatives; and the final environmental statement on the wilderness recommendation and alternatives.

Glen Canyon Development Concept Plans / Environmental Assessments

Environmental Assessment / Development Concept Plan for Lone Rock Beach (1981)

An environmental assessment and management / development concept plan (EA/DCP) was written to provide site-specific guidance for the management of Lone Rock Beach (NPS 1981). The 1981 Environmental Assessment / Development Concept Plan for Lone Rock Beach (Lone Rock EA/DCP) provided management actions and visitor facilities for a more controlled and maintainable type of recreational use of the beach. The Lone Rock EA/DCP also designated a distinct 180-acre ORV high-intensity use area that runs contiguous to the Lone Rock Beach shoreline. This area designated for off-road use is the only location in Glen Canyon where ATVs are allowed to operate. A finding of no significant impact (FONSI) on the EA/DCP was signed on August 31, 1981.

Paiute Farms/San Juan Marina Development Concept Plan Environmental Assessment (1986)

A development concept plan / environmental assessment (DCP/EA) was written to provide site-specific guidance for the development of an interim facility for the San Juan Marina at Paiute Farms while the development of a permanent site was being planned and the feasibility of a permanent road to the site determined (Utah Navajo Industries 1986).

Environmental Assessment and Management / Development Concept Plans for Lake Powell's Accessible Shoreline (1988)

The guiding document for management of Lake Powell's 20 accessible shoreline areas is the Environmental Assessment and Management / Development Concept Plans for Lake Powell's Accessible Shorelines (NPS 1988). The purpose of the EA/DCP was to manage Lake Powell's shorelines to reduce resource degradation, visitor use conflicts, and safety hazards at 20 shoreline sites with road access. A majority of Lake Powell's 1,960 miles of shoreline (at full pool) consist of sandstone cliffs or rockslide areas that are not accessible by road. The 20 shoreline sites that are accessible by road were identified in the Glen Canyon 1979 GMP. The Accessible Shoreline EA/DCP tiered from the GMP to provide site-specific management strategies for the accessible shorelines. Twelve of the 20 accessible shoreline sites were developed to provide for off-road driving. A FONSI on the EA/DCP was signed on November 3, 1988.

The fluctuating levels of Lake Powell have significantly affected use of and access to many shoreline sites currently designated as open to vehicles. As a result, three of the shoreline areas – Warm Creek, Crosby Canyon, and Bullfrog North and South – are currently closed to the public through the Superintendent's Compendium (NPS 2013a).

Antelope Point Marina and Resort Development Concept Plan/Environmental Assessment (2002).

The Antelope Point Marina and Resort DCP/EA (NPS and Navajo Nation 2002) examined the proposed development of the Antelope Point Marina to include under the preferred alternative a floating marina village and boat docks, dry storage for boats, campground and RV park, resort hotel and cultural center, optional employee housing, and supporting infrastructure. The Antelope Holdings, LLC, formerly known as G.M.F. Antelope, LLC, was selected by the Navajo Nation and NPS to develop and operate this resort and marina.

Lees Ferry Area Improvements Final Environmental Assessment/Assessment of Effect (2006)

The environmental assessment/assessment of effect was prepared in response to the need to undertake a variety of tasks designed to improve visitor use and satisfaction at the Lees Ferry Developed Area of Glen Canyon National Recreation Area (NPS 2006d). The action alternative included replacement of a variety of utilities and facilities as well as stabilization of the bridge over the Paria River and the access road to Lonely Dell Ranch and the installation of a radio repeater to improve health and safety of visitors and staff.

Development Concept Plan and Environmental Assessment (2006)

The 2006 Uplake DPC/EA included proposed management action for three areas: Hite, Halls Crossing, and Bullfrog (NPS 2006b; 2006c). The overall purpose of the Uplake DCP was to evaluate a range of alternatives for the future management of the uplake marinas and associated developed areas at Bullfrog, Halls Crossing, and Hite to ensure the protection of Glen Canyon resources and values while offering recreation opportunities as provided for in the Glen Canyon's enabling legislation, purpose, mission, and goals.

Uplake Development Concept Plan / Environmental Assessment (2008)

The 2008 Uplake DCP/EA addressed issues related to the addition and management of floating facilities at Bullfrog and Halls Crossing and the possibility of a primitive type launch ramp at Farley Canyon (NPS 2008e, 2009c). This DCP/EA was an update to the previous Uplake DCP, which was completed in 2006.

Resources Management Plan, Cultural Component, Glen Canyon National Recreation Area (1987)

The Cultural Resources Management Plan (CRMP) (NPS 1987b) provides detailed information on how NPS personnel will carry out the programmatic responsibilities outlined in Director's Order 28. These responsibilities include research to identify, evaluate, and interpret the cultural resources at the recreation area. The CRMP also provides a means to integrate cultural resources management issues into recreation area planning.

Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan / Environmental Assessment (1995/1993)

The Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan (NPS 1995) and the accompanying environmental assessment (NPS 1993) is an interpark management plan developed to increase consistency and protection for visitors to both the Maze District of Canyonlands and the Orange Cliffs in Glen Canyon. The goal of the backcountry management plan is to protect resources, while providing for high-quality visitor experiences. The Orange Cliffs Special Management Unit (Orange Cliffs Unit) of Glen Canyon adjoins Canyonlands National Park, is similar in physiography, and has many of the same management issues as the Canyonlands Maze District.

Orange Cliffs

The backcountry management plan was predicated on the Glen Canyon GMP, which states that the Orange Cliffs Special Management Unit is to be "maintained as a critical backdrop for Canyonlands National Park and as a major vantage point for spectacular views into the park." The Orange Cliffs Unit is managed "to maintain a relatively primitive, undeveloped atmosphere" and to provide "year-round access to Panorama Point" (NPS 1979).

The backcountry management plan will be used to ensure that the alternatives identified in this plan/DEIS are consistent with the backcountry management plan and do not compromise the purpose or significance of the Orange Cliffs Unit of Glen Canyon or the Maze District of Canyonlands National Park.

Grazing Component of the General Management Plan (1999)

The Grazing Component of the GMP (NPS 1999a) was prepared to further define the grazing resources component of the GMP for Glen Canyon. The plan is composed of several elements: (1) description of the existing resources protection and grazing administration responsibilities of NPS and BLM; (2) an assessment of the current range condition by resource; (3) goals, objectives, and recommendations for grazing practices and management actions; and (4) maximum grazing intensities (utilization) compatible with the purpose of the recreation area. The grazing component was analyzed in an environmental assessment and complied with the GMP. The grazing component fits within the purpose and intent of the enabling legislation for Glen Canyon.

Glen Canyon National Recreation Area, Archeological Resources Protection Plan (2002)

This resources protection plan (NPS 2002b) targets archeological sites including cliff dwellings, granaries, open habitation sites, lithic and ceramic scatters, and rock art panels. All of these site types are prehistoric reflecting Native American occupation of the Glen Canyon area over the last 10,000 years. The plan echoes some of the information found in the CRMP but identifies and outlines programs and procedures directed specifically at the archeological resource base.

Personal Watercraft EIS (2003)

NPS prepared an EIS that evaluated a range of alternatives and strategies for the management of personal watercraft use at Glen Canyon. The goal is to ensure the protection of Glen Canyon resources and values while offering recreational opportunities as provided for in the recreation area's enabling legislation, purpose, mission and goals. Upon completion of this process in accordance with NEPA, NPS took action to adopt special regulations to manage personal watercraft use at Glen Canyon.

OHV Interim Management Plans at Lone Rock Beach and at Accessible Shorelines (2007)

Currently, Glen Canyon has in place interim management plans to continue the management of off-road use at Lone Rock Beach and Lone Rock Beach Play Area(NPS 2007h), and at the accessible shorelines (NPS 2007i), with the exception of Paiute Farms and Nokai Canyon. This new ORV management plan will supersede all prior ORV management plans.

Garfield County General Management Plan Resource Management Section (2007)

Garfield County includes more than 300,000 acres of Glen Canyon within its boundaries. The plan (Garfield County 2007) puts forth the need for collaborative OHV management activities between the county and Glen Canyon to be analyzed and developed including but not limited to use of existing roads and trails, development of an OHV play area in the Bullfrog region, trail head construction, designation of OHV open areas, and necessary law enforcement and educational activities. It is the county's desire to work cooperatively with Glen Canyon to develop a balanced recreation and management plan that considers wilderness, semi-primitive uses, OHV play areas, OHV routing system, semi-developed primitive campgrounds, and shoreline/Lake Powell management. The county also desires to jointly develop with Glen Canyon a methodology for managing OHV use and the criteria for designating and managing routes for OHV travel and OHV open areas.

San Juan County Travel Plan (2013)

The Travel Plan is incorporated as part of San Juan County's Master Plan. Motorized travel on roads in the County is critical to San Juan County's economy and the livelihood of County residents. The Travel Plan outlines roads and trails that provide a myriad of recreational opportunities to those who live in and visit the County.

Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road (2012)

The Programmatic EA for Special Recreation Permits for Organized Use along Hole-in-the-Rock Road was prepared by the BLM and NPS to consider increasing the maximum group size for noncommercial educational and heritage-focused groups on the Hole in the Rock Road within the Grand Staircase Escalante National Monument and Glen Canyon. NPS signed a FONSI and Determination of No Impairment on April 6, 2012 to adopt the selected action as described in the final Hole-in-the-Rock EA. The Hole-in-the-Rock EA analyzed the effects of large organized group activities along the Hole-in-the-Rock Road on national park resources and values within Glen Canyon. The EA also analyzed environmental effects of such activities on the natural and cultural resources within Grand Staircase Escalante National Monument. The FONSI approves group use limits up to 145 people at one time with a maximum of 29 vehicles. The maximum length of stay is 3 days / 2 nights (groups) and 12 days (equestrian and reenactments). No more than one NPS permit would be issued at a time to minimize the potential for user conflicts and resource damage. No permits would be issued during the Memorial Day, July 4, and Labor Day holiday weekends.

SUPERINTENDENT'S COMPENDIUM (2013)

Under the provisions of 16 USC, Section 3 and 36 CFR 1, the compendium designates closures, permit requirements, and other restrictions imposed under the discretionary authority of the Superintendent for Glen Canyon National Recreation Area (NPS 2013a). Regulations listed in the compendium are a requirement in addition to those listed in Parts 1-7 of Title 36 unless otherwise noted. In addition to the compendium regulations, written determinations, which explain the reasoning behind the superintendent's use of discretionary authority, are required by 36 CFR 1.5 (c) and appear in the document as italicized print or are available for review in the Chief Ranger's Office. Regulations in the Compendium that are related to off-road use define areas where ORVs may be used, and provide the authority for area closures. These regulations include the following:

- Section 1.5: Closures and public use limits.
- Section 1.6(f): Activities requiring a permit.
- Section 2.10 (a): Camping conditions and permits.
- Section 4: Vehicles and traffic safety.

Chapter 2 Alternatives

CHAPTER 2: ALTERNATIVES

INTRODUCTION

This chapter describes the actions that the National Park Service (NPS) may implement to manage off-road use and on-road off-highway vehicle (OHV) and street-legal all-terrain vehicle (ATV) use on general management plan (GMP) roads in Glen Canyon National Recreation Area (Glen Canyon). Off-road use is evaluated and described under four geographic components: Lone Rock Beach, Lone Rock Beach Play Area, accessible shoreline areas, and the Ferry Swale area. A fifth geographic component, Glen Canyon GMP roads (paved and unpaved), addresses on-road OHV and street-legal ATV use. This chapter presents the proposed alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options.

The Council on Environmental Quality (CEQ) requires NPS to "rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated" (40 CFR 1502.14[a]). According to the CEQ, a reasonable alternative is one that is technically and economically feasible and shows evidence of common sense. The alternative must also meet project objectives to a large degree and resolve the project need.

The CEQ requires that the alternatives under consideration include a no-action alternative (40 CFR 1502.14[d]). The no-action alternative "sets a baseline of existing impact continued into the future against which to compare impacts of action alternatives" (NPS 2011a, section 2.7). The no-action alternative would be a continuation of existing management practices and assumes that no new management actions would be implemented beyond those available when the ORV management planning process started. NPS is also required to identify its "preferred alternative" if one exists (40 CFR 1502.14). Further, NPS is required to identify the "environmentally preferable alternative," which is the alternative that best protects the biological and physical environment and best protects, preserves, and enhances historic, cultural, and natural resources.

Alternatives initially identified by the interdisciplinary team (IDT) or the public which failed to meet these criteria were dismissed from further evaluation (see "Alternatives Eliminated from Further Consideration" later in this chapter for the explanations of dismissal). This chapter presents a no-action alternative and four action alternatives.

***Conventional Motor Vehicle**: A motor vehicle designed primarily for use and operation on streets and highways and is licensed and registered for interstate travel but can be used off-road.*

***Off-road Vehicle (ORV)**: NPS defines ORVs broadly as a motorized vehicle (conventional or nonconventional) designed for or capable of cross-country travel on or immediately over natural terrain.*

***OHV**: State law defines these as a nonconventional motor vehicle designed primarily for off-road use.*

***Street-legal ATV**: An ATV that qualifies under the state's motor vehicle and traffic code to be operated on state roads and highways.*

ALTERNATIVES DEVELOPMENT PROCESS

NPS began the process of developing alternatives in the summer of 2007. NPS conducted internal scoping with Glen Canyon employees to identify issues and constraints on the planning process. Then in September 2007 NPS conducted public scoping to seek input on the planning process and issues related to off-road use and on-road OHV and street-legal ATV use at Glen Canyon.

In the fall of 2010, Glen Canyon released a range of preliminary alternatives for this Off-road Vehicle Management Plan / Draft Environmental Impact Statement (plan/DEIS) for public review and comment. The preliminary alternatives, which were developed in part with the input received during the 2007 public scoping period (including three public scoping meetings), were presented in a brochure that was available locally at public meetings, and on the NPS planning website (http://parkplanning.nps.gov/glca). NPS invited the public to submit comments from October 18, 2010, through November 30, 2010, on the scope of the planning process and the elements of the preliminary alternatives. NPS met with a number of cooperating agencies, including the adjacent counties and the Bureau of Land Management (BLM), throughout the process. Additionally, NPS continued to work with neighboring Tribes to address off-road use issues and concerns with these governments. The alternatives presented in this chapter include changes made as a result of the public and internal scoping process.

ELEMENTS COMMON TO ALL ALTERNATIVES

The following management actions are common to all alternatives, including the no-action alternative. NPS will implement these actions upon adoption of the final Record of Decision (ROD) regardless of which alternative is selected.

CLARIFICATION OF THE MANAGEMENT OF GLEN CANYON LANDS BELOW LAKE POWELL FULL POOL

Comments received during internal and public scoping for this plan/DEIS reflected general confusion regarding the status of Glen Canyon lands “below full pool” of Lake Powell. Succinctly stated, the shoreline area below full pool is not open to off-road use by any vehicle unless designated for off-road use. For the purposes of the NPS prohibition against off-road use, there is no distinction between NPS-managed lands above or below full pool.

As it relates to off-road use, the shoreline of Lake Powell, regardless of lake elevation, is managed under the same laws, policies, and management plans as those lands that exist above the normal high water mark, or full pool, of Lake Powell. As described in chapter 3 under the heading “Management Zoning,” full pool for Lake Powell is the 3,700-foot elevation contour. The management zones established by the Glen Canyon GMP (NPS 1979) are coincident with the fluctuating water levels of Lake Powell. As Lake Powell drops in elevation, the lands exposed by the receding waters are subject to the same environmental protections and public use regulations as those lands above the high water mark.

Off-road use in all alternatives would be restricted to designated ORV routes and areas. Driving along the shoreline of Lake Powell, including below full pool, would be prohibited outside any designated ORV area. Driving along washes or streambeds below full pool to the lakeshore would be prohibited.

Conventional Motor Vehicle Operator Requirements

In addition to NPS traffic regulations, operators of conventional motor vehicles at Glen Canyon are responsible for complying with all applicable statutes and regulations.

NPS adopts non-conflicting state traffic and vehicle laws for the management of motor vehicles. This action is authorized under 36 CFR 4.2, "State law applicable," which states, "Unless specifically addressed by regulation in this chapter, traffic and the use of vehicles within a park are governed by State law. State law that is now or may later be in effect is adopted and made a part of the regulations in this part." All GMP roads (paved and unpaved) at Glen Canyon are open to travel by conventional motor vehicles. Any future change to state law that may affect motor vehicle operation and use at Glen Canyon would be reviewed by NPS for conformity with this plan/DEIS. NPS maintains the authority to alter or adopt additional motor vehicle use rules and requirements as needed for the maintenance of public health and safety, the protection of environmental or scenic values, the protection of natural or cultural resources, the furtherance of scientific research, the implementation of management responsibilities, the equitable allocation and use of facilities, or the avoidance of conflict between visitor use activities.

Use Area Rules

All rules applicable to public use, recreation, and travel at Glen Canyon would remain in effect. These include, but are not limited to, the following types of rules:

- Those pertaining to designated roads, posted speed limits, operating hours, quiet hours, fees, zebra mussel decontamination, pack-it-in/pack-it-out litter management, human waste management, and prohibitions against collection and defacing/damaging resources.
- Other area use rules and regulations found in the Superintendent's Compendium (NPS 2013a), the Code of Federal Regulations (CFR), and any other statute, document, policy, or plan that provides for the use and regulation of national park system units.

Under all alternatives, the Glen Canyon superintendent may take action as warranted under 36 CFR 1.5 to impose public use limits, place limits or restrictions on activities, or close areas, if the action is necessary for the maintenance of public health and safety, the protection of environmental or scenic values, the protection of natural or cultural resources, the furtherance of scientific research, the implementation of management responsibilities, the equitable allocation and use of facilities, or the avoidance of conflict between visitor use activities. These public use limits or closures are compiled annually in a Superintendent's Compendium.

Administrative Uses and Other Authorized Uses

Administrative uses at Glen Canyon would continue, including use by government officials. NPS off-road use outside of public access areas or NPS operation areas is infrequent. Other users such as lease holders, permit holders, or any other individual with authority from NPS to operate at Glen Canyon may continue these uses.

ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (ALTERNATIVES B, C, D, AND E)

The following management actions are common to all action alternatives. NPS would implement these actions upon adoption of the final ROD and subsequent regulation if one of the four action alternatives were selected.

Designation of Roads Open to OHV and Street-Legal ATV Use

Alternatives B, C, D, and E identify GMP roads as either open or closed to on-road OHV and street-legal ATV use. OHVs and street-legal ATVs are prohibited on any GMP road identified as closed under the given alternative regardless of local county ordinances or state law. To understand which GMP roads are open for OHV and street-legal ATV use, see figures 5, 6, 8, and 9, later in this chapter. Generally, state OHV equipment and vehicle requirements apply to OHV and street-legal ATV use on paved and unpaved GMP roads (see the "Motor Vehicle Operator and Equipment Requirements" section later in this chapter).

All designated areas for off-road use, including proposed ORV routes under alternatives A, C, and E, and GMP roads open to OHV and street-legal ATV use would be designated and posted with appropriate signs that include use rules and regulations.

Roads in Glen Canyon would be designated and posted with road numbers. Signs would indicate the status of a road segment as open or closed to OHV and street-legal ATV use and signs would delineate the designated travel routes. Signs indicating that off-road use is prohibited would remain in place or would be posted as needed.

Communications Strategy

A noteworthy problem identified during scoping was the lack of clear guidance regarding regulations governing recreational off-road use and on-road OHV and street-legal ATV use in Glen Canyon. The multiple government jurisdictions, the transboundary nature of roads, and the lack of active management from NPS has resulted in confusion about which regulations apply throughout Glen Canyon. To address this confusion, a communications strategy would be developed that would include the following features:

- The Glen Canyon website would provide information about the ORV Management Plan. The site would include detailed information regarding the authorized activities or prohibited use implemented under the selected alternative.
- Glen Canyon would produce an informational brochure describing the ORV Management Plan. The brochure would be provided to the public.
- NPS interpretive and law enforcement staff would be informed and equipped to answer visitor questions and concerns regarding the ORV Management Plan.
- NPS would develop partnerships with Tread Lightly!, off-roading groups, and other appropriate entities in the community to improve communications, distribute information, and develop community awareness regarding on- and off-road ATV and OHV use and the stewardship of Glen Canyon's resources and values.

Motor Vehicle Operator and Equipment Requirements

All motor vehicle use must comply with state motor vehicle and operator requirements. Operators of conventional motor vehicles, OHVs, and street-legal ATVs are responsible for complying with all applicable Utah and Arizona statutes and regulations pertaining to the lawful operation of motor vehicles in Glen Canyon.

Table 1 lists OHV[2, 3] operator (see clarification of ORV and OHV in chapter 1) and vehicle requirements for Arizona and Utah. These requirements are subject to change and may not be inclusive of all requirements.

TABLE 1: OFF-HIGHWAY VEHICLE OPERATOR AND EQUIPMENT REQUIREMENTS (2011) FOR UTAH AND ARIZONA

REQUIREMENT	UTAH	ARIZONA
Registration/ decal	All OHVs must be registered.	OHV decal required (see exceptions).
Age restrictions	Operators age 8–15 must obtain an education certificate. Operators age 16 and older must have a valid driver's license or education certificate. All children under the age of 18 must be under the direct supervision of an adult 18 years or older. Other requirements apply.	
Helmets	Operators and passengers under 18 years of age must have a helmet with a Department of Transportation (DOT)–approved safety rating.	Operators and passengers under 18 years of age must have a helmet with a DOT-approved safety rating.
Brakes	Brakes must be sufficient to stop and hold the machine.	Brakes must be sufficient to stop and hold the machine.
Headlights and taillights	A headlight and taillight are required when the vehicle is being operated between sunset and sunrise.	Lighted head and taillights are required if the vehicle is operated between one half-hour after sunset and one half-hour before sunrise. Brake light and at least one red rear reflector are required if the taillight does not reflect.
Flags	Flags are required in certain situations.* See regulations.	Flags are required in certain areas. See regulations.
Mufflers / spark arresters	Both a muffler and a spark arrester are required.	A muffler or noise dissipative device that prevents sound above 96 decibels is required. A U.S. Department of Agriculture–approved spark arrester is required.
Eye protection		Eye protection is required for operators of vehicles not equipped with windshields.
License plate		The license plate is required to be securely fastened to the rear of the OHV and clearly visible.
Seat and footrest		The vehicle must have a seat and footrest for the operator as well as for passengers if the vehicle is designed to carry passengers.
Mirrors		A rearview mirror is required.

*Required for Lone Rock Beach Play Area under alternatives C and E.

[2] Utah definition of OHV is any snowmobile, all-terrain Type I vehicle, all-terrain Type II vehicle, or motorcycle (Utah State Parks and Recreation n.d.)

[3] Arizona definition of OHV is any vehicle operated on unimproved roads, trails and approved use areas not suitable for conventional two-wheel-drive vehicular travel. Examples include ATVs, trail motorcycles and dirt bikes. It does not apply to pickup trucks, SUVs, cars, and other recreational vehicles (RVs) (Arizona n.d.).

Under Utah state law, no one under the age of 8 is allowed to operate any OHV on public lands, roads, or trails. Operators ages 8 through 15 may drive an OHV provided that they possess an education certificate issued by Utah State Parks and Recreation or the equivalent from their home state. Resident operators aged 16 years or older may operate an OHV if they possess either a valid driver's license or an approved OHV education certificate. Education certificates are issued to anyone aged 8 years or older who completes the Utah State Parks and Recreation's "Know Before You GO!" OHV education course.

Closing Undesignated Off-road Vehicle Routes and Restoring Them to Natural Conditions

Under all action alternatives, NPS would close areas not designated for off-road use. NPS may use a number of different techniques to close and restore areas where unauthorized off-road use has occurred. These techniques include using signs, boulders, or other physical barriers and reestablishing native vegetation in these areas where appropriate.

MEASURES TO MONITOR, AVOID, MINIMIZE, OR MITIGATE OFF-ROAD VEHICLE IMPACTS UNDER ALTERNATIVES C, D, AND E

NPS developed the following management and mitigation strategies to address the impacts that may occur from the implementation of alternatives C, D, and E, which would allow off-road use as proposed in this plan/DEIS. The objectives are to improve site design and control, reduce incidents of disturbance to lands, restore disturbed areas, track findings and accomplishments, and increase public awareness of the environmental impacts related to off-road use.

The IDT developed a preliminary set of indicators (table 2) for each resource or value analyzed in this plan/DEIS. The indicators were selected by consulting scientific literature, conducting research, and applying guidance from management documents and NPS policies, including Executive Order 11644.

Monitoring and Mitigation

Monitoring procedures would be developed to identify resource impacts, assess and document the extent of disturbance, and mitigate impacts or restore areas affected by off-road use and disturbance. NPS would monitor potential indicators to determine whether to take additional management actions.

Monitoring techniques would include staff observations and documentation of potential indicators described above. Some indicators, such as the presence of social routes (tracks outside ORV routes and areas and off of designated roads) and expansion of areas designated for off-road use may be monitored periodically by aerial photography. Glen Canyon staff would regularly monitor the number of motor vehicle accidents, vandalism, and other compliance issues resulting from off-road use and on-road OHV and street-legal ATV use.

Table 2: Potential Indicators for Monitoring and Management Actions

Resource or Value	Potential Indicator(s)	What Does It Potentially Indicate / What Is the Cause for Concern?	Potential Management Actions
Soils	Tire tracks outside designated use areas or off-road	Areas designated for off-road use may be poorly defined and identified. Changes in soil structure due to crushing and shearing affect ecological processes and functions, cause erosion, crush burrows and impact ground-dwelling and burrowing animals, affect vegetation, and can lead to increases in invasive plants.	Improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence; restoration of native plants; and closures.
Vegetation (including threatened and endangered vegetation)	Crushing or other damage to native plants	Areas designated for off-road use may be poorly defined or identified. Impacts on plants can lead to losses in productivity, increases in impacts on soils, loss of habitat for wildlife, and increased susceptibility to invasive plants.	Improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence; restoration of native plants; closures; and additional restrictions on vehicle type or other alterations to use.
Safety	Motor vehicle accidents / personal injury	These incidents can indicate unsafe operator behavior and/or unsafe operating conditions or poor site design.	Improved signs and communication/education with partners and users; traffic requirements such as speed limit changes; and additional closures.
Recreation Resources and Visitor Experience	Litter / sanitation / vandalism / evidence of vehicle maintenance / evidence of hazardous materials	These indicate site degradation and ineffective communication of rules or problems with user behavior.	Improved signs and communication/education with partners and users and enhanced NPS presence; and closures.
	Conflict	Conflict indicates crowding, inappropriate forms of use or user behavior, degraded conditions, impacts on soundscapes, or similar issues.	Improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence; and closures.
	Expansion of ORV areas and routes	The expansion of designated ORV routes and areas indicates inappropriate forms of use, poor site design, or problems with user behavior.	Improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence; restoration of native plants; and closures.
	Social routes	The creation of social routes indicates inappropriate user behavior, poor site design, ineffective enforcement, and degradation of resources.	Improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence; restoration of native plants; and closures.
	Air quality and visual impacts	Impacts on air quality and visual resources could indicate increased dust at certain times of the year, such as spring and early summer.	Photographic monitoring using permanent photo points may require changes including closures at certain times of year or certain routes.

Resource or Value	Potential Indicator(s)	What Does It Potentially Indicate / What Is the Cause for Concern?	Potential Management Actions
Cultural Resources	Evidence of site disturbance, vandalism / evidence of visitation to areas near ORV routes and areas where off-road use would be discontinued	Archeological resources are at risk due to inappropriate user behavior, poor site selection, or intentional disturbance of archeological sites.	Monitoring efforts at National Register-eligible sites; reduction of use during particular times of the year and/or at specific locations based on surface conditions; relocation of road segments that are threatening or causing resource damages; improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence; closures; and data recovery. Additional site-specific treatments could include repairs, rehabilitation, or other preservation treatments to historic fabric to stabilize resources that have been damaged or are threatened by damage; and revegetation and drainage control to stabilize the resource-supporting sediment matrix that is damaged or threatened by damage.
Paleontological Resources	Evidence of site disturbance, vandalism / evidence of visitation to areas near ORV routes and areas where off-road use would be discontinued	Paleontological resources are at risk due to inappropriate user behavior, poor site selection, or intentional disturbance of paleontological sites.	Improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence; and inventories, monitoring, and either closing the shoreline and/or removing the artifacts if they are uncovered, depending on the fossil or the type of paleontological site resource.
Invasive Plants	Increase in invasive plants	Increases in invasive plants may indicate disturbance to soils or native vegetation, changes in resource conditions, or transport of seeds by off-road use.	Improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence, restoration of native plants; closures; and additional restrictions on vehicle type or other alterations to use.
Special-status Species	Declines in special-status species through evidence of direct mortality (animals) or declines in abundance (plants)	Declines of special-status species along roads may be linked to increased mortality (direct collisions, dust emissions, etc.), indicating disturbance and impacts caused by increased off-road use.	Develop monitoring plans for species that survey data suggest may be affected; use education, physical barriers, enhanced NPS presence, or closures. Closure or seasonal closure for lambing areas for Desert Bighorn Sheep at Ferry Swale.
Compliance	Number of incidents	Poor compliance may be due to poor site design, selection, monitoring, and/or enforcement.	Improved signs and communication/education with partners and users; physical barriers; enhanced NPS presence; and closures.

Monitoring serves three critical functions. First, monitoring allows Glen Canyon managers to understand whether conditions are stable or changing, what the trends of any change may be, and whether conditions are approaching or exceeding management standards. Second, monitoring allows Glen Canyon managers to assess the effectiveness of current management actions. Third, monitoring provides the data necessary for managers to make informed judgments and take defensible management actions.

Off and on-road vehicle management actions would be implemented if monitoring indicates that off-road use or on-road use is impacting resources, or that trends are negative and resources are at risk. The decision to implement any management action would be based on feedback provided by the monitoring program, consultation with outside experts, the professional judgment of NPS staff and management, and the authorities available to NPS. The management actions that could be employed to reduce, minimize, or mitigate impacts are described in table 2. The management actions may be taken in any order and are not described by preference.

Archeological surveys were conducted to sample the study areas under discussion in this plan/DEIS. After consultation with the State Historic Preservation Office (SHPO), the Tribes, and other interested parties, additional archeological surveys may be conducted if deemed necessary based on the analysis of this data in conjunction with relevant environmental variables. Surveys may be conducted to identify resource areas of traditional importance to the Tribes as deemed necessary following consultation with the Tribes, the SHPO, and other interested parties. Cultural resource identification efforts and mitigation strategies for National Register-eligible sites and landscapes will be stipulated as provisions of a programmatic memorandum of agreement. Consultation concerning the provisions to be incorporated into the programmatic memorandum of agreement is ongoing.

Temporary Closures

Under alternatives C, D, and E, Glen Canyon may temporarily close areas that would be designated open under this plan. These areas would be temporarily closed for resource protection purposes, including cultural and natural resource survey and monitoring. Any temporary closures would be published in the Superintendent's Compendium and would be posted at the closed area.

ALTERNATIVES

The alternatives for managing off-road use and on-road OHV and street-legal ATV use at Glen Canyon are detailed below. Table 3 provides a comparison by alternative for each of the five components.

ALTERNATIVE A: NO ACTION

See figures 3 and 4.

The Department of the Interior regulations implementing National Environmental Policy Act (NEPA) state that there are two interpretations of the term "no-action." First, "no-action" may mean "no change" from a current management direction or level of management intensity (e.g., if no ground-disturbance is currently underway, no action means no ground-disturbance). Second, "no-action" may mean "no project" in cases where a new project is proposed for implementation (43 CFR 46.30). The no-action alternative is developed for two purposes; a no-action alternative may represent the agency's past and current actions or inaction on an issue continued into the future and may serve to set a baseline of existing impacts continued into the future against which to compare the impacts of action alternatives. The no-action alternative presented here meets both of these purposes and represents "no change" from the current level of management direction and level of management intensity (figures 3 and 4).

TABLE 3: ALTERNATIVES OVERVIEW MATRIX

	ALTERNATIVE A: NO ACTION	ALTERNATIVE B: NO OFF-ROAD USE	ALTERNATIVE C: INCREASED MOTORIZED ACCESS	ALTERNATIVE D: DECREASED MOTORIZED ACCESS	ALTERNATIVE E: MIXED USE (NPS PREFERRED ALTERNATIVE)
Highlights	Off-road use would continue at 15 designated ORV areas. Street-legal ATVs would be authorized for use on GMP roads. No OHVs or street-legal ATVs would be allowed within the Orange Cliffs Special Management Unit (Orange Cliffs Unit). Approximately 53 miles of ORV routes would be designated.	No ORV areas would be designated. Street-legal ATVs would be authorized for use on designated GMP roads. No OHVs or street-legal ATVs would be allowed within the Orange Cliffs Unit. No ORV routes would be designated.	Conventional motor vehicles, OHVs, and street-legal ATVs would be authorized for use at 17 designated ORV areas only by permit, subject to water level closures. OHVs and street-legal ATVs would be authorized for use on all GMP roads to include the Orange Cliffs Unit. Fifteen miles of ORV routes would be designated.	Conventional motor vehicles would be authorized for use at five designated ORV areas (Lone Rock Beach, Hite Boat Ramp, Farley Canyon, Dirty Devil, and Stanton Creek), only by permit, subject to water level closures. No OHVs or street-legal ATVs would be authorized for use in Glen Canyon. No ORV routes would be designated.	Conventional motor vehicles and street-legal ATVs would be authorized for use at 16 areas only by permit, subject to water-level closures. A vehicle-free area would be designated at Lone Rock Beach. Street-legal ATVs would be authorized for use on paved GMP roads. OHVs and street-legal ATVs would also be authorized for use on unpaved GMP roads. No OHVs or street-legal ATVs would be authorized for use in the Orange Cliffs Unit. Fifteen miles of ORV routes would be designated.
Lone Rock Beach	Off-road use by conventional motor vehicles, OHVs, and street-legal ATVs would continue. Utah rules regulating OHVs and street-legal ATVs would remain in effect.	Off-road use by all vehicles would be discontinued and the area would be restored to natural conditions.	Same as alternative A, with additional requirement for an ORV permit.	Off-road use by conventional motor vehicles would be authorized only by permit. No OHVs or street-legal ATVs would be allowed.	Same as alternative C except approximately 20 acres of the beach would be designated as a vehicle-free zone (no vehicles of any type would be allowed in this zone).
Lone Rock Beach Play Area	Off-road use by conventional motor vehicles, OHVs, and street-legal ATVs would continue. Utah rules regulating OHVs and street-legal ATVs would remain in effect.	Off-road use by all vehicles would be discontinued and the area would be restored to natural conditions.	Same as alternative A, with additional requirement for an ORV permit and safety flag.	Same as alternative B.	Same as alternative C.

	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Accessible Shoreline Areas	Off-road use by conventional vehicles only would continue at 13 existing areas (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp), subject to water-level closures.	Off-road use at 15 areas (13 existing areas plus Nokai Canyon and Paiute Farms) would be discontinued and these areas would be restored to natural conditions.	Fifteen areas (13 existing areas plus Nokai Canyon and Paiute Farms) would be authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs, only by permit, subject to water-level closures.	Four areas (Dirty Devil, Farley Canyon, Hite Boat Ramp, and Stanton Creek) would be authorized for use only by conventional motor vehicles, only by permit, subject to water-level closures. Off-road use at eleven areas would be discontinued.	Fourteen areas (12 existing areas plus Nokai Canyon and Paiute Farms) would be authorized for use by conventional motor vehicles and street-legal ATVs, only by permit, subject to water-level closures. Off-road use at Warm Creek would be discontinued.
GMP Roads	Street-legal ATVs would be authorized for use on GMP roads in Glen Canyon with the exception of the Orange Cliffs Unit. Conventional motor vehicles are currently and would continue to be authorized on all GMP roads in Glen Canyon, including the Orange Cliffs Unit.	Same as alternative A.	OHVs and street-legal ATVs would be authorized for use on all GMP roads, including the Orange Cliffs Unit. Conventional motor vehicles are currently and would continue to be authorized on all GMP roads in Glen Canyon, including the Orange Cliffs Unit.	OHVs and street-legal ATVs would not be authorized for use on any GMP roads. Conventional motor vehicles are currently and would continue to be authorized on all GMP roads in Glen Canyon, including the Orange Cliffs Unit.	Street-legal ATVs would be authorized for use on paved GMP roads. OHVs and street-legal ATVs would also be authorized on unpaved GMP roads. No OHVs or street-legal ATVs would be authorized on GMP roads in the Orange Cliffs Unit. Conventional motor vehicles are currently and would continue to be authorized on all GMP roads in Glen Canyon, including the Orange Cliffs Unit.
Ferry Swale	Conventional motor vehicles, OHVs, and street-legal ATVs would be authorized for use on approximately 53 miles of designated ORV routes.	No ORV routes would be designated and existing routes would be restored to natural conditions.	Conventional vehicles, OHVs, and street-legal ATVs would be authorized for use on approximately 15 miles of designated ORV routes by permit. Other existing routes would be restored to natural conditions.	Same as alternative B.	Same as alternative C.

In compliance with the settlement agreement reached in Friends of the Earth v. Department of Interior, Glen Canyon developed interim OHV management plans for the accessible shorelines, Lone Rock Beach, and Lone Rock Beach Play Area. The interim OHV plans will remain in effect until the completion of this plan/DEIS. The interim OHV plans serve as the no-action alternative for off-road use at the accessible shorelines and at Lone Rock Beach and Lone Rock Beach Play Area. These plans reflect long-standing off-road use in Glen Canyon and are consistent with recreation area planning documents over previous decades which repeatedly reaffirm and plan for off-road use, including the Proposed General Management Plan (1979), Lone Rock Beach Development Concept Plan and Environmental Assessment (1981), Environmental Assessment and Management/Development Concept Plans for Lake Powell's Accessible Shorelines (1988), Uplake Development Concept Plan and Environmental Assessment (2006), and the 2008 Uplake Development Concept Plan and Environmental Assessment (2008). Therefore, the no-action alternative reflects off-road use at accessible shorelines and the Lone Rock Beach and Lone Rock Beach Play Area that Glen Canyon has planned for in previous NEPA documents. The no-action alternative for Ferry Swale represents current levels of use, which the NPS has allowed, in some cases by posting signage and information about access to that area.

Lone Rock Beach

Under the no-action alternative, current management practices would continue at Lone Rock Beach. Off-road driving at Lone Rock Beach occurred prior to the formal establishment of Glen Canyon in 1972. NPS designated Lone Rock Beach as an ORV area under the 1981 Lone Rock Beach Development Concept Plan and Environmental Assessment (Lone Rock DCP/EA) (NPS 1981).

Lone Rock Beach is currently open to conventional vehicles, OHVs, and street-legal ATVs. Motor vehicle operators must conform to all applicable state licensing, registration, and insurance requirements. The speed limit at Lone Rock Beach is 15 miles per hour (mph).

Lone Rock Beach and the play area (described below) are the only locations in Glen Canyon where the use of OHVs is allowed. Utah's OHV program, currently described in Utah Code Annotated (UCA) 41-22-1 et seq., authorizes riders as young as 8 years of age to participate in recreational OHV[4] use, which includes the use of ATVs, dirt bikes, and similar vehicles. The program includes the following requirements:

- All OHV owners and out-of-state operators must purchase an annual OHV registration fee and display a registration decal.
- No person under 8 years of age is allowed to operate any OHV on public lands in Utah.
- Participants between the ages of 8 and 15 are required to complete an OHV education program sponsored by Utah State Parks.
- Participants 16 years or older may operate an OHV if they possess either a valid driver's license or an OHV education certificate.
- OHVs must have mufflers and approved spark arresters, brakes, and headlights and taillights if operated between sunset and sunrise.
- Individuals under 18 years of age must wear a DOT-approved helmet.

[4] NPS uses the term off-road vehicle (ORV) rather than off-highway vehicle (OHV) in order to be consistent with NPS-specific laws and policies. This paragraph refers to state law.

- Currently, riders who comply with applicable Utah OHV requirements are allowed to operate their OHVs and street-legal ATVs on Lone Rock Beach and in the play area.
- All operators of motor vehicles must obey all traffic laws while on Lone Rock Beach. The current speed limit on Lone Rock Beach is 15 mph.

Lone Rock Beach Play Area

Located on a hill above and to the southwest of Lone Rock Beach is a fence-enclosed 180-acre area that is open to high-intensity motor vehicle use. This area was set aside under the same 1981 Lone Rock DCP/EA that analyzed use at Lone Rock Beach (NPS 1981).

The play area is the only location in Glen Canyon where conventional motor vehicles, OHVs, and street-legal ATVs are allowed to be operated in an unrestricted manner. This area is intended as a place where motor vehicle operators can challenge themselves, develop riding skills, operate at high speeds, perform jumps and hill climbs, and so on. All vehicle operators in the play area must conform to the same requirements as those for Lone Rock Beach. There is no speed limit at the play area.

Accessible Shoreline Areas

Twelve accessible shoreline areas at Glen Canyon are managed under the 1988 Environmental Assessment and Management/Development Concept Plans for Lake Powell's Accessible Shoreline (EA/DCP) (NPS 1988) and one (Hite Boat Ramp) is managed under the 2006 Uplake Development Concept Plan / Environmental Assessment (NPS 2006b). These designated ORV areas are intended to provide public access by conventional motor vehicle to the Lake Powell shoreline for the purposes of recreational use (fishing, swimming, boating, etc.). The public is allowed to depart the road and drive directly to the shoreline and park in designated ORV areas. The ORV areas are not intended to be play areas; climbing hills in vehicles, driving at high speeds, and similar behaviors are prohibited.

These 13 accessible shoreline areas would remain open only to conventional motorized vehicle use (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp), subject to water-level closures. Motor vehicle operators would be required to conform to all applicable state licensing, registration, and insurance requirements. The operation of any OHV or street-legal ATV would be prohibited in the 13 ORV areas.

As described in chapter 3, the designated ORV areas were established at a time when Lake Powell was at or near full pool. When the surface of Lake Powell is at these higher elevations, the designated ORV areas are bounded by natural topographical features, resulting in a confined space. Because the Lake Powell shoreline has fluctuated in recent years, more topography has been exposed at the ORV areas. In some instances the designated ORV area is no longer bounded by natural features. The result is that land beyond the designated ORV area has been exposed to off-road use. These laterally expanded areas would not be open, however, travel perpendicular to the water level would be allowed.

Currently, three ORV areas are temporarily closed through the Superintendent's Compendium: Bullfrog North and South, Crosby Canyon, and Warm Creek. These areas have been closed because low-water conditions have created access to acreage beyond the designated ORV area, but the areas could be reopened if future conditions allowed.

In addition, Paiute Farms and Nokai Canyon are shoreline areas that are currently being accessed by the public, but are not officially open under the 1988 Accessible Shorelines EA/DCP or the 2006 DCP/EA. The no-action alternative would discontinue use of these two areas and management actions taken to prevent access.

Travel on GMP Roads

Conventional motor vehicles would continue to be authorized for operation on all GMP roads (paved and unpaved) in Glen Canyon. In addition, street-legal ATVs would be authorized to operate on all GMP roads in Glen Canyon, including GMP roads in the Ferry Swale area, with the exception of the Orange Cliffs Special Management Unit, subject to the same restrictions and rules as conventional motor vehicles. All GMP roads in the Orange Cliffs Special Management Unit would be closed to OHV and street-legal ATV use. Roads open for conventional motor vehicle and street-legal ATV use are those roads designated in the 1979 Glen Canyon GMP (NPS 1979). The speed limit on unpaved GMP roads is currently 45 mph unless otherwise posted. Speed limit on paved GMP roads is 45 mph but varies between 35 and 65 mph on U.S. Highways and State Routes.

See Arizona Revised Statutes (ARS) 28-1171–1181, "Off-highway Vehicles." for the applicable Arizona motor vehicle and operator requirements. The Utah Statute is described above under "Lone Rock Beach." Additionally, in Utah, Chapter 41-22-30 Utah Annotated Codes governs the use of OHVs on roads, where:

> (2) A person may not operate and an owner may not give that person permission to operate an off-highway vehicle on any public land, trail, street, or highway of this state unless the person:
>
> (a) is under the direct supervision of a certified off-highway vehicle safety instructor during a scheduled safety training course;
>
> (b) (i) has in the person's possession the appropriate safety certificate issued or approved by the division; and
>
> (ii) if under 18 years of age, is under the direct supervision of a person who is at least 18 years of age if operating on a public highway that is:
>
> (A) open to motor vehicles; and
>
> (B) not exclusively reserved for off-highway vehicle use; or
>
> (c) has in the person's immediate possession a valid motor vehicle operator's license, as provided in Title 53, Chapter 3, Uniform Driver License Act.

Direct supervision is defined as oversight at a distance of no more than 300 feet and within which visual contact is maintained and advice and assistance can be given and received.

Ferry Swale

Several GMP roads exist in the Arizona portion of Glen Canyon in an area known as Ferry Swale. These roads connect Glen Canyon to BLM property in the Vermilion Cliffs. Over the years, new routes extending from these GMP roads have been established by users. Some of these routes connect Glen Canyon to existing BLM routes and roads while others do not provide access. Currently there exists approximately 70 miles of unauthorized ORV visitor-created routes, of which approximately 53 miles of user-created routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs under the no-action alternative. GMP roads in Ferry Swale are addressed above in the section "Travel on GMP Roads."

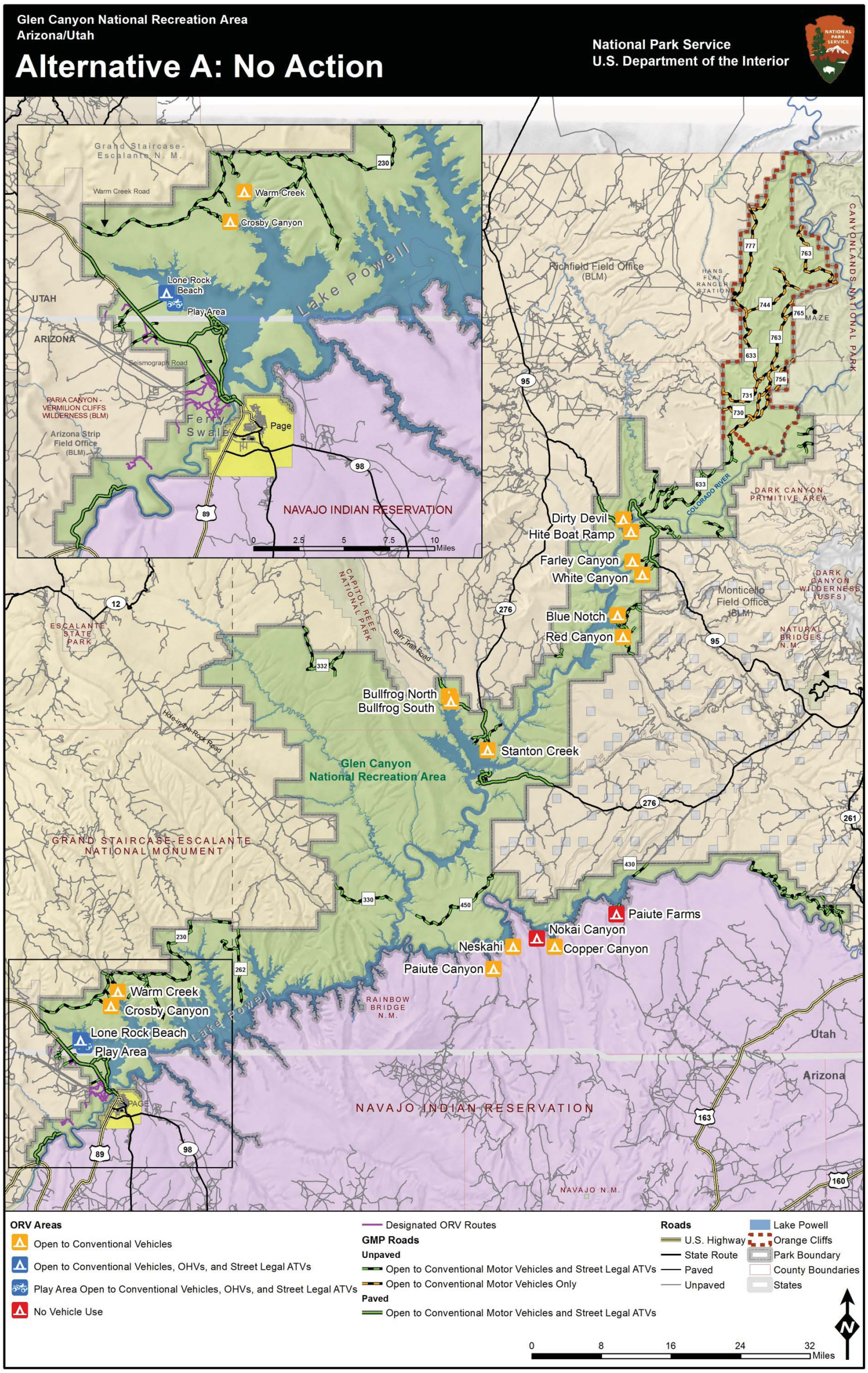


FIGURE 3: ALTERNATIVE A: NO ACTION

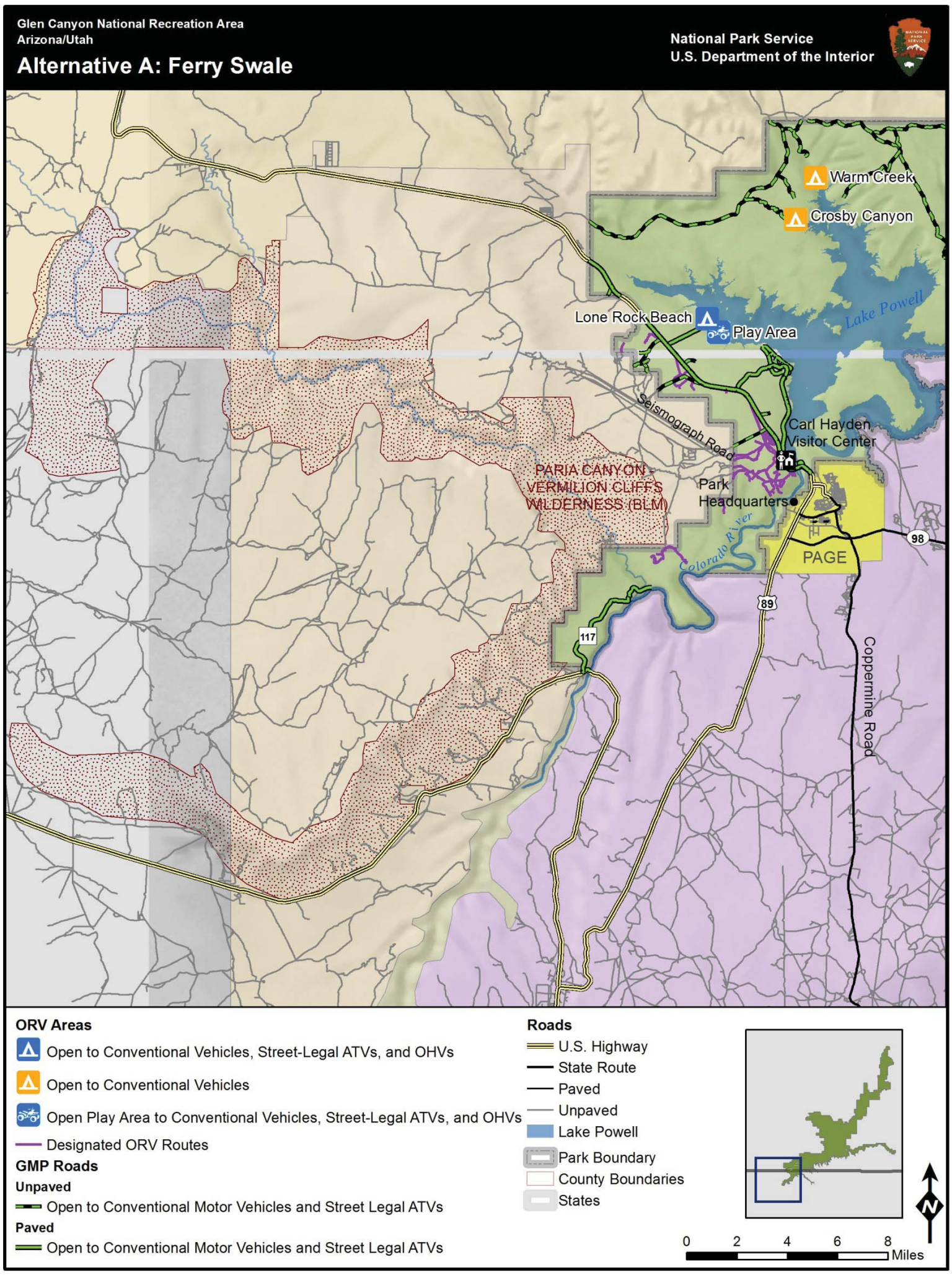


FIGURE 4: DESIGNATED ORV ROUTES IN FERRY SWALE: ALTERNATIVE A

ALTERNATIVE B: NO OFF-ROAD USE

PROJECT COMPONENTS UNDER ALTERNATIVE B

See figure 5.

Lone Rock Beach

Off-road use at Lone Rock Beach would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs and the area restored to natural conditions.

Lone Rock Beach Play Area

Off-road use at the Lone Rock Beach Play Area would be discontinued permanently to conventional motor vehicles, OHVs and street-legal ATVs and the area restored to natural conditions.

Accessible Shoreline Areas

No areas would be designated for off-road use. Off-road use at 13 accessible shoreline areas, in addition to Paiute Farms and Nokai Canyon, would be permanently discontinued and the areas restored to natural conditions.

Travel on GMP Roads

Alternative B would be the same as alternative A. Conventional motor vehicles would continue to be authorized to operation on all GMP roads (paved and unpaved) in Glen Canyon. In addition, street-legal ATVs would be authorized to operate on all GMP roads (paved and unpaved) in Glen Canyon, subject to the same restrictions and rules as conventional motor vehicles. All GMP roads in the Orange Cliffs Special Management Unit would be closed to OHV and street-legal ATV use. The speed limit on unpaved GMP roads would be reduced to 25 mph or as posted. The speed limits on paved GMP roads would not change and would remain as currently posted.

Ferry Swale

No ORV routes would be designated and any existing user-created routes would be restored to natural conditions. Off-road use by any type of motor vehicle in the Ferry Swale area would be illegal. GMP roads in Ferry Swale are addressed above in the section “Travel on GMP Roads.”

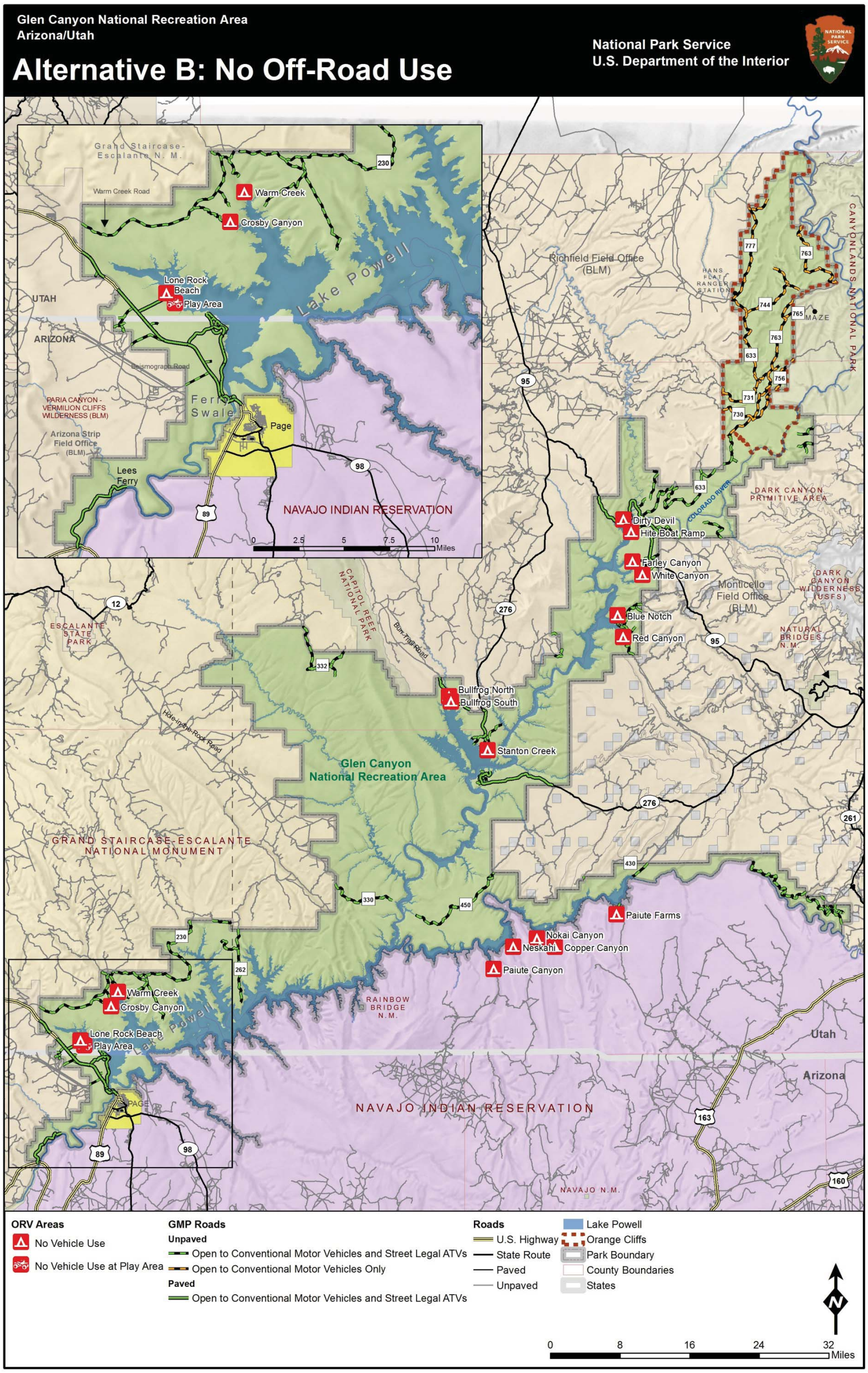


FIGURE 5: ALTERNATIVE B: NO OFF-ROAD USE

ALTERNATIVE C: INCREASED MOTORIZED ACCESS

See figures 6 and 7.

Lone Rock Beach

Alternative C would be the same as alternative A with the addition of a requirement for an ORV permit. Lone Rock Beach would be open to conventional motor vehicles, OHVs, and street-legal ATVs.

All operators of motor vehicles must obey all traffic laws while on Lone Rock Beach. The speed limit on Lone Rock Beach would be 15 mph or as posted. Lone Rock Beach would not be open to beach "cruising": beach users would be allowed to drive to their destination and park for the duration of their stay, but drivers would not be allowed to drive up and down the beach. Motor vehicles may be operated from the operator's camping location to the Lone Rock Beach Play Area only to access the play area. Motor vehicle operators must conform to all applicable state licensing, registration, and insurance requirements.

Lone Rock Beach Play Area

The Lone Rock Beach Play Area would be open for conventional motor vehicles, OHVs, and street legal ATVs to operate in an unrestricted manner, as described under alternative A, with the addition of a requirement for an ORV permit. Additionally, all vehicles operating on the dunes would be required to display a red or orange whip flag at least 8 feet off the ground while being operated. The safety flag may also be attached to the protective headgear of a person operating a motorcycle so that the safety flag is at least 18 inches above the top of the operator's head. For additional information, see Utah OHV regulations (UCA 41-22-1 et seq.).

Accessible Shoreline Areas

Fifteen accessible shoreline areas (13 existing shoreline areas as well as Paiute Farms and Nokai Canyon) would be authorized for use by conventional motor vehicles, OHVs, and street- legal ATVs, only by permit, subject to water-level closures. The speed limit at accessible shoreline areas would be 15 mph or as posted. Quiet hours after 10:00 p.m. would be implemented to prevent excessive noise. Motor vehicle operators would be required to conform to all applicable state licensing, registration, and insurance requirements.

Travel on GMP Roads

Conventional motor vehicles would continue to be authorized to operate on all GMP roads (paved and unpaved) in Glen Canyon. In addition, OHVs and street-legal ATVs would be authorized to operate on all GMP roads, including roads in the Orange Cliffs Special Management Unit. All on-road OHV and street-legal ATV use would be subject to the same restrictions and rules as conventional motor vehicle use. The speed limit on unpaved GMP roads would be 25 mph or as posted. The speed limits on paved GMP roads would not change and would remain as currently posted.

Ferry Swale

In order to facilitate access to adjacent BLM lands and provide connectivity with GMP roads, conventional motor vehicles, OHVs, and street-legal ATVs would be allowed, by permit, to operate on approximately 15 miles of designated ORV routes (see figure 7). Other existing user-created routes would be restored to natural conditions. The speed limit on these routes, for all vehicles, would be 25 mph or as posted. GMP roads in Ferry Swale are addressed above in the section "Travel on GMP Roads."

ORV Fee Permit System

- Permits would be required for off-road use at accessible shoreline areas, Lone Rock Beach, and Lone Rock Beach Play Area, and on designated ORV routes in Ferry Swale.
- A permit system would be implemented as a means to better manage the ORV plan. Requiring all operators desiring to travel off-road in Glen Canyon to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations, safety, and resource protection.
- Permit fees would be used to recover NPS costs for managing areas designated for off-road use. Costs include monitoring, signs, education programs, and partnerships, as well as the administrative costs associated with administering the permits.
- Permits could be revoked for violation of applicable regulations or terms and conditions of the permit.

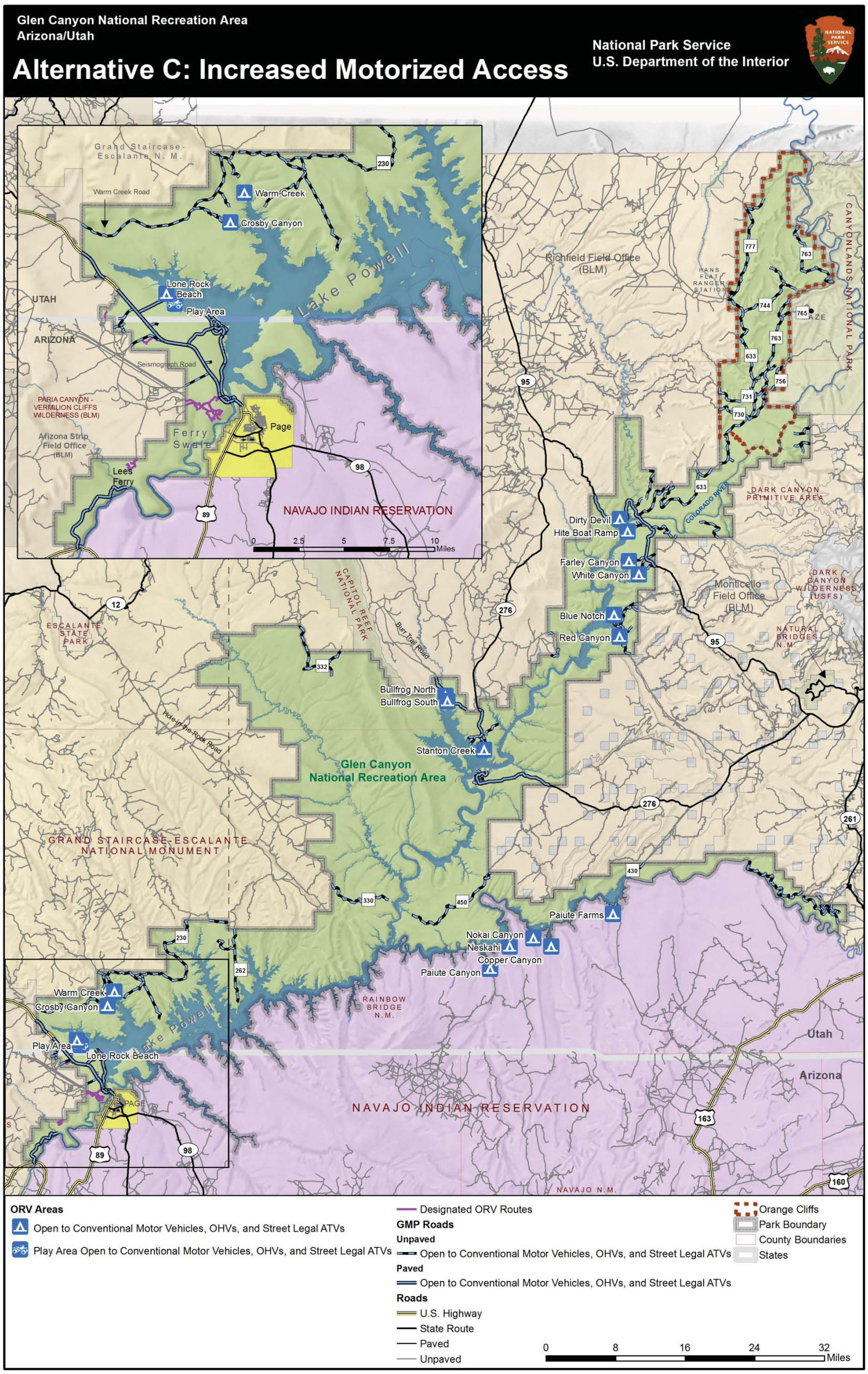


FIGURE 6: ALTERNATIVE C: INCREASED MOTORIZED ACCESS

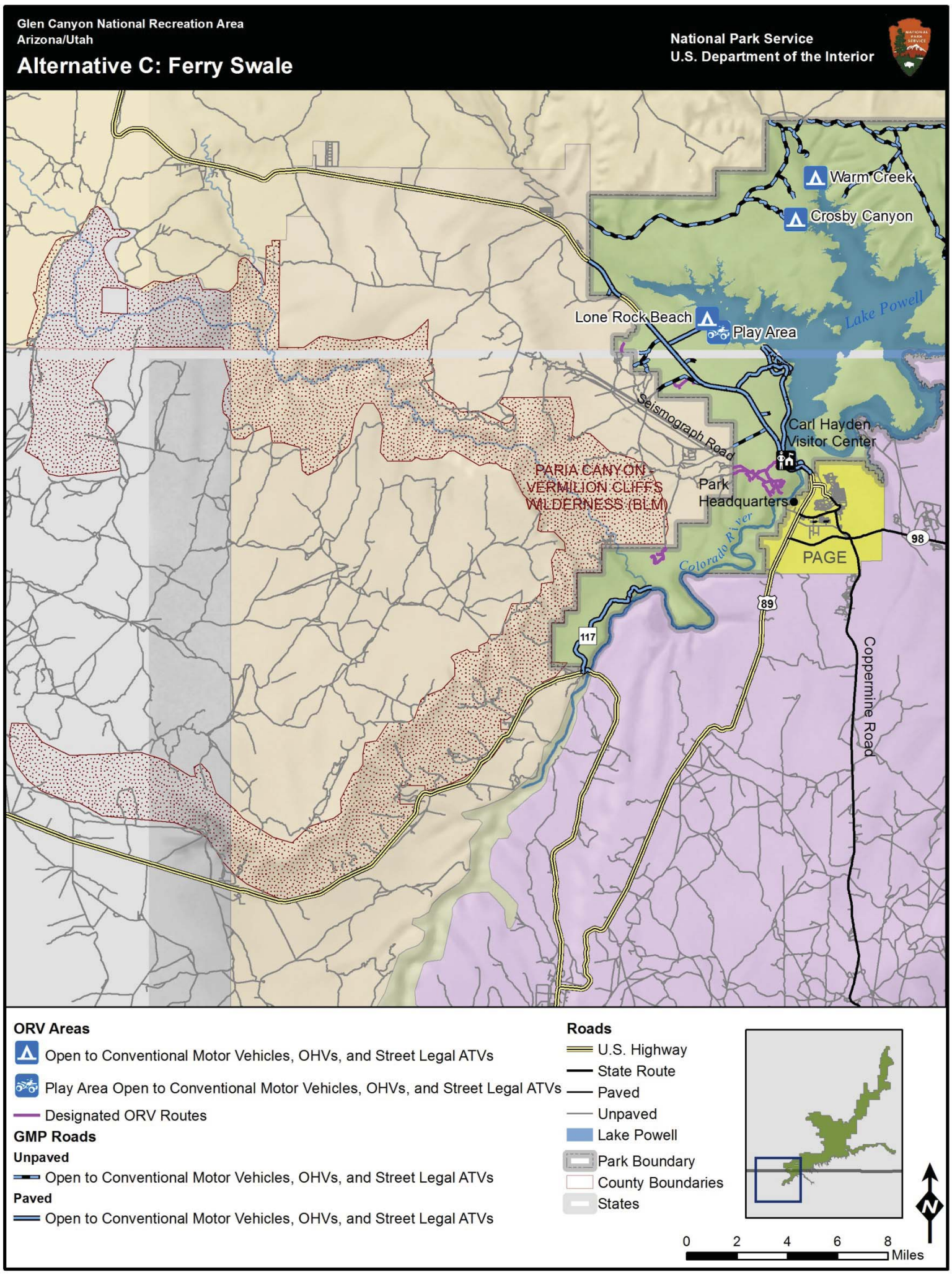


FIGURE 7: DESIGNATED ORV ROUTES IN FERRY SWALE: ALTERNATIVE C

ALTERNATIVE D: DECREASED MOTORIZED ACCESS

See figure 8.

Lone Rock Beach

Lone Rock Beach would remain open by permit to conventional motor vehicles only. All OHV and street-legal ATV use in Lone Rock Beach would be prohibited.

All operators of conventional motor vehicles must obey all traffic laws while on Lone Rock Beach. The speed limit on Lone Rock Beach would be 15 mph or as posted. Motor vehicles may be operated from the operator's camping location to the Lone Rock Beach Play Area only to access the play area. Motor vehicle operators must conform to all applicable state licensing, registration, and insurance requirements.

Lone Rock Beach Play Area

Alternative D would be the same as alternative B. Off-road use at the Lone Rock Beach Play Area would be discontinued and the area would be restored to natural conditions.

Accessible Shoreline Areas

Off-road use at eleven accessible shoreline areas would be permanently discontinued and the areas would be restored to natural conditions. Use of the following shoreline areas would be discontinued to vehicle access under this alternative: Warm Creek, Red Canyon, Neskahi, Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Paiute Canyon, White Canyon, Paiute Farms, and Nokai Canyon. Paiute Farms and Nokai Canyon are shoreline areas that are currently being accessed by the public, but are not officially open under the 1988 Accessible Shorelines DCP/EA. Under alternative D, the closure of Paiute Farms and Nokai Canyon would continue and management action could be taken to prevent access.

Four accessible shoreline areas (Dirty Devil, Farley Canyon, Hite Boat Ramp, and Stanton Creek) would be authorized for use by conventional motor vehicles, only by permit, subject to water-level closures. A speed limit of 15 mph would be implemented at the shoreline areas. Quiet hours after 10:00 p.m. would prevent excessive noise.

Motor vehicle operators would be required to conform to all applicable state licensing, registration, and insurance requirements. The operation of any OHV or street-legal ATV would be prohibited in the four open ORV areas.

Travel on GMP Roads

Only conventional motor vehicles would be authorized to operate on all GMP roads (paved and unpaved) in Glen Canyon. All OHV and street-legal ATV use on all GMP roads would be prohibited.

Ferry Swale

Alternative D would be the same as alternative B. No ORV routes would be designated and use of any existing user-created routes in the Ferry Swale area would be illegal by any type of motor vehicle. GMP roads in Ferry Swale are addressed above in the section "Travel on GMP Roads."

ORV Fee Permit System (Same as Alternative C)

- Permits would be required for off-road use at accessible shoreline areas, Lone Rock Beach, and Lone Rock Beach Play Area, and on designated ORV routes in Ferry Swale.
- A permit system would be implemented as a means to better manage the ORV plan. Requiring all operators desiring to travel off-road in Glen Canyon to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations, safety, and resource protection.
- Permit fees would be used to recover NPS costs for managing areas designated for off-road use. Costs include monitoring, signs, education programs, and partnerships, as well as the administrative costs associated with administering the permits.
- Permits could be revoked for violation of applicable regulations or terms and conditions of the permit.

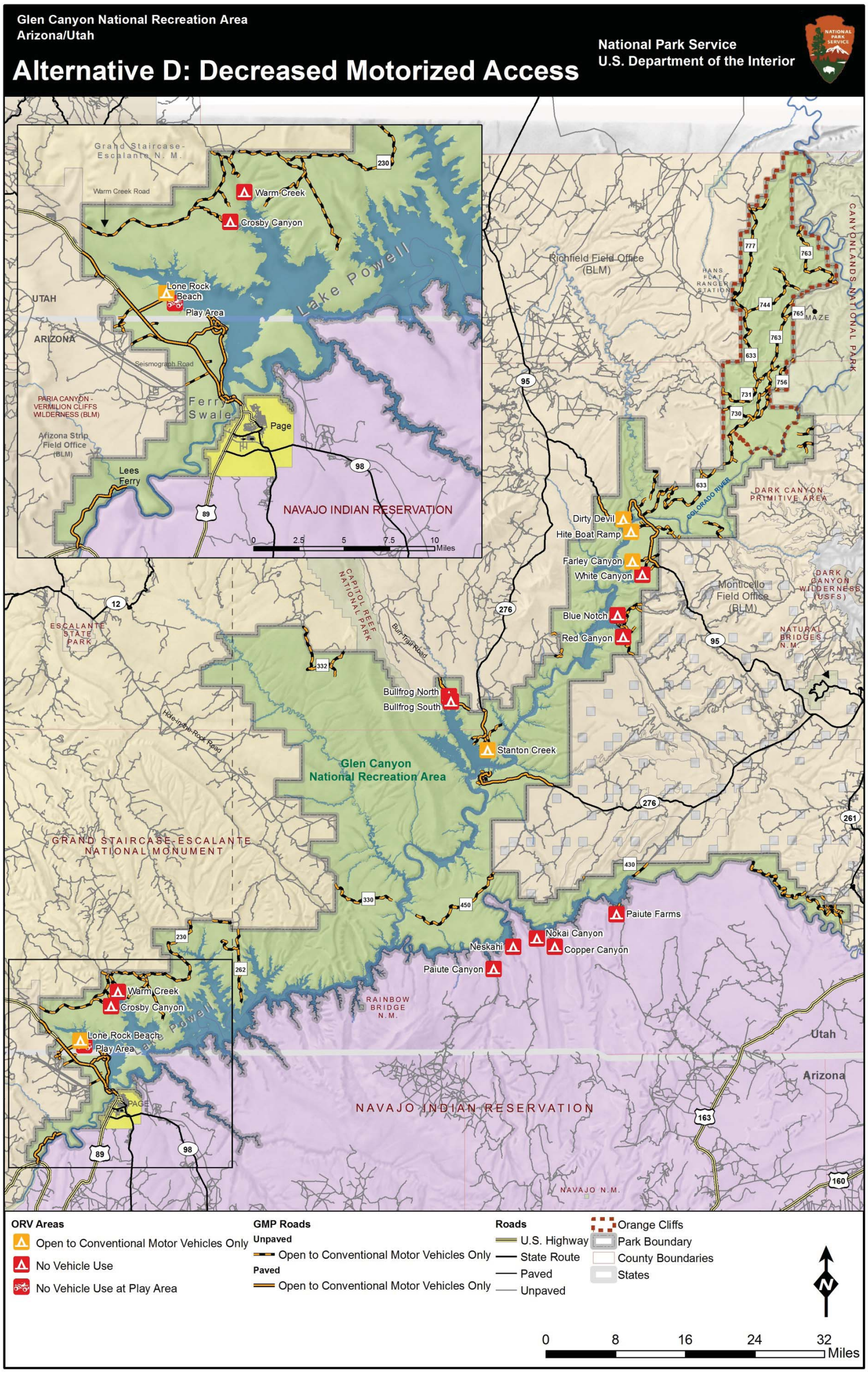


FIGURE 8: ALTERNATIVE D: DECREASED MOTORIZED ACCESS

ALTERNATIVE E: MIXED USE (NPS PREFERRED ALTERNATIVE)

See figures 9 and 10.

Lone Rock Beach

Lone Rock Beach would remain open by permit to conventional motor vehicles, OHVs, and street-legal ATVs. A portion of Lone Rock Beach (approximately 20 acres) would be designated as a vehicle-free zone to provide a unique experience for tent campers who would prefer to be separated from all motor vehicle users.

All operators of motor vehicles must obey all traffic laws while on Lone Rock Beach. The speed limit on Lone Rock Beach would be 15 mph or as posted. Motor vehicle operators must conform to all applicable state licensing, registration, and insurance requirements.

Lone Rock Beach Play Area

Alternative E would be the same as alternative C. Lone Rock Beach Play Area would remain open by permit to conventional motor vehicles, OHVs, and street-legal ATVs. All vehicles operating on the dunes would be required to obtain an ORV permit and display a red or orange whip flag at least 8 feet off the ground while being operated. The safety flag may also be attached to the protective headgear of a person operating a motorcycle so that the safety flag is at least 18 inches above the top of the operator's head. For additional information, see Utah OHV regulations (UCA 41-22-1 et seq.).

Accessible Shoreline Areas

Off-road use at one accessible shoreline area would be discontinued permanently (Warm Creek). Fourteen areas (12 existing areas plus Paiute Farms, and Nokai Canyon) would be authorized for use by conventional motor vehicles and street-legal ATVs, only by permit, subject to water-level closures. The speed limit at accessible shoreline areas would be 15 mph or as posted. Quiet hours after 10:00 p.m. would be implemented to prevent excessive noise. Motor vehicle operators would be required to conform to all applicable state licensing, registration, and insurance requirements.

Travel on GMP Roads

Conventional motor vehicles would continue to be authorized to operation on all GMP roads (paved and unpaved) in Glen Canyon. Street-legal ATVs would be authorized to operate on paved GMP roads in Glen Canyon. OHVs and street-legal ATVs would be authorized on unpaved GMP roads. No OHVs or street-legal ATVs would be authorized on GMP roads in the Orange Cliffs Special Management Unit. All on-road OHV and street-legal ATV use would be subject to the same restrictions and rules as conventional motor vehicle use. The speed limit on unpaved GMP roads would be 25 mph or as posted. The speed limits on paved GMP roads would not change and would remain as currently posted.

Ferry Swale

Alternative E would be the same as alternative C. In order to facilitate access to adjacent BLM lands and provide connectivity with unpaved GMP roads, conventional motor vehicles, OHVs, and street-legal ATVs would be allowed by permit to operate on approximately 15 miles of designated ORV routes (see figure 10, the same as under alternative C). The speed limit on these routes, for all vehicles, would be 25 mph or as posted. GMP roads in Ferry Swale are addressed above in the section "Travel on GMP Roads."

ORV Fee Permit System (Same as Alternative C)

- Permits would be required for off-road use at accessible shoreline areas, Lone Rock Beach, and Lone Rock Beach Play Area, and on designated ORV routes in Ferry Swale.
- A permit system would be implemented as a means to better manage the ORV plan. Requiring all operators desiring to travel off-road in Glen Canyon to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations, safety, and resource protection.
- Permit fees would be used to recover NPS costs for managing areas designated for off-road use. Costs include monitoring, signs, education programs, and partnerships, as well as the administrative costs associated with administering the permits.
- Permits could be revoked for violation of applicable regulations or terms and conditions of the permit.

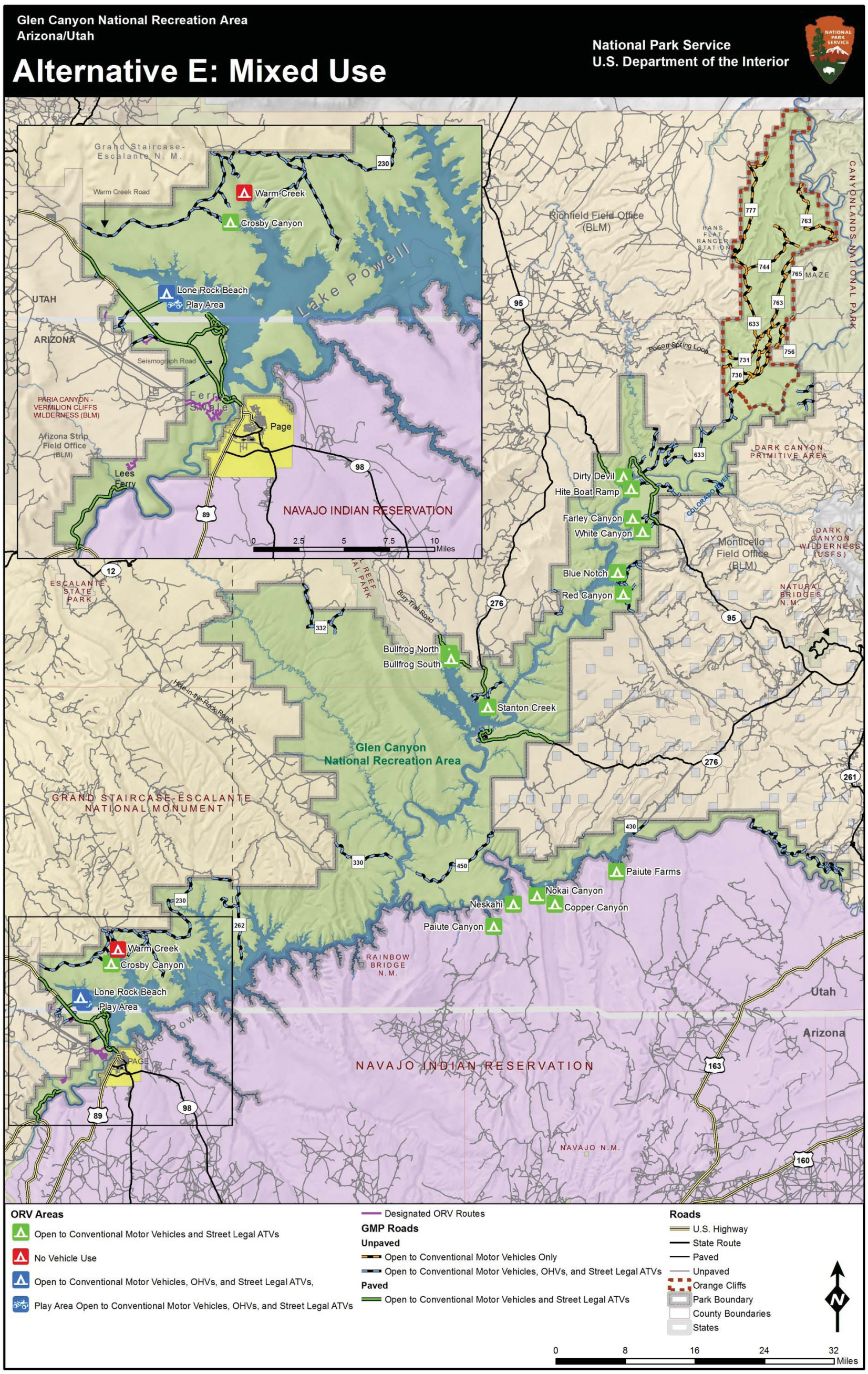


Figure 9: Alternative E: Mixed Use (NPS Preferred Alternative)

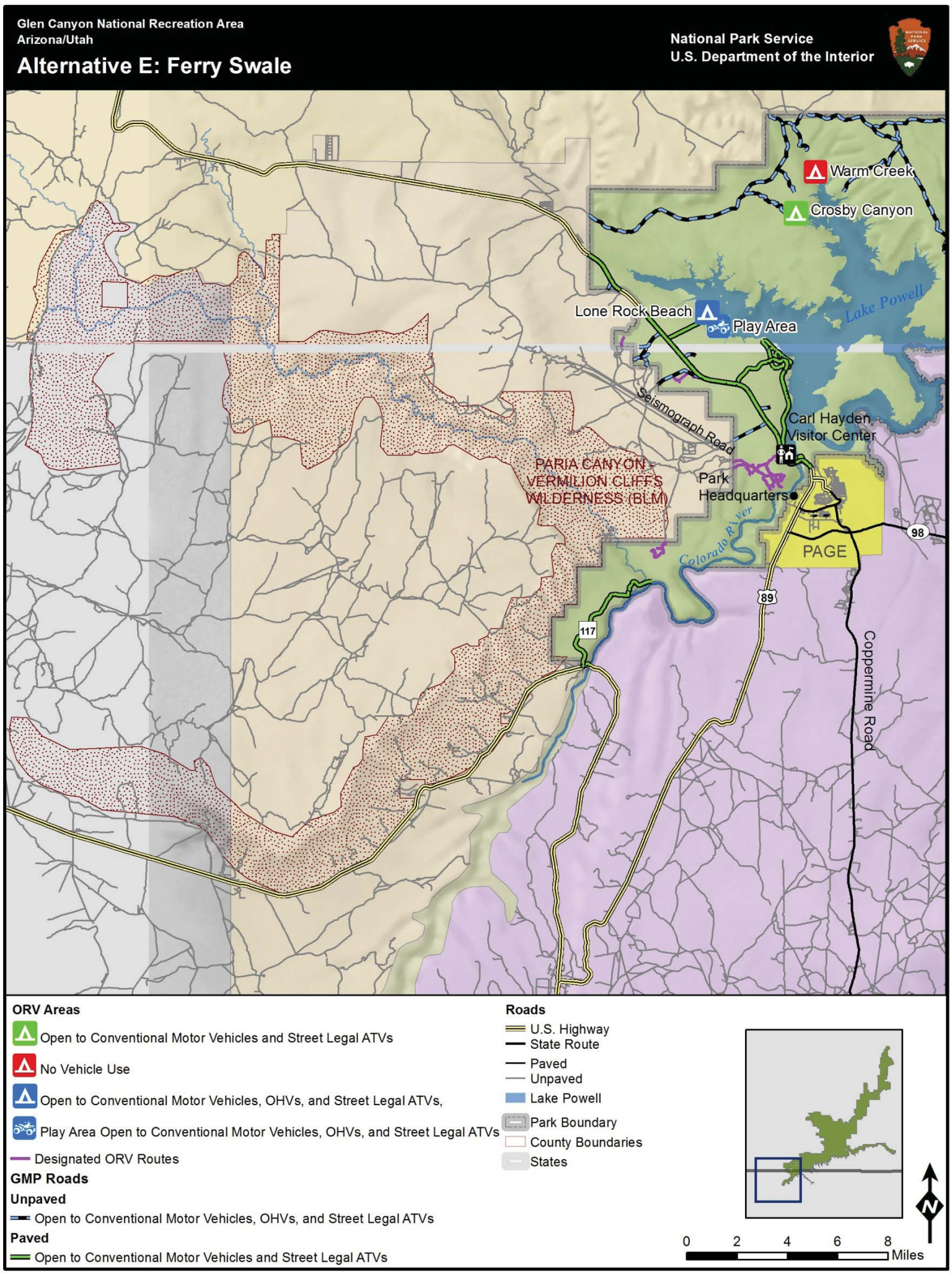


FIGURE 10: DESIGNATED ORV ROUTES IN FERRY SWALE: ALTERNATIVE E

ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

The CEQ provides clear direction that federal agencies should not routinely dismiss alternatives as unreasonable. For instance, if an alternative meets any of the following criteria, but is otherwise feasible, it must be included in the range of alternatives. The alternative may be:

1. Outside the scope of what Congress has approved or funded.
2. Outside the legal jurisdiction of the Glen Canyon National Recreation Area.
3. Undesirable to an outside applicant but reasonable to the Glen Canyon National Recreation Area.
4. In conflict with a law.
5. Outside those alternatives provided for by a GMP or other park planning document (particularly if the plan is outdated or no longer applicable).

The CEQ states that although the above items may be temporary obstacles to action, the analysis provided through an environmental impact statement (EIS) may likewise serve as a vehicle for change. As a rule, however, alternatives analyzed in NPS documents should be consistent with the laws, policies, and regulations that guide NPS (NPS 2011a, 55).

Director's Order 12 (NPS 2011a, section 4.5) states that an alternative may be eliminated from further study for any of the following reasons:

1. The alternative is technically or economically infeasible.
2. The alternative fails to meet project objectives or resolve project needs.
3. The alternative is duplicative of other, less environmentally damaging or less expensive alternatives.
4. There is conflict with an up-to-date and valid park plan, statement of purpose and significance, or other longstanding NPS policy.
5. The alternative would result in too great an environmental impact.

The planning process resulted in a broad exchange of ideas regarding development of an ORV management plan for Glen Canyon. Several management options were considered but ultimately not carried forward for further analysis because the options were beyond the scope of the planning analysis or were determined to be unreasonable. The following proposed management actions were considered but not carried forward for further analysis by the IDT for the following reasons.

ADOPTING EQUIPMENT/OPERATOR REGULATIONS FOR ATVS ON GLEN CANYON ROADS IN AN NPS SPECIAL REGULATION

Several commenters suggested that NPS adopt special equipment and operator requirements for the use of OHVs on unpaved GMP roads. NPS considered developing specific equipment and operator requirements, including but not limited to the requirement that OHV and ATV operators possess a valid driver's license. However, creating a new set of requirements for OHV and ATV operation on unpaved GMP roads in Glen Canyon would create a confusing regime of regulations for visitors and law enforcement.

Glen Canyon currently crosses two state jurisdictions, Arizona's and Utah's, and visitors with OHVs and ATVs from both states typically know the regulations governing OHV and ATV use in the respective jurisdictions. In the preamble to Part 4 of Chapter 36 of the Code of Federal Regulations, NPS makes clear that "the foundation of its

vehicle and its traffic safety regulations [are] the nonconflicting provisions of the respective State vehicle codes." This "reflects the fact that NPS generally considers the respective States to be the appropriate authorities to regulate traffic, and relies heavily on the adoption of State vehicle codes." In addition, "NPS regulations supplementing those codes are limited to ones that are necessary to resolve visitor safety and/or resource protection concerns that cannot be satisfied…by applying and enforcing State vehicle code provisions." Creating a new regulatory regime for OHV and ATV use on unpaved GMP roads in Glen Canyon would create a new regulatory overlay that would be inconsistent with both states, with counties, and with other adjacent federal jurisdictions that authorize OHV and ATV use.

Because of enforcement concerns and the potential to create confusing, conflicting regulations, this alternative element was not carried forward for further analysis. The alternatives instead reflect vehicle and operator requirements provided in state law.

Development of Additional All-terrain Vehicle / Off-road Vehicle Areas

During public scoping, a number of commenters, including one county government, indicated a preference for the development of a new ATV/ORV play area in the vicinity of the Bullfrog developed area.

Glen Canyon recently evaluated visitor use and needs to develop a management strategy for the Bullfrog developed area and other uplake development areas. The December 2006 Uplake Development Concept Plan (NPS 2006b, 2006c) did not include the development of an ORV/ATV play area in its review of visitor use needs at the Bullfrog developed area.

The IDT did not carry forward this alternative element for the development of new ORV/ATV areas for the following reasons:

- The development of additional visitor use areas, including ORV areas, would be outside the scope of this planning effort, as defined in chapter 1.
- The development of new ORV/ATV areas would not meet project objectives or needs.
- The development of new ORV areas would be anticipated to result in adverse natural and cultural impacts, and would require additional site-specific evaluation and planning beyond the scope of this plan.
- The development of new ORV areas would be inconsistent with NPS guidance and policy, which do not promote the development of ORV play areas.

RS 2477 Rights-of-Way

A number of commenters requested that the plan acknowledge state- or county-asserted Revised Statute (R.S.) 2477 rights-of-way. No regulations to either assert or recognize R.S. 2477 rights-of-way currently exist. Courts may ultimately determine the validity of R.S. 2477 claims. This plan/DEIS does not adjudicate, analyze, or otherwise determine the validity of claimed rights-of-way. Nothing in the plan/DEIS extinguishes any valid right-of-way, or alters in any way the legal rights the states and counties have to assert and protect R.S. 2477 rights or to challenge in federal court or other appropriate venues any use restrictions imposed by the plan/DEIS that they believe are inconsistent with their rights. While R.S. 2477 claims have been asserted by states and counties, it is beyond the scope of this plan/DEIS to recognize or reject R.S. 2477 claims. Nothing in this plan/DEIS is intended to provide evidence bearing on or addressing the validity of any R.S. 2477 claims. At such time as a decision is made on R.S. 2477 claims, NPS could adjust its travel routes accordingly, if necessary. Therefore, the acknowledgment of R.S. 2477 rights-of-way was not carried forward for analysis in this plan/DEIS.

Inclusion of a Wilderness Baseline Inventory in the ORV Plan

Commenters suggested that NPS include a wilderness inventory as part of the ORV plan. Specifically, some commenters requested that the areas below the high water mark where waters have receded be assessed for wilderness qualities. Questions regarding wilderness designation or study are not within the scope of this plan. A wilderness analysis and study was included in the 1980 Wilderness Recommendation (NPS 1980). This recommendation used the management zoning outlined in the Glen Canyon GMP, which addressed areas below the high water mark that are exposed as the lake levels recede. None of the paved or unpaved GMP roads, or off-road routes or areas are in proposed wilderness; therefore, a wilderness study will not be included as part of the plan.

Designation of Certain New ORV Routes

A number of commenters, including cooperating agencies, requested that NPS open Rincon Road as an ORV route. NPS considered but rejected this proposal for two reasons. First, Rincon Road is within the proposed wilderness boundary at Glen Canyon. NPS policy requires that Glen Canyon "take no action that would diminish the wilderness eligibility of an area possessing wilderness characteristics until the legislative process of wilderness designation has been completed" (NPS *Management Policies 2006* Section 6.3.1). Motor vehicle uses, such as the one proposed, are not permitted within proposed wilderness, consistent with NPS policy. Therefore, in order to consider this type of use on Rincon Road, Glen Canyon would need to revise its wilderness boundary. Changes to the wilderness boundary are outside the scope of this plan. In addition, it is outside the scope of the plan to evaluate Glen Canyon's road system. Opening Rincon Road is inconsistent with current planning documents, including the Glen Canyon GMP, which closed Rincon Road to vehicle traffic.

Some commenters requested designation of other routes within Glen Canyon. One commenter requested Glen Canyon to designate the spur off of John's Canyon Road as an ORV route. This suggestion was considered but dismissed because this particular spur is not within NPS jurisdiction. Another commenter requested designating spurs off of Hole in the Rock Road near Iceberg Canyon as an ORV route. This request was considered but rejected because the spurs are located within the proposed wilderness boundary. As noted previously, NPS policy prohibits vehicle traffic within proposed wilderness. Finally, this area may be accessed by foot from Hole-in-the-Rock Road if visitors wish to use the area.

Changes to the Road System

During the public scoping a number of commenters raised the issue of changing Glen Canyon's authorized road system to open additional roads for public use. Commenters largely focused on the GMP closure of the Rincon Road on Wilson Mesa, and the John's Canyon Road below Muley Point. Garfield County has expressed a strong desire to open the closed Harris Wash–Silver Falls route to ATVs.

The 1979 Glen Canyon GMP (NPS 1979) designated the official road system of Glen Canyon after extensive public input and evaluation of existing roads for natural and cultural resource conditions, historic visitor use patterns, recreation demand, traffic circulation needs, and other relevant issues.

NPS acknowledges that the GMP roadmap is not entirely accurate and that it is depicted at a scale that is not useful for the detailed effort necessary for this plan/DEIS. NPS worked with the BLM and in 2006 conducted a road survey to correct misaligned GMP-authorized roads. These realignments of designated roads are reflected in the road system map printed in this document.

Addressing issues related to closed roads such as the Rincon or Harris Wash–Silver Falls would require additional NEPA evaluation. NPS would address these road issues with the counties and other stakeholders independent of this planning document.

Therefore, alternatives to open, close, or alter the Glen Canyon road network were not carried forward for further analysis by the IDT because changes to the road system would not be consistent with current management plans, including the 1979 Glen Canyon GMP (NPS 1979) and the 1980 Wilderness Recommendation. In addition, any changes to the designated road system would require an extensive road evaluation process, which is beyond the scope of this plan.

HOW THE ALTERNATIVES MEET PROJECT OBJECTIVES

As previously discussed, all action alternatives analyzed in this plan/DEIS must meet all objectives to a large degree, addressing the stated purpose of action and resolving the need for action. Each action alternative (B, C, D, and E) provide safe and healthful visitor enjoyment by instituting additional safety measures and speed limits or by eliminating uses. The action alternatives provide protections for the biological and physical environment by monitoring for off-road impacts or on-road OHV and ATV impacts and providing mitigation measures when resources may be adversely impacted. All action alternatives protect cultural resources by eliminating use in areas where resources have not been appropriately surveyed and protected. All alternatives provide clear guidelines on where and when vehicles may be used off-road or on-road at Glen Canyon.

CONSISTENCY WITH THE PURPOSES OF NEPA

NPS requirements for implementing NEPA include an analysis of how each alternative meets or achieves the purposes of NEPA, as stated in sections 101(b) and 102(1). CEQ Regulation 1500.2 establishes policy for the implementation of NEPA by federal agencies. Federal agencies shall, to the fullest extent possible, interpret and administer the policies, regulations, and public laws of the United States in accordance with the policies set forth in NEPA (sections 101(b) and 102(1)); therefore, other acts and NPS policies are referenced as applicable in the following discussion.

1. **Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.**

   All of the action alternatives proposed would manage off-road motor vehicle use and on-road OHV and street-legal ATV use at Glen Canyon in a manner to best protect the resources

   Alternative B would meet the natural, physical, and cultural resource related objectives (soils, vegetation, wildlife, soundscapes, paleontology, archeology, and wilderness) because off -road use would no longer be permitted within Glen Canyon. The absence of off-road use would result in a near absence of sound emissions and would eliminate vehicle disturbance to soils, vegetation, wildlife, cultural resources, and wilderness values. Alternative B would meet the purpose of fulfilling the responsibilities of each generation as trustee of the environment for succeeding generations, by providing most of Glen Canyon free from impacts to natural, physical, and cultural resources as a result of eliminating off-road use.

   Alternative D would only allow recreational off-road use by conventional motor vehicles in a limited number of areas. Therefore, alternative D would meet this purpose because some level of off-road use would be allowed, but the use of OHVs or street-legal ATVs would be prohibited in Glen Canyon, thereby reducing impacts.

   Alternatives C and E, which would allow use of motorized vehicles capable of off-road use at levels higher than current conditions, have the greatest potential to create impact to resources. However, implementation of monitoring and mitigation protections would minimize the potential to disturb wildlife during a time when they are most susceptible to disturbance. This off-road use would have greater impacts on the soils, vegetation, soundscape, cultural resources, and wilderness values, resulting in a disturbance to resources.

Alternative A would allow off-road use at Glen Canyon at current use levels. Analysis for this draft plan/DEIS shows there would be impacts to these natural, physical, and cultural resources. There would be no monitoring or management actions under alternative A and resources may not be preserved to the extent of the alternatives with monitoring and management actions (C, D, and E) for succeeding generations.

2. **Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.**

   All alternatives meet this purpose because the Glen Canyon National Recreation Area is a safe visitor destination that is both aesthetically and culturally pleasing, and all of the alternatives encourage healthful recreation in an outdoor environment. The action alternatives (alternatives B, C, D, and E) would increase safety by identifying GMP roads as either authorized or not authorized for use by OHVs and street-legal ATVs, establishing a communication strategy for clear guidance regarding regulations governing off-road motor vehicle use and on-road OHV and street-legal ATV use in Glen Canyon, and requiring all motor vehicles to comply with state motor vehicle and operator requirements. The prohibition of off-road motor vehicle use in Glen Canyon would provide the safest and most healthful recreation environment for visitors and employees. However, on-road OHV and street-legal ATV use on GMP roads in mixed traffic conditions (with conventional motor vehicles) could cause some safety issues. However, the reduction of speed limits would somewhat mitigate this concern.

   Alternative C and E would authorize on-road street-legal ATV use on paved GMP roads and on-road OHV and street-legal ATVs use on unpaved GMP roads in mixed traffic conditions (with conventional motor vehicles) which could cause some safety issues. However, the reduction of speed limits would somewhat mitigate this concern. Therefore, alternatives C and E meet this purpose.

   Alternative D would prohibit the use of OHVs and street-legal ATVs throughout Glen Canyon, thereby decreasing risks to the health and safety of visitors and employees and meeting this purpose.

   Alternative A would generally reduce risks associated with use of motor vehicles capable of off-road use. Motor vehicle use in mixed traffic conditions (with conventional motor vehicles and street-legal ATVs) on GMP roads in Glen Canyon could cause a concern for public safety. NPS would continue to monitor and patrol use areas and implement an education program to inform visitors of safety requirements and precautions. Therefore alternative A meets this purpose.

3. **Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.**

   All of the action alternatives offer a wide range of visitor use opportunities, including off-road use (which would be prohibited under alternative B) and on-road OHV and street-legal ATV (which would be prohibited under alternative D). However, the type and diversity of off-road use and on-road OHV and/or street-legal ATV use allowed under a particular alternative could provide for a different way for visitors to experience the Glen Canyon National Recreation Area, or lead to resource degradation or risks to health and safety with higher levels of use.

   Alternative B allows for levels of use that are lower than current levels, but still provides for a variety of uses (albeit less than alternatives A, C, D, and E) and resource protection. Visitors would still have various opportunities for use and resources would still be offered protection. Alternative C would allow for higher use levels. Alternative D provides for off-road use by conventional motor vehicles only. Because alternative D would still provide for a range of visitor experiences and protect resources, it would meet this purpose. Alternative E would diversify the types of vehicles allowed for off-road and on-road use. Motor vehicle use in mixed traffic conditions (OHVs and street-legal ATVs with conventional motor vehicles) would be allowed on designated GMP roads in Glen Canyon under alternative E. However, alternative E would establish a non-vehicle area at Lone Rock Beach (another use of the beach that was previously unavailable), creating new visitor use opportunities. Therefore, alternative E would meet this purpose.

Alternative A would allow for use a wide range of visitor use opportunities to include street-legal ATVs on GMP roads, but only conventional vehicles in accessible shoreline areas, and conventional motor vehicles, OHVs, and street-legal ATVs at Lone Rock Beach, Lone Rock Beach Play Area, and on designated ORV routes in Ferry Swale. Due to the varied but concentrated use of OHVs and street-legal ATVs in these three areas, alternative A meets this purpose.

4. **Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice**.

   All alternatives would preserve important historic and cultural aspects of our national heritage in the long term and would meet this purpose. Alternatives that provide for lower levels of off-road use (alternatives B and D) would meet this purpose for cultural and natural resources by reducing the potential to impacts to these resources. However, alternatives B and D would only support diversity and variety of individual choice to a partial degree as discussed under criteria 1 and 2. As discussed under criteria 3, alternatives A, C, and E would best support diversity and variety of individual choice (to a large degree) because of the multiple options provided for experiencing the Glen Canyon National Recreation Area with off-road activities and the use of alternative types of vehicles to the conventional motor vehicle. Alternatives A, C, and E would preserve important historic and cultural aspects of our national heritage in the long term by protecting known resources.

5. **Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.**

   Balancing population and resource use under this draft plan/DEIS would include protecting the resources unimpaired for the enjoyment of present and future generations and providing access for visitors to experience the natural resources of the Glen Canyon National Recreation Area. NPS *Management Policies 2006* states that the enjoyment contemplated by the Organic Act is broad; it is the enjoyment of all the people of the United States and includes enjoyment both by people who visit parks and by those who appreciate them from afar. It also includes deriving benefit (including scientific knowledge) and inspiration from parks, as well as other forms of enjoyment and inspiration. Recognizing that the enjoyment by future generations of the national parks can be ensured only if the superb quality of resources and values is left unimpaired, Congress has provided that when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant. For all alternatives except for alternative B (and to a lesser degree alternative D), visitors would have opportunities to enjoy the more remote areas of Glen Canyon that can only be reached by off-road use, such as the accessible shoreline areas. Alternative B would meet this purpose because it would not allow for off-road use but would offer the highest level of protection to natural resources.

   As discussed above, alternatives A, C, D, and E would continue to provide for off-road use in Glen Canyon, with monitoring and management measures for alternatives C, D, and E. Use levels could be higher under alternatives C and E due to allowance of OHVs and street-legal ATVs on designated GMP roads (alternatives C and E) and OHVs and street-legal ATVs in some ORV areas (alternatives C and E). Use levels under alternative D would be below current levels because OHVs and street-legal ATVs would not be permitted for use at Glen Canyon. Alternatives C, D, and E would meet the purpose as the public would be provided access to the amenities in the Glen Canyon National Recreation Area that require off-road use.

6. **Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.**

   For reasons discussed above, in varying degrees the action alternatives (alternatives B, C, D, and E) would promote enhancement of renewable resources because all motor vehicle use must comply with state motor vehicle requirements. The second purpose, "approach the maximum attainable recycling of depletable resources," is less relevant to the development of this ORV plan because it relates to "green" building or

management practices. There would be little construction related to any alternative, with the exception of signage to designate ORV areas, identify unpaved GMP roads as either open or closed to on-road OHV and street-legal ATV use, post speed limits, etc. As discussed in chapter 1 of this document, each of the alternatives would require the Glen Canyon National Recreation Area to continue to operate under the guidelines and requirements stated in the NPS *Management Policies 2006*. Therefore each alternative would meet this purpose.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

NPS is required to identify the environmentally preferable alternative in its NEPA documents for public review and comment. NPS, in accordance with the Department of the Interior policies contained in the Departmental Manual (516 DM 4.10) and the CEQ's NEPA's Forty Most Asked Questions, defines the environmentally preferable alternative (or alternatives) as the alternative that best promotes the national environmental policy expressed in NEPA section 101(b) (516 DM 4.10). In its Forty Most Asked Questions, the CEQ further clarifies the identification of the environmentally preferable alternative, stating, "Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (Q6a).

After completing the environmental analysis, NPS identified "Alternative B, No Off-road Use," as the environmentally preferable alternative in this plan/DEIS because it establishes management measures that would reduce the impact of off-road use on the landscape. These measures include the following:

- Eliminating off-road use at Lone Rock Beach, the Lone Rock Beach Play Area, and accessible shoreline areas would eliminate soil damage and provide a better opportunity for natural resources, including vegetation, to be restored. Additionally, cultural and paleontological resources in the area would be protected.

- Eliminating illegal user-created ORV routes at Ferry Swale would provide a better opportunity for natural resources in this area to be restored. Additionally, cultural and paleontology resources (known and unknown) in the area would be protected.

- Eliminating off-road use would maintain the isolated and primitive characteristics of the Glen Canyon backcountry by limiting operation of motor vehicles to designated roads.

NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

The preferred alternative is that alternative "which the agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors" (46 FR 18026, Q4a). Alternative E (Mixed Use) was identified as the NPS preferred alternative. In identifying its preferred alternative, NPS considered factors such as the extent to which alternatives meet plan objectives, environmental consequences, management flexibility and Glen Canyon's enabling legislation.

All of the alternatives satisfied the requirements of 36 CFR 4.10 and establish clear policies to guide recreational use at Glen Canyon. However, alternative E was preferred for the following reasons. Alternative E, more so than alternative C, provides the largest range of experiences for visitors and enhances experiences of different user groups, such as OHV users, conventional motor vehicle users, and those who seek a more primitive camping experience. Although the number of areas designated for off-road use is greater under alternative E than alternatives B or D, alternative E would provide monitoring and mitigation to ensure the necessary resource protection. Monitoring and management actions (as outlined in table 2) would be implemented to ensure protection of resources. Alternative E provides the most flexibility for Glen Canyon to manage visitor access

through management actions such as improved signage, use of physical barriers, and closure of areas if there is evidence of disturbance outside of designated ORV areas. Because alternative E would provide for a greater variety of uses throughout Glen Canyon, it would have less of an impact on the socioeconomics of the area as well.

NPS will consider comments on this draft plan/DEIS and may modify or adjust the preferred alternative accordingly. Any modifications or adjustments will be disclosed in the published final EIS. A ROD will follow the final EIS and will be made available to the public.

ENVIRONMENTAL IMPACTS SUMMARY

Table 4 summarizes the anticipated environmental impacts of the alternatives. The information contained in table 4 is based on the environmental analysis presented in detail in "Chapter 4: Environmental Consequences." Only those impact topics that have been carried forward for analysis in this plan/DEIS, as identified in chapter 1, are included in this table.

TABLE 4: ENVIRONMENTAL IMPACT SUMMARY BY ALTERNATIVE

IMPACT TOPIC	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Geology and Soils	Direct adverse impacts from crushing, shearing, compaction, and erosion on 250 acres of soil and geology at Lone Rock Beach; 180 acres at Lone Rock Beach Play Area; approximately 5,900 acres at 13 accessible shorelines; and along approximately 53 miles of ORV routes at Ferry Swale. Approximately 858 acres of low to moderately erodible soils directly disturbed at accessible shoreline areas and approximately 200 acres in Ferry Swale. No impacts on soils from conventional motor vehicle and street-legal ATV use on paved GMP roads; direct impacts on 714 acres of low to moderately erodible soils from compaction and indirect impacts on 3,428 acres of low to moderately erodible soils along unpaved GMP roads.	Beneficial impacts on soils and geology at approximately 250 acres at Lone Rock Beach, 180 acres at Lone Rock Beach Play Area; 7,300 acres at 15 accessible shorelines; and Ferry Swale as a result of discontinuation of off-road use in Glen Canyon. Direct and indirect impacts on soils and geology along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Direct adverse impacts from crushing, shearing, compaction, and erosion on 250 acres of soils and geology at Lone Rock Beach; 180 acres at Lone Rock Beach Play Area; approximately 7,300 acres at 15 accessible shorelines; and along approximately 15 miles of ORV routes at Ferry Swale. Approximately 867 acres of low to moderately erodible soils directly disturbed at accessible shoreline areas and approximately 34 acres in Ferry Swale. Direct and indirect impacts on soils and geology along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to but more intense than alternative A.	Direct adverse impacts from crushing, shearing, compaction, and erosion on 250 acres of soil and geology at Lone Rock Beach; and approximately 1,100 acres at four accessible shorelines. Approximately 138 acres of low to moderately erodible soils directly disturbed at accessible shoreline areas. Beneficial impacts on soils and geology at Lone Rock Beach Play Area, 11 accessible shorelines, and Ferry Swale as a result of discontinuation of off-road use. Direct and indirect impacts on soils and geology along GMP roads from conventional motor vehicle would be similar to but less intense than alternative A.	Direct adverse impacts from crushing, shearing, compaction, and erosion on 250 acres of soil and geology at Lone Rock Beach; 180 acres at Lone Rock Beach Play Area, and approximately 6,000 acres at 14 accessible shorelines; and along approximately 15 miles of ORV routes at Ferry Swales. Beneficial impacts on soils at Warm Creek from discontinuation of off-road use. Approximately 888 acres of low to moderately erodible soils directly disturbed at accessible shoreline areas and approximately 34 acres in Ferry Swale. Direct and indirect impacts on soils and geology along paved GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A and more intense along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs.
Vegetation	Direct adverse impacts on vegetation communities consisting primarily of grasses, weeds, and bushes at Lone Rock Beach and Lone Rock Beach Play Area. Direct impact on vegetation at 13 accessible shorelines consisting primarily of blackbrush (416 acres), sand sagebrush (933 acres), and shadscale (612 acres) –dominant shrub species in upland shrublands of Glen Canyon. No direct impacts on vegetation from conventional motor vehicle and street-legal ATV use along paved GMP roads. Approximately 791 acres of blackbrush and 595 acres of shadscale directly impacted and 3,857 acres of blackbrush and 2,855 acres of shadscale indirectly impacted along unpaved GMP roads. Direct and indirect impacts on vegetation along 53 miles of designated ORV routes – primarily to shadscale and fourwing saltbrush.	Beneficial impacts on vegetation at Lone Rock Beach, Lone Rock Beach Play Area; 15 accessible shorelines; and Ferry Swale from discontinuation of off-road use in Glen Canyon. Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Direct adverse impacts on vegetation communities consisting primarily of grasses, weeds, and bushes at Lone Rock Beach and Lone Rock Beach Play Area. Direct impact on vegetation at 15 accessible shorelines consisting primarily of blackbrush (688 acres), sand sagebrush (933 acres), and shadscale (1,684 acres). Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to but more intense than alternative A. Direct and indirect impacts on vegetation along 15 miles of designated ORV routes – primarily to shadscale.	Direct adverse impacts on vegetation communities consisting primarily of grasses, weeds, and bushes at Lone Rock Beach. Continued direct impacts on vegetation at four accessible shorelines consisting primarily of blackbrush (166 acres) and shadscale (215 acres) –dominant shrub species in upland shrublands of Glen Canyon. Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles would be similar to but less intense than alternative A. No direct or indirect impacts on vegetation at Lone Rock Beach Play Area or Ferry Swale as a result of discontinuation of off-road use.	Direct adverse impacts on vegetation communities consisting primarily of grasses, weeds, and bushes at Lone Rock Beach and Lone Rock Beach Play Area. Direct impact on vegetation at 14 accessible shorelines consisting primarily of blackbrush (688 acres), sand sagebrush (933 acres) and shadscale (1,561 acres). Beneficial impacts on vegetation at Warm Creek from discontinuation of off-road use. Direct and indirect impacts on vegetation along paved GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A and more intense than alternative A along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs. Direct and indirect impacts on vegetation along 15 miles of designated ORV routes – primarily to shadscale.

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Wildlife and Wildlife Habitat	Direct adverse impacts on wildlife and wildlife habitat at Lone Rock Beach, Lone Rock Beach Play Area, approximately 5,900 acres at 13 accessible shorelines, and along 53 miles of designated ORV routes in Ferry Swale as a result of disturbance, dust, displacement, vehicle-wildlife collisions, noise, and habitat destruction. Direct and indirect adverse impacts on wildlife along GMP roads from habitat disturbance and reduction, dust, and habitat fragmentation; and to wildlife habitat from erosion and sedimentation and potential for transport of invasive species.	Beneficial impacts on wildlife and wildlife habitat at Lone Rock Beach, Lone Rock Beach Play Area, 15 accessible shorelines, and Ferry Swale from discontinuation of off-road use. Direct and indirect impacts on wildlife and wildlife habitat along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Direct adverse impacts on wildlife and wildlife habitat at Lone Rock Beach, Lone Rock Beach Play Area, approximately 7,300 acres at 15 accessible shorelines, and concentrated along 15 miles of designated ORV routes in Ferry Swale as a result of disturbance, displacement, vehicle-wildlife collisions, noise, and habitat destruction. Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to but more intense than alternative A.	Direct adverse impacts on wildlife and wildlife habitat at Lone Rock Beach and at approximately 1,100 acres at four accessible shorelines as a result of disturbance, displacement, vehicle-wildlife collisions, noise, and habitat destruction. Beneficial impacts on wildlife and wildlife habitat at 11 accessible shorelines and Ferry Swale as a result of discontinuation of off-road use. Direct and indirect impacts on vegetation along GMP roads from conventional motor vehicles would be similar to but less intense than alternative A.	Direct adverse impacts on wildlife and wildlife habitat at Lone Rock Beach, Lone Rock Beach Play Area, and approximately 6,000 acres at 14 accessible shorelines as a result of disturbance, displacement, vehicle-wildlife collisions, noise, and habitat destruction. Beneficial impacts on wildlife and wildlife habitat at Warm Creek as a result of discontinuation of off-road use. Impacts at Ferry Swale would be the same as alternative C. Direct and indirect impacts on wildlife and wildlife habit along paved GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A and more intense than alternative A along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs.
Special-status Species	Adverse impacts on special-status species at Lone Rock Beach, Lone Rock Beach Play Area, 13 accessible shorelines, and along 53 miles of designated ORV routes in Ferry Swale as a result of habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement. Adverse impacts on special-status species along GMP roads from habitat disturbance and reduction, dust, and habitat fragmentation; and to their habitat from erosion and sedimentation, and potential for transport of invasive species. Alternative A may affect, but is not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions.	Beneficial impacts on special-status species at Lone Rock Beach, Lone Rock Beach Play Area, 15 accessible shorelines, and Ferry Swale as a result of discontinuation of off-road use. Impacts on special-status species along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A. Alternative B may affect, but is not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally-listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions	Adverse impacts on special-status species at Lone Rock Beach, Lone Rock Beach Play Area, 15 accessible shorelines, and along 15 miles of designated ORV routes Ferry Swale as a result of habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement. Impacts on special-status species along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to but more intense as alternative A. Alternative C may affect, but is not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally-listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions	Adverse impacts on special-status species at Lone Rock Beach and four accessible shorelines as a result of habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement. Beneficial impacts on special-status species at Lone Rock Beach Play Area and Ferry Swale plus 11 accessible shorelines as a result of discontinuation of off-road use. Impacts on special-status species along GMP roads from conventional motor vehicles would be similar to but potentially less intense than alternative A. Alternative D may affect, but is not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions.	Adverse impacts on special-status species at Lone Rock Beach, Lone Rock Beach Play Area, and 14 accessible shorelines as a result of habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement. Beneficial impacts on special-status species at Warm Creek as a result of discontinuation of off-road use. Impacts at Ferry Swale would be the same as alternative C. Impacts on special-status species along paved GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A and more intense along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs. Alternative E may affect, but are not likely to adversely affect the following federally or state-listed, or Glen Canyon species of concern. No effect on federally listed southwestern willow flycatcher, yellow-billed cuckoo, Brady pincushion cactus, Navajo sedge, and Jones' cycladenia are expected as these species are not known to occur in habitat that would be impacted by management actions

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Soundscapes	Direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs total 362,269 acres of land (28.88% of the Glen Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur.	Direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs total 351,408 acres of land (28.02% of the Glen Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially decreased through implementation of the 96-dBA limit on OHVs and street-legal ATVs (80,906 fewer acres within the direct impact noise effect zone or 21.57% of Glen Canyon).	Direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs total 479,270 acres of land (38.21% of the Glen Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially increased through implementation of the 96-dBA limit on OHVs and street-legal ATVs (101,715 fewer acres within the direct impact noise effect zone or 30.10% of Glen Canyon land area).	Direct impacts as a result of noise generated from conventional motor vehicles total 6,351 acres of land (0.51% of the Glenn Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to conventional vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would not be affected by the 96-dBA limit because no OHV or street-legal ATV use would be allowed (the limit only applies to OHVs and street-legal ATVs).	Direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs total 373,135 acres of land (28.75% of the Glen Canyon land area). These areas could potentially experience a 3-dBA increase in natural ambient due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially increased through implementation of the 96-dBA limit on OHVs and street-legal ATVs (82,190 fewer acres within the direct impact noise effect zone or 23.20% of Glen Canyon).
Visitor Use and Experience	Current visitor use patterns would continue at Lone Rock Beach, Lone Rock Beach Play Area, and 13 accessible shorelines. Some visitor experience could be diminished at Lone Rock Beach, Lone Rock Beach Play Area, and Ferry Swale as a result of noise and air emissions produced by OHVs and street-legal ATVs. No measurable changes are expected on visitors using conventional motor vehicles or street-legal ATVs on GMP roads. Visitors seeking a quiet, backcountry experience may be adversely impacted by the noise street-legal ATVs produce in the more remote areas of Glen Canyon.	Visitor use patterns would be considerably impacted at Lone Rock Beach, Lone Rock Beach Play Area, 15 accessible shorelines, and Ferry Swale due to the discontinuation of off-road use. Although visitors would not be able to engage in off-road use in these areas, they would still be able to access the sites by parking at the end of the road and walking to the site. Impacts on visitor use and experience from conventional motor vehicles and street-legal ATVs on GMP roads would be the same as alternative A.	Impacts on visitor use and experience at Lone Rock Beach and Lone Rock Beach Play Area would be similar to alternative A, but with an additional small adverse impact on visitor experience with the requirement to obtain a permit. An increase in number of accessible shorelines and authorization of OHVs and street-legal ATVs for use at accessible shorelines, in addition to conventional motor vehicles, would increase the areas available for OHVs and street-legal ATV opportunities and provide a beneficial impact for these users. Expansion and authorization of OHV and street-legal ATV use at accessible shorelines could result in adverse impacts on visitors seeking a quieter experience as a result of increase in noise and air emissions from OHVs and street-legal ATVs. Impacts on visitor use and experience from conventional motor vehicles, OHVs, and street-legal ATVs on GMP roads would be similar to but more intense and widespread than alternative A.	Impacts on visitor use and experience at Lone Rock Beach would be similar to alternative A, but with an additional small adverse impact on visitor experience with the requirement to obtain a permit. Visitor use patterns would be considerably impacted at Lone Rock Beach Play Area and Ferry Swale as a result of discontinuation of off-road use in these areas, resulting in severe adverse impacts. Four accessible shoreline areas would remain available for use by conventional motor vehicles, but depending on the level of use, visitors may experience a negative impact from increased crowding. However, generally, visitor experience at these shoreline areas would not be noticeably impacted and overall visitor use patterns would not likely change because two of the four accessible shorelines already experience high visitation comparable to other accessible shorelines. Visitor use patterns would change substantially as access by OHVs or street-legal ATVs within Glen Canyon would not be authorized.	Impacts on visitor use and experience at Lone Rock Beach, Lone Rock Beach Play Area, and Ferry Swale would be similar to alternative C. An increase in number of accessible shorelines and authorization of street-legal ATVs for use at accessible shorelines, in addition to conventional motor vehicles, would increase the areas available for street-legal ATV opportunities and provide a beneficial impact for those users. Expansion and authorization of street-legal ATV use at accessible shorelines could result in adverse impacts on visitors seeking a quieter experience as a result of increase in noise and air emissions from street-legal ATVs. Impacts on visitor use and experience from conventional motor vehicles and street-legal ATVs on paved GMP roads would be the same as alternative A and more intense and widespread from on unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs.
Archeology	Direct adverse impacts on archeological resources could involve 3 not evaluated sites in Lone Rock Beach Play Area; 3 eligible sites and 2 not evaluated sites at accessible shorelines; and 6 eligible sites and 3 not evaluated sites in Ferry Swale. Indirect impacts on archeological resources could involve 3 not evaluated sites at Lone Rock Beach; 1 not evaluated site at Lone Rock Beach Play Area; and 19 eligible sites and 37 not evaluated sites at accessible shorelines; and 17 eligible sites and 6 not evaluated sites along GMP roads.	Indirect adverse impacts on archeological resources could involve 17 eligible sites and 6 not evaluated sites along GMP roads.	Direct adverse impacts on archeological resources could involve 3 not evaluated sites in Lone Rock Beach Play Area; 6 eligible sites and 4 not evaluated sites at accessible shorelines; and 6 eligible sites and 3 not evaluated sites in Ferry Swale. Indirect impacts on archeological resources could involve 3 not evaluated sites at Lone Rock Beach; 1 not evaluated site at Lone Rock Beach Play Area; and 19 eligible sites and 37 not evaluated sites at accessible shorelines; and 39 eligible sites and 23 not evaluated sites along GMP roads.	Indirect impacts on archeological resources could involve 3 not evaluated sites at Lone Rock Beach; 8 eligible sites and 5 not evaluated sites at accessible shorelines; and no eligible sites or not evaluated sites along GMP roads.	Direct adverse impacts on archeological resources could involve 3 not evaluated sites in Lone Rock Beach Play Area; 6 eligible sites and 2 not evaluated sites at accessible shorelines; and 6 eligible sites and 3 not evaluated sites in Ferry Swale. Indirect impacts on archeological resources could involve 3 not evaluated sites at Lone Rock Beach; 1 not evaluated site at Lone Rock Beach Play Area; and 19 eligible and 37 not evaluated sites at accessible shorelines; and 17 eligible sites and 6 not evaluated sites along GMP roads.

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Ethnographic Resources	Beneficial impact as a result of continued access to the Hole-in-the Rock traditional cultural property (TCP) site by members of The Church of Jesus Christ of Latter-day Saints for permitted activities. Potential for indirect adverse impacts on the Hole-in-the-Rock and potentially National Register-eligible Hole-in-the-Rock landscape TCP as a result of conventional motor vehicles and street-legal ATVs allowed on the Hole-in-the-Rock Road (an unpaved GMP road).	Impacts would be the same as alternative A.	Increased beneficial impacts for members of The Church of Jesus Christ of Latter-day Saints as a result of continued and increased access (by conventional motor vehicles, OHVs, and street-legal ATVs on Hole-in-the-Rock Road) to the Hole-in-the Rock TCP site for permitted activities. Increased potential for indirect adverse impacts on the Hole-in-the-Rock and potentially National Register-eligible Hole-in-the-Rock landscape TCP as a result of conventional motor vehicles, OHVs, and street-legal ATVs allowed on the Hole-in-the-Rock Road.	Decreased beneficial impacts for members of The Church of Jesus Christ of Latter-day Saints as a result of continued but decreased access (only by conventional motor vehicles on Hole-in-the-Rock Road) to the Hole-in-the Rock TCP site for permitted activities. Decreased potential for indirect adverse impacts on the Hole-in-the-Rock and potentially National Register eligible Hole-in-the-Rock landscape TCP as a result of reduction in the type of motor vehicles (conventional motor vehicles only) allowed on the Hole-in-the-Rock Road.	Impacts would be the same as alternative C, as the Hole-in-the-Rock would be accessed by conventional motor vehicles, OHVs, and street-legal ATVs.
Socioeconomics	The current level of visitation at Glen Canyon is expected to continue. Visitation and use of Lone Rock Beach, Lone Rock Beach Play Area, 13 accessible shorelines, and Ferry Swale is expected to continue, beneficially contributing to local economies and supporting jobs, income, and gross regional product. The ability to continue to ride conventional motor vehicles and street-legal ATVs on GMP roads would likely have a minimal impact on socioeconomic resources. Use of 53 miles of designated ORV routes in Ferry Swale would have limited impacts on socioeconomic resources.	Potential adverse impacts would occur with decreased visitor spending as a result of discontinuation of off-road use within Glen Canyon. Impacts on socioeconomic resources from use of GMP roads by conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Visitation and use of Lone Rock Beach and Lone Rock Beach Play Area would remain similar to alternative A, beneficially contributing to local economies and supporting jobs, income, and gross regional product; although a permit system may discourage a small amount of visitation to these sites. Additional opportunities for OHV and street-legal ATV use at the 15 accessible shorelines and on GMP roads could also contribute to the local economy. Because off-road use has been rapidly increasing in Utah and Arizona, allowing OHVs and street-legal ATVs at accessible shorelines could result in increased visitation to these areas. Beneficial impacts on socioeconomic resources from use of GMP roads and 15 miles of designated ORV routes in Ferry Swale by conventional motor vehicles, OHVs, and street-legal ATVs would be limited.	Prohibition of OHV and street-legal ATVs within Glen Canyon would lead to decreased visitation by these types of vehicles at Lone Rock Beach and Lone Rock Beach Play Area, although this portion of visitation is very small. Visitation overall within Glen Canyon would be expected to slightly decrease, with slight adverse effects on local economies. The loss of visitation at 11 accessible shoreline areas where off-road use would be discontinued would adversely impact local economies (assumed to equal the total visitation at Stanton Creek – approximately 14,000 annual visitors) with a potential loss of $2.3 million in visitor spending and 28 jobs. These economic impacts would account for a very small portion of the employment and economic activity in the study area. Impacts on socioeconomic resources from use of GMP roads by conventional motor vehicles would be limited.	Impacts on socioeconomic resources would be expected to be the similar to those described under alternative C, where visitation and visitor spending associated with users at Lone Rock Beach, Lone Rock Beach Play Area, and Ferry Swale would continue to beneficially contribute and support local economies. Additional opportunities would beneficially contribute to local economies as a result of expanded street-legal ATV use at the 14 accessible shorelines and OHV uses on unpaved GMP roads. Because off-road use has been rapidly increasing in Utah and Arizona, allowing street-legal ATVs at accessible shorelines could result in increased visitation to these areas. However, it is expected that beneficial effects on local economies would be limited.
Health and Safety	Adverse impacts on health and safety as conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to operate together at Lone Rock Beach, Lone Rock Beach Play Area, along 53 miles of designated ORV routes at Ferry Swale.	Beneficial impacts on health and safety of conventional motor vehicle users, OHV users, and street-legal ATV users, as off-road use would be eliminated from Lone Rock Beach, Lone Rock Beach Play Area, all accessible shorelines areas, and Ferry Swale.	Adverse impacts on health and safety as conventional motor vehicles, OHVs and street-legal ATVs would be allowed to operate together at Lone Rock Beach, Lone Rock Beach Play Area, at 15 accessible shorelines, along GMP roads, and along 15 miles of designated ORV routes at Ferry Swale. Additional requirement for ORV permit and flag at Lone Rock Beach Play Area would provide some beneficial impacts.	Beneficial impacts on health and safety of conventional vehicle users, OHV users, and street-legal ATV users, as off-road use would be eliminated from Lone Rock Beach Play Area and Ferry Swale. Additional beneficial impacts as a result of only conventional vehicles authorized for use within Glen Canyon – at Lone Rock Beach and four authorized accessible shorelines.	Adverse impacts for health and safety as conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to operate together at Lone Rock Beach, Lone Rock Beach Play Area, along unpaved GMP roads, and along 15 miles of designated ORV routes at Ferry Swale. Additional requirement for ORV permit and flag at Lone Rock Beach Play Area would provide some beneficial impacts, similar to alternative C.

Impact Topic	Alternative A: No Action	Alternative B: No Off-road Use	Alternative C: Increased Motorized Access	Alternative D: Decreased Motorized Access	Alternative E: Mixed Use (NPS Preferred Alternative)
Paleontological Resources	Adverse impacts on paleontological resources stemming from erosion as a result of motor vehicle use on 250 acres Lone Rock Beach, 180 acres at Lone Rock Beach Play Area, approximately 5,900 acres at 13 accessible shorelines, and along approximately 53 miles of ORV routes at Ferry Swale. Approximately 1,057 acres of geologic formation with varying degrees of trace paleontological resources (including Organ Rock, Moenkopi, Chinle, Tropic Shale, and Carmel Formations) directly disturbed at accessible shoreline areas and approximately 155 acres in Ferry Swale. No direct impacts on paleontological resources from conventional motor vehicle and street-legal ATV use on paved GMP roads; direct impacts on approximately 2,000 acres and indirect impacts on approximately 5,400 acres of geologic formations with potential for paleontological resources along unpaved GMP roads.	Beneficial impacts on paleontological resources at approximately 250 acres at Lone Rock Beach, 180 acres at Lone Rock Beach Play Area, 7,300 acres at 15 accessible shorelines, and Ferry Swale from discontinuation of off-road use in Glen Canyon. Direct and indirect impacts on paleontological resources along GMP roads from conventional motor vehicles and street-legal ATVs would be the same as alternative A.	Adverse impacts on paleontological resources stemming from erosion as a result of motor vehicle use on 250 acres Lone Rock Beach, 180 acres at Lone Rock Beach Play Area, approximately 7,300 acres at 15 accessible shorelines, and along approximately 15 miles of ORV routes at Ferry Swale. Approximately 1,152 acres of geologic formation with varying degrees of trace paleontological resources (including Organ Rock, Moenkopi, Chinle, Tropic Shale, and Carmel Formations) directly disturbed at accessible shoreline areas and approximately 11 acres in Ferry Swale. Direct and indirect impacts on paleontological resources along GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to alternative A.	Adverse impacts on paleontological resources stemming from erosion as a result of motor vehicle use on 250 acres Lone Rock Beach and approximately 1,100 acres at 4 accessible shorelines. Approximately 230 acres of geologic formation with varying degrees of trace paleontological resources (including Organ Rock, Moenkopi, Chinle, Tropic Shale, and Carmel Formations) directly disturbed at accessible shoreline areas. No direct or indirect impacts at Lone Rock Beach Play Area, 11 accessible shorelines and Ferry Swale from discontinuation of off-road use in those areas. Impacts on paleontological resources along GMP roads from conventional motor vehicles, would be similar to alternative A.	Adverse impacts on paleontological resources stemming from erosion as a result of motor vehicle use on 250 acres Lone Rock Beach, 180 acres at Lone Rock Beach Play Area, approximately 6,000 acres at 14 accessible shorelines, and along approximately 15 miles of ORV routes at Ferry Swale. Beneficial impacts on paleontological resources at Warm Creek from discontinuation of off-road use. Approximately 1,074 acres of geologic formation with varying degrees of trace paleontological resources (including Organ Rock, Moenkopi, Chinle, Tropic Shale, and Carmel Formations) directly disturbed at accessible shoreline areas and approximately 11 acres in Ferry Swale. Impacts on paleontological resources along paved GMP roads from conventional motor vehicles, and street-legal ATVs and along unpaved GMP roads from conventional motor vehicles, OHVs, and street-legal ATVs would be similar to alternative A.
Wilderness	Without the 96-dBA limit, 16.13% of proposed wilderness areas would be directly impacted by motor vehicle noise.	With the 96-dBA limit, 10.63% of proposed wilderness areas would be directly impacted by motor vehicle noise.	With the 96-dBA limit, 17.15% of proposed wilderness areas would be directly impacted by motor vehicle noise.	With (and without the 96-dBA limit) 0.11% of proposed wilderness areas would be directly impacted by motor vehicle noise. The degree and geographic extent of impacts on soundscapes and thus wilderness would not be affected by the 96-dBA limit because no OHV or street-legal ATV use would be allowed (the limit only applies to OHVs and street-legal ATVs).	With the 96-dBA limit, 10.74% of proposed wilderness areas would be directly impacted by motor vehicle noise.

Chapter 3 Affected Environment

CHAPTER 3: AFFECTED ENVIRONMENT

INTRODUCTION

This "Affected Environment" chapter describes the resources of Glen Canyon National Recreation Area (Glen Canyon) that could be affected by the implementation of any of the proposed off-road vehicle (ORV) management alternatives as described in chapter 2 of this Off-road Vehicle Management Plan / Draft Environmental Impact Statement (plan/DEIS). The resources described here correspond to those identified in chapter 1 as impact topics. The affected environment descriptions serve as the baseline against which the National Park Service (NPS) will evaluate the anticipated impacts of proposed management actions. This evaluation is the focus of "Chapter 4: Environmental Consequences."

This chapter describes the resources of Glen Canyon in two sections. The first section presents an overview of the general project setting, including landscape, location, and management zoning of Glen Canyon. The second section describes the general resources evaluated and identified in chapter 1 as impact topics, including geology and soils, vegetation, wildlife and wildlife habitat, special-status species, soundscapes, visitor use and experience, cultural resources, socioeconomics, health and safety, paleontological resources, and wilderness.

GENERAL PROJECT SETTING

Glen Canyon, located in the Colorado Plateau physiographic province, extends more than 200 miles from the Green River in southern Utah downstream to Lees Ferry in Arizona. It is a desert region of rock, arid shrublands, grasslands, and low-growing pinyon/juniper woodlands. As shown in the vicinity map (refer to figure 1 in chapter 1), Glen Canyon is bordered by Canyonlands National Park to the northeast; the Red Rock Plateau to the east; the Henry Mountains to the north; Grand Staircase–Escalante National Monument (Grand Staircase–Escalante), Dixie National Forest, and Capitol Reef National Park to the northwest and west; and the Navajo Indian Reservation to the south. Glen Canyon surrounds Lake Powell.

Glen Canyon extends more than 200 miles from the Green River in Southern Utah downstream to Lees Ferry in Arizona.

Congress authorized the construction of the Glen Canyon Dam in the Colorado River Storage Project Act of 1956 (PL 84-485). The primary purposes of the project were to prevent flooding on the Colorado River, create a reservoir to meet downstream water requirements, and generate hydroelectric power. Incidental to construction activities, the city of Page, Arizona, was established about 2 miles from the dam site to provide housing and other services for workers. Page now serves as the largest gateway community to Glen Canyon.

Lake Powell was formed by the inundation of the Colorado River following the construction of the Glen Canyon Dam between 1960 and 1963. The 186-mile-long Lake Powell formed along the courses of the Colorado River and three tributaries: the Escalante, San Juan, and Dirty Devil Rivers. Lake Powell is the second-largest reservoir by volume in North America, and the largest reservoir in North America by surface acreage, length, and shoreline length. The lake includes parts of Arizona and Utah, and is within the jurisdiction of several agencies. These include the Park Service, the Bureau of Reclamation, and the Bureau of Land Management (BLM); the Navajo Nation; the states of Utah and Arizona; one Arizona county (Coconino); and four Utah counties (Garfield, Kane, San Juan, and Wayne).

The Bureau of Reclamation manages the Glen Canyon Dam. It was designed to accommodate lake levels ranging from 3,490 feet to 3,700 feet above sea level. As the water level changes, the surface of Lake Powell varies in area from 52,000 acres to 163,000 acres and the shoreline fluctuates from 990 miles to 1,960 miles in length. Usually, the lake surface is about 160,000 acres, which represents approximately 13% of Glen Canyon. Annual fluctuations in

lake levels typically are about 25 vertical feet. The lake level rises in the spring as water from snowmelt runoff and spring storms collects behind the dam. It then declines throughout the rest of the year, particularly during summer and early fall as water is released for electrical power generation and irrigation.

Approximately 13% of Glen Canyon is inundated by Lake Powell. The other 87% of Glen Canyon consists of upland desert incised by deep canyons, dry washes, and steep cliffs, as well as talus, and clay or slickrock badlands. Much of the lake's shoreline consists of steep slopes and cliff walls. Elevations in Glen Canyon vary from approximately 3,600 feet (at low lake levels) to over 7,500 feet above sea level.

Glen Canyon was established in 1972 "to provide for public outdoor recreation use and enjoyment of Lake Powell and adjacent lands, and to preserve and protect the scenic, scientific, and historic features contributing to public enjoyment of the area" (PL 92-593). The primary management objective of Glen Canyon, as established in the General Management Plan (GMP), is "to manage the recreation area so that it provides maximal recreational enjoyment to the American public and their guests" (NPS 1979). NPS is responsible for managing all federal lands and waters within Glen Canyon boundaries (NPS 1987a).

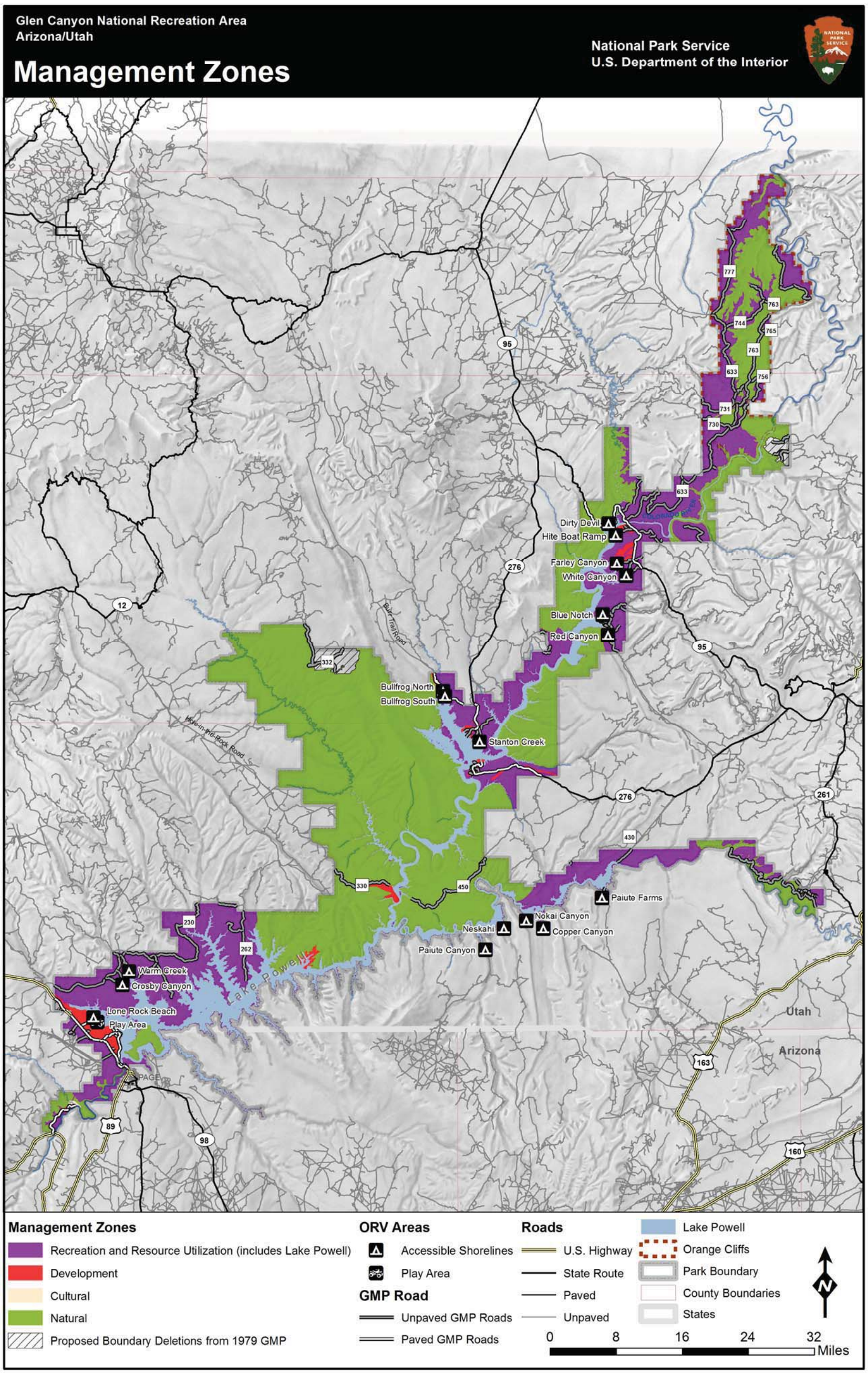
The area of analysis is broad. Natural topographical features generally contain the accessible shoreline areas, and therefore these shoreline areas are limited in extent and easily described in terms of resource conditions. The designated road system (GMP roads [paved and unpaved]), however, opens vast expanses of Glen Canyon to potential illegal ORV impacts, and the resources that may be subjected to impacts from illegal cross-country travel are extensive.

As lake levels drop and the shoreline recedes from the original designated ORV area, ORV users are authorized to continue traveling a natural course toward the lakeshore from the end of the access route. This natural course is considered a normal extension of the original ORV area access route. As Lake Powell has dropped in elevation, users have continued on a natural course past the high water terminus of the original road to reach the new lakeshore, a practice often referred to as "chasing the water." This allows for the establishment of a temporary social road. NPS has instituted temporary closures of ORV areas where the practice of chasing the water has resulted in damage to resources or has exceeded acceptable parameters, or where it has become evident that the natural topographic features of the area cannot contain off-road use.

Management Zoning

The 1979 Glen Canyon GMP specifies the long-term allocation of the approximately 1,246,000 acres of land and water resources in Glen Canyon through four management zones (figure 11). Additions to Glen Canyon not shown in figure 11 are in the four management zones as designated in the 1979 GMP (NPS 1979). Figure 11 shows the four management zones, as well as Glen Canyon boundary deletions, which are boundary adjustments documented in the 1979 GMP.

The Recreation and Resource Utilization Zone (557,890 acres, or 45% of Glen Canyon) consists of areas possessing somewhat less scenic value, greater susceptibility to human activities, potential or actual mineral resources, or value for utility rights-of-way or development. The Recreation and Resource Utilization Zone includes the entire surface (up to 163,000 acres) of Lake Powell. The remaining area in this zone (almost 400,000 acres) consists of dry land and includes about half of the lake shoreline. NPS manages the zone to maintain natural processes and enhance fish and game populations. Consumption of renewable and nonrenewable resources is subject to the protection of recreational values.



Note: NPS Route 450 corridor (Hole-in-the-Rock Trail) is managed as a "Cultural Zone" per the 1979 GMP; scale of this map prohibits this depiction.

FIGURE 11: MANAGEMENT ZONES

The Development Zone (19,270 acres, or less than 2% of Glen Canyon) is managed to provide visitor services and maintain facilities. This zone includes the permanent structures and operations necessary to support recreation activities and allows a wide range of recreational use. It includes the areas around Lees Ferry; the complex that includes the Glen Canyon Dam, Carl Hayden Visitor Center, and Wahweap Marina; and the developments at Halls Crossing, Bullfrog, Hite, Dangling Rope, Antelope Point, Llewellyn Gulch, and Hans Flat in the Orange Cliffs area.

The Cultural Zone (25 acres, or less than 1% of Glen Canyon) is managed for the preservation and interpretation of cultural, historic, and archeological resources, including restoration where deemed appropriate. This zone is composed of several areas located primarily along Wilson Mesa and the Escalante River.

The Natural Zone (668,670 acres, or 54% of Glen Canyon) includes Glen Canyon's outstanding scenic resources, relatively undisturbed areas isolated and remote from the activities of man, or areas bordering on places with established land-use practices complementary to those of the Natural Zone. NPS manages the Natural Zone to maintain isolated, natural processes. Consumption of renewable resources is subject to the protection of the recreational values of the area. The majority of the Natural Zone is proposed as wilderness.

The lakeside boundary of the Natural Zone is concurrent with the fluctuating water levels of Lake Powell except at Antelope Island. The zoning acreage under the GMP was established at the 3,700-foot contour of Lake Powell. As such, as the lake level has declined, there has been a corresponding increase in the total acreage of the Natural Zone. NPS treats the Natural Zone for Antelope Island differently because below the 3,620-foot contour, Antelope ceases to be an island. In this situation the Natural Zone is concurrent with the top of the south side of the channel between Antelope Island and Castle Rock. When lower than the 3,620-foot contour, the Natural Zone remains at this channel (NPS 1979).

Full pool on Lake Powell is considered 3,700 feet above sea level. The 1979 GMP established this elevation, which is the elevation considered as full pool by the U.S. Army Corps of Engineers for jurisdiction over permitting purposes. Glen Canyon Dam can accommodate a pool of 3,711 feet, beyond which the dam is overtopped. The 1988 Environmental Assessment and Management / Development Concept Plans for Lake Powell's Accessible Shorelines (EA/DCP) references a pool elevation of both 3,700 feet and 3,711 feet (NPS 1988). For the purposes of analysis in this plan/DEIS, however, 3,700 feet is the full pool mark (NPS 1979).

The GMP provides examples of allowed recreational activities for each management zone. The intent was to ensure that current and future public uses of Glen Canyon were evaluated and managed to preserve the integrity of the management zones, as well as the unique characteristics for which certain land and water resources were set aside (NPS 1979).

Motorized recreation was recognized as a permitted activity for the Recreation and Resource Utilization Zone and the Development Zone. The recreational description of these two zones includes scenic touring by conventional motor vehicles and boat as acceptable activities. Activities such as riding trail bikes and dune buggies are also recognized as acceptable activities in designated use areas. All the ORV areas at Glen Canyon are located in either the Recreation and Resource Utilization Zone or the Development Zone (NPS 1979). Although the Hole-in-the-Rock Road is in the Recreation and Resource Utilization Zone, the corridor is narrow and is surrounded by proposed wilderness.

Under the GMP, the use of motorized equipment is prohibited in the Natural Zone. Such uses would be inappropriate given the characteristics of these areas. The GMP describes the Natural Zone as possessing Glen Canyon's outstanding scenic resources and relatively undisturbed areas, isolated and remote from human activities (NPS 1979).

GEOLOGY AND SOILS

GEOLOGY

The geology of Glen Canyon represents a spectacular example of exposed Colorado Plateau rocks (Sprinkle et al. 2000) and is characterized by relatively flat-lying Mesozoic and Paleozoic sedimentary rocks. This area of high-standing crustal blocks is largely pristine due to a lack of rock deformation over the last 300 million years. The area stands in stark contrast to the highly deformed Southern Rocky Mountains region to the northeast and the Basin and Range regions to the west and south.

The bedrock units of Glen Canyon range in age from 300 million years (Late Pennsylvanian) to 85 million years (Late Cretaceous). Vigorous downcutting of the Colorado and San Juan River systems has exposed more than 8,500 feet of sedimentary rock strata. The strata contain a visible record of marine, marginal marine, coastal, and alluvial plain, vast desert, and small oasis conditions over a vast period.

Glen Canyon consists primarily of sedimentary strata of the Triassic and Jurassic ages. The majority of Glen Canyon is of the Moenkopi and Chinle Formations of the Triassic, and the Glen Canyon Group of the Jurassic. The Moenkopi, of Lower and Middle Jurassic age, is exposed most noticeably in the Hite area and the Orange Cliffs. The Moenkopi is distinguishable by its maroon to reddish brown sandstones, mudstones, shales, and lighter-colored carbonate layers.

Glen Canyon consists primarily of sedimentary strata of the Triassic and Jurassic ages.

Above the Moenkopi is the Chinle Formation, composed of brilliantly colored limestone, claystone, siltstone, sandstone, and arkose and conglomerate beds, many of which contain petrified wood and coal seams. In Glen Canyon, the Chinle exposure is largely confined to the Orange Cliffs, Red and White Canyons, the Rincon, and in sections of the San Juan River. The Chinle exposure is also very widespread in the Circle Cliffs–Escalante Canyons area and in the Purple Hills. The Chinle erodes to form slopes between the underlying Moenkopi and the overlying Glen Canyon Group (described below). When dry, it is structurally weak, and such weakness increases when wet, with the potential of forming large landslide blocks in areas.

Above the Chinle is the block-forming Wingate sandstone, the lowest formation of the Glen Canyon Group. The Wingate consists of massive sandstone with large sweeping tangential crossbeds. The orange-red vertical cliffs of the Wingate can be up to 330 feet high, and are the formation for which the Orange Cliffs are named. The Wingate is usually capped by the Kayenta Formation, which often forms small ledges and step-like benches between the Wingate and the overlying Navajo Sandstone. The Kayenta is an orange to reddish sandstone interbedded with siltstone and rare lenses of limestone. The weathered sections can appear pale red with a purplish cast.

The Navajo Sandstone is the uppermost formation of the Glen Canyon Group and is prominent throughout Glen Canyon. Where it is exposed in its entirety, the tan to light reddish brown Navajo sandstone can form massive, near-vertical cliffs reaching 600 to 1,500 feet high. Where the younger rocks were removed the sandstone erodes into the characteristic domes and knobs dissected by deep ravines.

The Chinle Formation, along with the Tropic Shale and Dakota Formations, is especially vulnerable to disturbance. These formations contain high amounts of bentonitic clays, which will swell when wet, slide easily, and appear to flow, resulting in an undermining of overlying materials. Compaction or scarring of the surface can cause accelerated sheet and gully erosion, which is further aggravated by the absence of vegetation.

Gully Erosion at Glen Canyon

In the uplake portions of Glen Canyon, upper Jurassic formation rocks dominate the landscape at the Bullfrog area, where rocks are typically thinly bedded siltstones and mudstones with occasional thin beds of white sandstone. Holocene gravels, dunes, and soils are scattered in the area. The rocks in the Hite Boat Ramp area are older than the rocks at Bullfrog, with geology at Hite being dominated by rocks of Permian and early Triassic age (NPS 2008e).

There are 36 miles of unpaved GMP road corridors on erosion-susceptible rock units in the Orange Cliffs and Smoky Mountain / Nipple Bench area. These deposits are highly unsuitable to all types of development, as noted in the GMP (NPS 1979).

Soils

Soils in Glen Canyon are integral to maintaining the physical, biological, and chemical integrity of the ecosystem. Wind and water action, both current and historic, have been and continue to be the dominant shaping forces in this region of canyons and plateaus. Unless soil deposits are protected from these natural forces they are subject to constant movement and erosion. The area receives little precipitation and contains scarce vascular vegetation cover. Soil and associated biological crusts provide three key functions in this water- and nutrient-limited environment: water absorption, resulting in decreased runoff; carbon and nitrogen fixation, providing mineral nutrients for vegetation growth; and porous material for physical support of soil structure and vegetation (Belnap 1993). Although wide swathes of Glen Canyon consist of bare rock, steep canyon walls, or bare rock with minimal soil cover, there are many areas that contain or have the potential to contain biological crusts and small areas of deeper alluvial soils. If such soils are disturbed, compacted, or eroded, the ecology of the entire ecosystem suffers a loss of productivity, diversity, and integrity.

Soils of Glen Canyon

Approximately one-third (400,000 acres) of Glen Canyon is exposed bare rock and the disintegrated shale and sandstone that make up canyon walls and plateau edges (NRCS 2010). The weathering of rock in flat areas such as plateaus and mesas, along with introduced windblown sand, may create a thin, noncontinuous soil mantle over the rock. This thin cover often has pockets of deeper soils in indented or sheltered areas, which frequently shift due to wind and erosion. These thin, shifting, constantly disturbed soils cover most of the remaining area. Because much of the soil in Glen Canyon is transported by water and wind, most of the deeper soils are present in protected areas such as dry streambeds, alluvial zones, former and existing canyons, and cliff bases. Deeper, more established soils make up a fraction of the Glen Canyon National Recreation Area (1,850 acres) (NRCS 2010).

Approximately one-third (400,000 acres) of Glen Canyon is exposed bare rock and the disintegrated shale and sandstone that make up canyon walls and plateau edges (NRCS 2010).

Soils in Glen Canyon are generally sandy, with most upland areas containing variants of sandy loam, loamy sand, and sand. There are also areas of high clay content, known as clay barrens, and areas with high mineral concentrations (NRCS 2010). Clay and silt loams may be found in alluvial areas or the shoreline area of Lake Powell where soil deposits are left behind by retreating waters. In sections of the accessible shoreline areas of Glen Canyon where soils are occasionally inundated, flooding creates anaerobic conditions and limits the development of biological crusts or vegetation. Shoreline areas and dry washes that are rarely covered in water may support increased vegetation because of deeper, more fertile alluvial or windborne soil deposits, protection from erosive forces, and/or increased moisture availability. Alluvial soil deposits and associated vegetation commonly occur at the edge of the high water line, especially in protected stream beds or canyons. Upland areas that contain sandy soils or sand mixed with clay and minerals may form either biological or physical crusts. The majority of the soils in ORV areas are shallow and subject to frequent shifting due to wind and water. Deeper, established soils are found in accessible shoreline areas (particularly in canyons), or at the base of rock outcrops or cliffs (above the high water line and/or protected from water run-off). These areas may contain biological crusts and vegetation, and are subject to less wind and water erosion because these processes fix the soil in place.

Biological crusts (or biotic crusts) are a key component of the ecosystem formed on the thin soils of Glen Canyon and across the Colorado Plateau region, where up to 70% of living ground cover may consist of biological crusts (Belnap 1994). Biological crusts are composed of a community of specialized organisms including cyanobacteria, green algae, lichens, mosses, microfungi, and other bacteria, and appear as dark, sponge-like-textured pinnacles of soil (Belnap and Lange 2001). The soil is stabilized when filaments of cyanobacteria and microfungi extend into the upper few millimeters of soil and secrete a gel-like substance that binds the soil particles together to form a cohesive matrix (Belnap and Gardner 1993; Belnap 1993). Once formed, biological crusts are an important foundation of the desert ecosystem and serve to retain soil moisture, reduce water and wind erosion, fix atmospheric nitrogen, and contribute to soil organic matter (Neff et al. 2005). The composition of species associated with biological soil crusts varies from site to site but the diversity of organisms in a crust is often greater than that of the vascular plants present in the area (Belnap and Lange 2001; Rosentreter et al. 2007). As such, these crusts are increasingly recognized for having a major influence on terrestrial ecosystems by stabilizing the soils, reducing runoff, increasing water absorption, and forming a base for the growth of lichens and bryophytes (Belnap et al. 2001).

Bathtub Ring on Far Shore

Soils in Glen Canyon may form biological crusts in areas free from historic or current nonnatural disturbance, with shallow soil and limited water and wind erosion. Biological crust cover generally increases in areas with low vascular plant cover, at lower elevation, and with more loosely embedded rocks, shallower soils, and fine soil texture (Belnap and Lange 2001). Soil chemistry also influences crust formation and composition with calcareous and gypsiferous soils supporting a high coverage of species-rich crust (McCune and Antos 1982). Biological crust formation is limited because over one-third of Glen Canyon consists of bare rock, and one-third has thin, shifting soils, with wide swathes containing high concentrations of minerals. Biological crusts are also unlikely to form in areas with high salt concentrations (Belnap and Lange 2001). Additionally, areas of Glen Canyon in the “bathtub ring” of Glen Canyon (the land around Lake Powell bleached by high water), or in dry streambeds and canyons, are subject to inundation during high water events. Flooded soils create anaerobic conditions, which inhibit the development of biological crusts due to the intolerance of lichen for low-oxygen or no-oxygen conditions (Winward 1980).

Nonbiotic crusts, known as physical crusts, also commonly occur in Glen Canyon. These crusts are primarily formed by raindrop impact, which breaks down the soil and fixes small-diameter silt and clay particles to the surface, creating strong, dense, soil layers ranging in thickness from 1 millimeter to 3 centimeters. The crusts have low infiltration rates, which limits drainage, resulting in increased water runoff and soil erosion, and in reduced germination and emergence rates of vascular plants (Belnap and Lange 2001). Aerial images of Glen Canyon show large areas of physical crusts, often indicated by white expanses of salts, lime, and silica, which are deposited at the surface during evaporation. Physical soil crusts are commonly formed in soils with low organic matter and low silt and clay content (Lemos and Lutz 1957; Belnap and Lange 2001). The formation of such crusts is reduced by livestock grazing management, soil surface protection, and increased soil organic matter (Belnap and Lange 2001; Neff et al. 2005). When left undisturbed, physical crusts pool water and may become a foundation for biological crusts (Belnap et al. 2001). Impermeable soils are also formed through trampling by livestock or through wheeled vehicle passage, which compact and shear the soil, resulting in more surface runoff along with the destruction of soil pores and structure (Adams et al. 1982; Payne et al. 1983). Because the compaction associated with livestock or vehicles destroys soil structure, these impermeable soils generally do not form the basis for biological crusts (Belnap and Lange 2001).

Soils in the Project Area

Lone Rock Beach

Lone Rock Beach is located in a highly disturbed area with heavy impacts caused by visitors traveling off designated trails, ORV traffic, and camping. In areas that are occasionally or seasonally inundated during high water levels, soil disturbance and compaction leads to increased erosion and runoff. Biological crusts are uncommon due to existing disturbance levels, and trails and associated compaction related to foot traffic and off-road use are omnipresent. Although some patches of vegetation, including four-wing saltbush (*Atriplex canescens*) and Russian thistle (*Salsola pestifer*), exist on older portions of the beach, soils are primarily thin and sandy with little vascular vegetation cover. Shoreline soils may contain deposits of fine clay or loam, with anaerobic conditions and occasional inundation, both of which limit plant growth. Soils found in this area are of the Pagina–Farb–rock outcrop association and rock outcrop–Needle association, which are generally shallow, fine, and sandy soils, derived from sandstone and deposited by the wind. Such soils are easily disturbed. There are also areas of exposed rock and sandy deposits, indicating that wind is a strong shaping force in the soils in the vicinity, and many of the soils are therefore transient and shallow.

Lone Rock Beach Play Area

This area is highly disturbed by off-road use, leading to erosion and compaction. Minimal biological or physical soil crusts and very little, if any, vascular vegetation cover exist in this area due to the physical disturbance from tire passes. ORV traffic results in increased soil loss due to disturbance from these vehicles, which loosens and kicks up soil, and subsequent wind action, which transports it away from the area. Soils found in this area are of the Pagina–Farb–rock outcrop association and rock outcrop–Needle association, which are generally shallow, fine, and sandy soils derived from sandstone and deposited by the wind. Such soils are easily disturbed. There are also areas of exposed rock and sandy deposits, indicating that wind is a strong shaping force in the soils in the vicinity, and many of the soils are therefore transient and shallow.

Ferry Swale

The Ferry Swale area is increasingly subject to off-road use along user-created routes, leading to soils erosion and compaction in descrete portions of the wider Ferry Swale area. Minimal biological or physical soil crusts and very little, if any, vascular vegetation cover exist in these portions of Ferry Swale due to the physical disturbance from tire passes. Soils in Ferry Swale include easily disturbed Farb-Pagina type soils. Other soil types include Juanalo,

Needle-Sheppard, and Pagina-Denazar. There are also areas of exposed rock and sandy deposits, indicating that wind is a strong shaping force of the soils in the vicinity.

Paved and Unpaved GMP Roads

Soils along these roads in the Uplake Area consist primarily of alluvial or colluvial soils derived from water and wind erosion of the surrounding bedrock. Soils along paved and unpaved GMP roads generally are not experiencing ongoing disturbances because paved and unpaved GMP roads are maintained for motor vehicle use. Soils in the vicinity of these roads may be disturbed by off-road vehicle travel. These soils include the Monue, Bluecheif, Moenkopi, and Moffat series.

The Monue series soils consist of very deep, well-drained, moderately rapidly permeable soils on alluvial terraces and eolian deposits on structural benches. These soils form from the erosion of sandstone. Soils are loamy fine sand. Slopes range from 1% to 12%. These soils are typically deeper than 60 inches, but may have bedrock at depths of 40 to 60 inches. Soils are typically used for rangeland.

The Bluechief series consists of moderately deep, well-drained, moderately to rapidly permeable soils that are formed in sandy eolian deposits and alluvium derived from sandstone. These soils are located on benches and fan terraces. Soils are fine sandy loam. Slopes range from 1% to 15%. Soil depths are typically 30 to 40 inches, but bedrock can occur at 20 inches. Soils in this series are typically used for rangeland, wildlife habitat, and recreation.

The Moenkopi series consists of very shallow and shallow, well-drained, moderately to rapidly permeable soils that formed in alluvium and residuum from sandstone and shale. Moenkopi soils are on mesas, hill slopes on structural benches, and plateaus. Soils are loamy sand. Slopes are 1% to 30%. Soil depths are typically 9 to 12 inches, but can range from 4 to 20 inches. Soils in this series are typically used for livestock grazing and wildlife habitat.

The Moffat series consists of very deep, well-drained, moderately rapidly permeable soils that formed in eolian and alluvial sediments. These soils are on plains, plains on structural benches, and alluvial fans and have slopes ranging from 1% to 25%. Soils are gravelly fine sand. Soil depths are typically 40 to 60 inches. Soils are typically used for rangeland.

Accessible Shoreline Areas

Areas where vehicles access shorelines may contain sensitive soils, particularly because roads and routes often lead through canyons and old or existing streambeds. Under the right conditions, these areas may contain better established soils with higher levels of organic components and more vegetation cover, or biological crusts (see detailed discussion of each shoreline area). Most soils found in these areas are poorly developed, shallow soils that erode easily and regenerate slowly. These areas may develop biological crusts where there are shallow slopes and minimal vascular vegetation cover. Many areas contain high percentages of rocky outcroppings with soil deposits on the slopes and at the bases of the outcroppings that are shallow, frequently shifted by the wind, and primarily sandy. Shoreline areas that are below the high water line of the reservoir already experience disturbance due to fluctuating water levels. However, further erosion, runoff, and compaction from off-road use may result in decreased water quality along with increased soil loss.

Neskahi, Dirty Devil, Copper Canyon, Farley Canyon, Paiute Canyon, and Stanton Creek: These accessible shoreline areas all contain Torriorthents–rock outcrop association soils. This association consists of nearly half rock outcrops, with most of the remainder made up of Torriorthents or similar soils. Better-established, deeper Myton soils are found in drainages, particularly at Farley Canyon. Torriorthents soils are sandy and gravelly talus derived from sandstone and shale, and are of variable depth. These soils are transported by wind or water and form a thin mantle over the rock. In areas of shallow slopes and sparse vegetation cover, these soils may form biological crusts.

Paiute Farms and Nokai Canyon: These accessible shorelines contain rock outcrop soil associations similar to those of other shorelines in the immediate vicinity, such as Copper Canyon. The Moenkopi Formation, in which these sites are situated, is described as thin-bedded. Rapid erosion at Paiute Farms has created a relatively level surface shallowly dissected by gullies and washes that drain northward into the former San Juan River channel (Fairley 1985; NPS 1986).

Stanton Creek: Soils in this area are rock outcrop–Needle association. Soils are derived from windblown sandstone, and rock outcrops cover the majority of the area. Soils are shallow, with rare areas of deeper soils where they were deposited by water or are protected from scouring winds. The topography of the areas limits the formation of biological crusts to gently sloping or flat areas. In areas of rock outcrop, the potential for erosion is minimal. In areas with soil cover where there is no vegetation or biological crust to fix the soil in place, there is frequent erosion due to wind, and water, and soils shift frequently. In areas where biological crusts have formed, or sand sagebrush grows, fixing the soil in place, there is less potential for wind or water erosion. Any physical disturbance to the area (tire tracks, foot traffic), may break down the biological crust or disrupt the root system of vegetation, increasing erosion potential.

Red Canyon and Blue Notch: These areas contain mostly Torriorthents–rock outcrop association soils, which are shallow, sandy soils generally located on slopes, with almost half consisting of rock outcrops. Because of the steeper topography generally found in these areas, biological crust formation would be less likely, except in areas of gentle slopes. The slopes on which these soils are found may be too steep for any ORV. Increased vehicle use is possible in those limited areas that do contain deeper, better established soils, because most access roads run through canyons, where protection from the wind and shallow slopes may allow for soil collection and subsequent vegetation stabilization. Physical disturbance to these better established soils, especially disruption to stabilizing biological crusts or to the root system of vegetation (blackbrush and shadscale) may increase erosion. Canyon areas are prone to flash floods or periods of fast moving water, and loose soil in the path of this water would be carried away.

Bullfrog South, Bullfrog North, Warm Creek, and Crosby Canyon: These areas contain a mixture of deeper, better-established, and loamy Pagina soils, and shallow, shifting, sandy Torriorthents–rock outcrop. As with many shoreline areas around Glen Canyon, rock outcroppings make up about a third of the surface area, with shallow soils prevalent and deeper soils occurring on flatter plateaus and structural benches. The deeper soils present in these areas are somewhat rare and may contain better established vegetation. In areas of shallow clay or loamy soil, biological crust formation is likely due to their ability to retain moisture for a longer period following a rainfall event. Biological crusts in these areas are susceptible to erosion due to physical disturbance (tire tracks, foot traffic), because a breakdown of the crust allows the underlying soil to be carried away by wind or water. Shallow, shifting Torriorthents soils are subject to frequent wind and water erosion, which would be accelerated by physical disturbances to these areas.

White Canyon: The soils in White Canyon are shallow, sandy, and shifting soils found in rock-outcrop-Needle association and Torriorthents–rock outcrop association. Nearly half of the area consists of exposed rock outcroppings. Soils are shallow with rare areas of deeper soils where they were deposited by water or are protected from scouring winds. The topography of the areas limits the formation of biological crusts to gently sloping or flat areas. In areas of rock outcrop, the potential for erosion is minimal. In areas with soil cover where there is no vegetation or biological crust to fix the soil in place, there is frequent erosion due to wind and water, and soils shift frequently. In areas where biological crusts have formed or with vegetation cover fixing the soil in place, there is less potential for wind or water erosion. Any physical disturbance to these areas (tire tracks, foot traffic), may break down the biological crust or disrupt the root system of vegetation, increasing the erosion potential.

Hite Boat Ramp: Although the Hite Boat Ramp area itself is located upon rock outcropping, soils in the Hite area include those from the Moenkopi series. The Moenkopi series consists of very shallow and shallow, well-drained, moderately to rapidly permeable soils that formed in alluvium and residuum from sandstone and shale. Moenkopi

soils occur on mesas, hill slopes on structural benches, and plateaus. Soils are loamy sand. Slopes are 1% to 30%. Soil depths are typically 9 to 12 inches, but can range from 4 to 20 inches. Soils in this series are typically used for livestock grazing and wildlife habitat.

Figure 12 shows soils in the project area.

VEGETATION

The vegetation of Glen Canyon is highly diverse and typical of the Colorado Plateau Region, consisting of a variety of arid and semiarid plant communities.

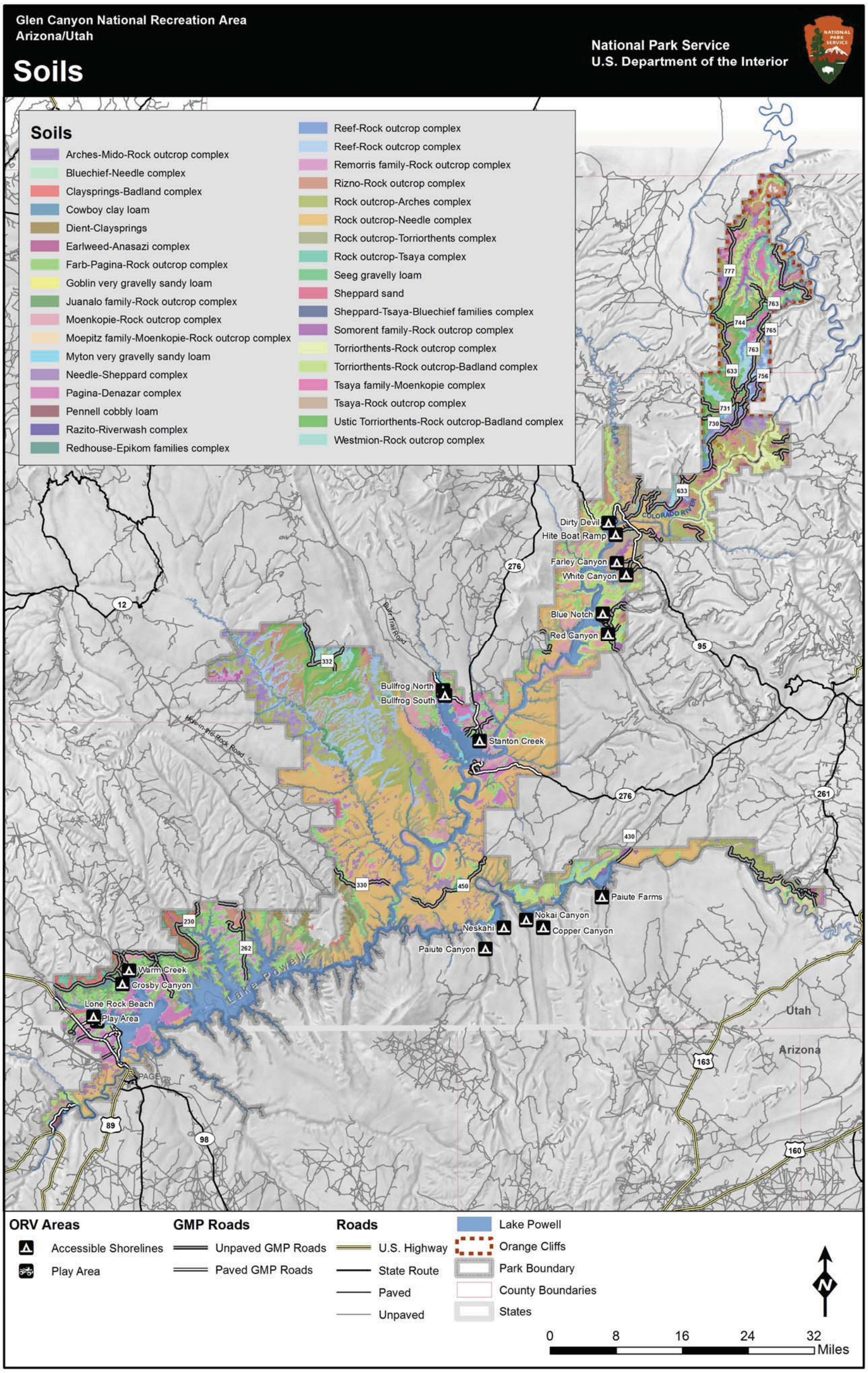
Glen Canyon lies in the Colorado Plateau Floristic Region. This region is roughly centered on the "four corners" region of the southwestern United States, occupying Arizona, Colorado, New Mexico, and Utah. The vegetation of Glen Canyon is highly diverse and typical of the Colorado Plateau Region, consisting of a variety of arid and semiarid plant communities. Generally, the majority of Glen Canyon below 5,000 feet above sea level is dominated by blackbrush shrubland on shallow rocky soils. Typically, surrounding these areas shadscale, a mixture of shadscale and blackbrush, sand sagebrush, and Cutler-Mormon-tea (*Ephedra cutleri*) can be found. Sandy soils support a mosaic of shrubland and grassland types. Clay barrens are common and generally vegetated by ephemeral annual forbs or dwarf shrubland that is dominated by species of saltbush (*Atriplex* spp.), including mat saltbush (*A. corrugata*) and four-wing saltbush. In areas along streams, Fremont cottonwood (*Populus fremontii*) can be frequently found. Areas above 5,000 feet above sea level are dominated by pinyon/juniper woodlands composed of stands of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*), interspersed with meadows dominated by big sagebrush (*Artemisia tridentata*) (figure 13).

Glen Canyon exhibits a tremendous diversity in vegetation types. Over 850 species of vascular plants were identified in Glen Canyon, including more than 30 Colorado Plateau–endemic plant species (Hill and Ayers 2009). Of these, 10 species are considered rare by the states of Utah and Arizona and three species are federally listed. The "Special-status Species" section of chapter 3 includes discussion in greater detail. The majority of Glen Canyon below 5,000 feet is considered shrubland and grasslands, with areas above 5,000 feet being recognized as woodlands.

Shrubland areas affected by off-road use include upland arid and semiarid, northern desert shrublands, upland dwarf shrublands, and riparian shrublands. In addition to shrublands, Glen Canyon is home to two woodland vegetation communities: upland and riparian. Additionally, Glen Canyon has springs and hanging gardens, a number of nonnative species, and relict plant communities.

Vegetation at the Warm Creek Area

Classification of the vegetation communities of Glen Canyon has been undertaken by Tuhy and MacMahon (1988), and by Spence (1995; Spence 2002 unpublished). Differences in vegetation associations and plant communities are due to local variations in environmental conditions: geologic formations, which affect soil types and water availability, elevation, and slope aspect affect the conditions available for distinct plant communities. The following sections describe the principal vegetative communities in Glen Canyon.



Note: Due to the extent of the map, not all soil types are displayed (more than 50 soils types occur within Glen Canyon's boundaries). Only soil types within the geographic scope of the plan are displayed.

FIGURE 12: SOILS IN THE PROJECT AREA, GLEN CANYON NATIONAL RECREATION AREA

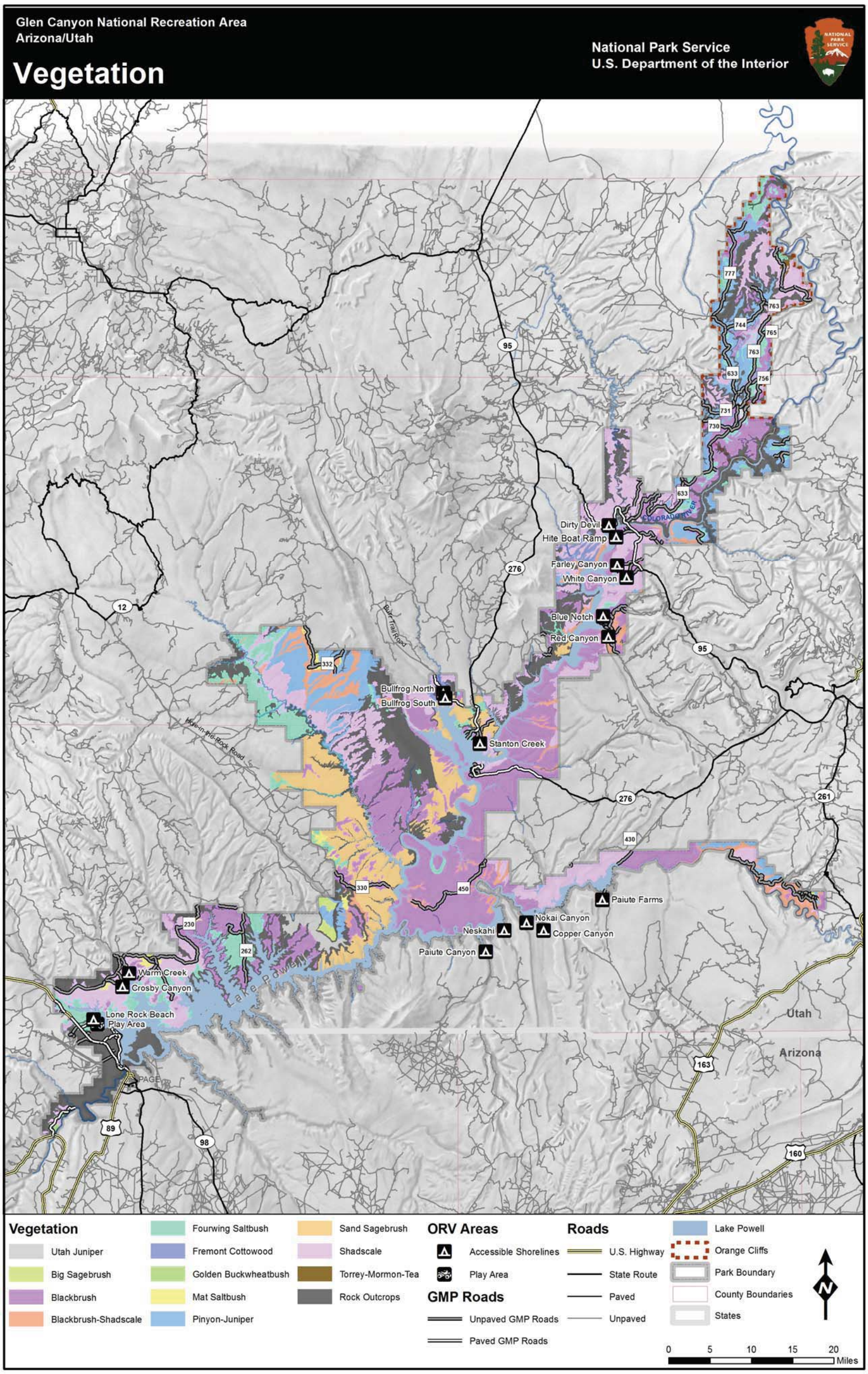


FIGURE 13: VEGETATION OF GLEN CANYON NATIONAL RECREATION AREA

Upland Shrubland

Upland arid and semiarid, northern desert shrublands and upland dwarf shrublands form the dominant vegetation in Glen Canyon. A variety of shrub species have adapted to the arid hot summer and cold winter climate of the region. Differences in species composition between shrublands are primarily related to soil characteristics, aspect, and elevation.

Blackbrush is the dominant shrub species over extensive areas in upland shrublands. Blackbrush grows on nonsaline, sandy or stony loams of old pediment slopes and terraces with caliche layers. Blackbrush sites with shallow soils are often found with well-developed biological soil crusts, which are highly susceptible to surface disturbance. In accessible shorelines where blackbrush is present include White Canyon, Blue Notch, Hite Boat Ramp, Red Canyon, and Warm Creek.

Shadscale is another relatively abundant evergreen shrub found throughout Glen Canyon. Shadscale stands often cover sites with finer-textured, relatively saline soils. This community covers less of Glen Canyon than blackbrush because the shale and siltstone formations that favor shadscale are less common in the area compared to the sandstone-derived soils that support blackbrush and sand shrub vegetation (see discussion of sand shrub communities in Vegetation in Accessible Shoreline Areas below). Shadscale is often found in association with galleta and Indian ricegrass in shallow sandy clay loams, but where the clay content is high it coexists with mat saltbush. Accessible shorelines where shadscale is found include Dirty Devil, White Canyon, Farley Canyon, Bullfrog South, Stanton Creek, Crosby Canyon, and Warm Creek.

Riparian Shrublands

In Glen Canyon two types of riparian shrublands occur, one associated with permanent water or a shallow water table and the second associated with ephemeral or intermittent streams. Along permanent streams, coyote willow (*Salix exigua*) and seepwillow (*Baccharis salicina*) are dominant, with understories that typically include horsetail (*Equisetum hyemale*), wiregrass (*Juncus balticus*), or species of bulrush (*Scirpus* spp.). Along the original Colorado River corridor, stands of arrowweed (*Tessaria sericea*) are common, with some patches still found below Glen Canyon Dam and in side canyons off Lake Powell.

Vegetation at the Alstrom Point Area

A facultative riparian species-rich shrubland can develop along intermittent or ephemeral stream channels. Dominant species include Apache plume (*Fallugia paradoxa*), cliffrose (*Purshia stansburiana*), and various species of rabbitbrush (*Chrysothamnus nauseosus* and *C. viscidiflorus*). The understory of these stands is typically composed of upland species found in the adjacent upland vegetation.

Many riparian shrublands in Glen Canyon have been invaded by nonnative species, primarily tamarisk (*Tamarix ramosissima*), Russian olive (*Elaeagnus angustifolia*), Ravenna grass (*Saccharum ravennae*), camelthorn (*Alhagi maurorum*), and Russian knapweed (*Acroptilon repens*). In many areas, tamarisk has become the dominant species. These areas then become susceptible to fire, which increases the dominance of tamarisk because it is a fire-adapted species.

Upland Woodlands

Upland woodland has vegetation dominated by trees, typically open canopy, with cover of 20% to 60% that supports various kinds of conifer woodlands, dominated by species of *Pinus* and *Juniperus*. These woodlands are widespread in the western and southwestern portions of United States and extend into Mexico. They tend to develop where precipitation is about 12 inches or more, although they can be found in drier regions, typically in areas where underlying rock holds water.

The pinyon/juniper alliance is the principal woodland community in Glen Canyon, consisting of the small pinyon pine and Utah juniper trees. These woodlands typically occur above 5,000 feet above sea level, up to elevations of 7,500 feet. They are highly variable depending on soil type, aspect, slope, and elevation. Many examples of the pinyon/juniper alliance are fairly open, with a sparse shrub understory. In a few areas, including the Orange Cliffs and Navajo Point, very dense stands of large old-growth pinyon/juniper exist. In these cases there is very little understory other than a few low shrubs and forbs (NPS 1993).

In addition, the pinyon/juniper alliance has a variety of associated shrub species typically found in nearby meadows, including big sagebrush, Utah serviceberry (*Amelanchier utahensis*), mountain mahogany (*Cercocarpus intricatus*), blackbrush, singleleaf ash (*Fraxinus anomala*), and roundleaf buffaloberry (*Shepherdia rotundifolia*).

Grazing is the most prevalent disturbance in pinyon/juniper woodlands, but recreation, including off-road driving, can also impact these areas. Disturbed stands often have high concentrations of cheatgrass (*Bromus tectorum*) and other nonnative annuals in their understory, and markedly reduced species diversity.

Riparian Woodlands

Stands of Fremont cottonwood occur throughout Glen Canyon along streams and sometimes in association with springs. There is typically a series of stands of this species of differing ages related to flooding, ranging from young dense congregations of saplings along recent stream channels to older, larger trees on high terraces. They are classified as woodlands rather than forests because most examples are rather open, with fairly low canopy cover. Fremont cottonwood is a critically important component in both breeding and migratory habitat for many bird species, with the majority found along the Escalante River. Stands of cottonwood also occur in alliance with Goodding willow (*Salix gooddingii*), or more rarely, box elder (*Acer negundo*).

On upper stream terraces and in somewhat drier sites, Fremont cottonwood is the sole tree species present, typically with a dense understory of upland shrubs, especially of rabbitbrush. Locations with cottonwood stands are attractive to recreationists because the trees provide cover and are associated with water. Heavy use of these areas can lead to soil compaction and erosion, the exposure of root systems, the trampling of understory vegetation, and direct damage to the trees from wood collection and other activities. Flooding is also a common disturbance in riparian woodlands stands.

A number of riparian woodlands in Glen Canyon have been invaded by nonnative species, primarily tamarisk (*Tamarix ramosissima*), sweet clover (*Melilotus* spp.), Russian olive, alfalfa (*Medicago sativa*), Russian thistle, rip gut brome (*Bromus diandrus*), Japanese brome (*Bromus japonicus*), and cheatgrass.

Springs and Hanging Gardens

Spring- and seep-supported plant communities are rare in the Colorado Plateau physiographic province, but occur with enough frequency in Glen Canyon that explorer John Wesley Powell named the area Glen Canyon due to the abundance of these glens, or hanging gardens. There are approximately 50 acres of hanging gardens (spring-fed colonies of plants found clinging to vertical cliff walls) in Glen Canyon. The springs are derived from a local aquifer primarily supplied by winter precipitation. The water supply moves through a porous sandstone unit until it

reaches a less permeable layer of rock, such as the Kayenta Formation. At this point, the water begins to flow laterally, seeping out of the stone and flowing over the cliff face. This water source provides suitable habitat for a rich array of plants to grow directly from the cliff face. Hanging gardens support a rich variety of water-loving plant species, such as ferns, lilies, sedges, and orchids. About 35 species of Colorado Plateau–endemic plants are associated with hanging gardens and related spring communities. These gardens are also hot spots of biodiversity, supporting many species of plants and associated terrestrial invertebrates, aquatic invertebrates, birds, mammals, and amphibians. Hanging gardens are very fragile and are easily damaged by cattle grazing, recreation, and other impacts that can damage the vegetation or soils on which these gardens depend. Existing off-road use and potential future off-road use would not impact the springs or hanging gardens.

Many other types of springs also occur in Glen Canyon, including limnocrenes, slope springs, gushettes, wetland springs, and mound springs. Biodiversity varies across these spring types, but overall tends to be lower than in hanging gardens.

Relict Plant Communities

A relict plant community is a community that once had a wider distribution but now only occurs in a localized area. There are two kinds of relict plant communities in Glen Canyon. One consists of patches of vegetation with species that do not typically occur in the region or at the elevations in Glen Canyon; these are ecological relicts. The second type consists of intact, ungrazed vegetation that retains pre-European settlement conditions. Tuhy and MacMahon (1988) identified these latter known and potential ungrazed native (relict) vegetation areas in Glen Canyon. These are locations where natural biological and physical processes occur unhindered by direct human influence. They are important because they serve as sanctuaries for individual species and plant communities, and have value for applied science as a baseline against which to compare the impacts of human intervention on the natural environment.

Of the 21 areas identified as in relict or near-relict condition, more than half were assessed by Tuhy and MacMahon as being candidates to become part of the Colorado Plateau regionwide network of relict areas. Most of these areas are found on upland benches and are inaccessible due to topography. Only one relict area, on the Grand Bench, is accessible by ORVs.

Ecological relicts include patches of California sawgrass (*Cladium californicum*) at springs and in hanging gardens, stands of bigtooth maple (*Acer grandidentatum*) in canyons off the Escalante Arm, and stands of Douglas fir (*Pseudotsuga menziesii*) associated with shaded alcoves (Spence 1994).

Nonnative Species

Nonnative plants are exotic plants introduced from other parts of the world. Nonnative, invasive species are nonnative species that are able to spread and invade into natural areas. The spread of invasive plants is regarded as one of the most serious ecological threats facing our nation, second only to outright habitat destruction. Invasive plants can outcompete native species, disrupt food chains, and change nutrient cycles.

NPS has identified 83 nonnative plant species in Glen Canyon. Of these known nonnative species, nine are controlled because of the threat they pose to native plants and plant habitats: Russian knapweed, African mustard (*Brassica tournefortii*), Russian olive, camelthorn, tamarisk (salt cedar), giant reed (*Arundo donax*), Uruguayan pampas grass (*Cortaderia selloana*), perennial peppergrass (*Lepidium latifolium*), and Ravenna grass. The remaining nonnative plant species are not prone to being invasive and are not a threat, or they are too abundant and too difficult to control, such as Russian thistle and cheatgrass.

Vegetation in Accessible Shoreline Areas

Vegetation in accessible shorelines is minimal and sparse. In the 13 accessible shoreline areas, as well as Nokai Canyon, Lone Rock Beach and the Lone Rock Beach Play Area, vegetation is minimal and primarily consists of blackbrush and shadscale. These accessible shorelines are typified by lower elevations and low to moderate sand slopes. Sand shrub communities typically include sand sagebrush, four-wing saltbush, Vanclevea (*Vanclevea stylosa*), Torrey-Mormon-tea, and plains beavertail (*Opuntia erinacea*). Grasses include Indian ricegrass (*Achnatherum hymenoides*) and dropseeds (*Sporobolus* spp.). A variety of forbs occur, including globemallow (*Sphaeralcea grossulariifolia*), bird's beak (*Cordylanthus wrightii*), pallid evening-primrose (*Oenothera pallida*), annual sunflower (*Helianthus petiolaris*), and numerous additional annual species. Biological soil crusts are typically common on sandy soils in these communities, especially under and around the shrubs.

Vegetation in Paiute Farms is typical of a desert shrub community, with the primary vegetation types being four-wing saltbush, Mormon tea (*Ephedra torreyana*), prickly-pear cacti (*Opuntia* spp.), rabbitbrush, and Russian thistle (NPS 1986). ORVs are also used in locations dominated by rock outcrops (Spence n.d.). Some slopes and heavily used accessible shorelines are completely denuded of vegetation, except for partial areas inhabited by sagebrush. Some species, such as snakeweed (*Gutierrezia microcephala*), dicoria (*Dicoria brandegeei*), and ragweed (*Ambrosia acanthicarpa*), that have taken advantage of ORV activity because they have adapted to various soil disturbances.

Vegetation Along Paved and Unpaved GMP Roads

Vegetation along both unpaved and paved GMP roads throughout Glen Canyon is typically minimal and sparse and is characteristically similar to the vegetation found within the region of Glen Canyon where the roads exist. Typical vegetation found along roads throughout Glen Canyon includes shadscale, blackbrush and rock outcrops, as well as the presence of pinyon-juniper and four-wing saltbrush in the northern, southwestern and Ferry Swale portion of Glen Canyon and mat saltbush sand sagebrush along NPS Roads 330, 332, and 230.

Vegetation in Ferry Swale

Vegetation in the Ferry Swale area is slightly different than vegetation throughout the remainder of Glen Canyon in that the majority of Ferry Swale is composed of rock outcrops. Rock outcrops dominate the landscape in the southwest and northwest portion of Ferry Swale. Some shadscale and golden buckwheat bush exist intermittently in the southwest portion, while the western, eastern, and central portion of Ferry Swale consists primarily of shadscale and fourwing saltbrush as well as some smaller areas of mat saltbrush.

WILDLIFE AND WILDLIFE HABITAT

The highly diverse vegetation of Glen Canyon creates important habitat for a diverse range of vertebrate animals.

Glen Canyon supports a complex and fragile ecosystem, with plants and wildlife that have developed unique adaptations to the arid conditions of their environments. Typical of the Colorado Plateau, the highly diverse vegetation of Glen Canyon creates important habitat for a diverse range of vertebrate animals, including mammals, fish, reptiles and amphibians, and birds (NPS 2007d). Within the boundaries of Glen Canyon, approximately 438 vertebrate species have been documented, including 64 species of mammals (NPS 2007b), 25 species of fish (NPS n.d.d), 31 species of reptiles (Drost et al. 2008), 6 species of amphibians (NPS n.d.e), and 316 species of birds (Spence, LaRue, and Grahame 2011). In addition, an unknown but potentially large number of arthropod species could be found in Glen Canyon. This section describes vertebrate wildlife that could be affected by off-road use. Fish species are not discussed because impacts to water quality in Glen Canyon from the alternatives proposed in the plan/DEIS would not be substantial. Therefore, it is expected that there would not be a substantial indirect impact to fish or its habitat, including species of special concern.

Mammals

Adaptations such as temperature control and water conservation help mammals survive the heat of the Colorado Plateau desert. Small mammals are more common than larger mammals in a desert environment because of their lower energy requirements, rates of heat loss, and food and water needs. Of the 64 mammal species documented in Glen Canyon, bats, rodents, and other small mammals are the most commonly observed. Deer mice, pocket mice, and several other species of mice are common small mammals in Glen Canyon. Ord's kangaroo rat is ecologically important because of its seed-caching behavior. The kangaroo rat will husk and cache seeds of Indian ricegrass and other grasses, sometimes forgetting caches (NPS 2008d) thus increasing seed dissemination.

Other herbivores include desert cottontail, black-tailed jackrabbit, squirrels, chipmunks, and four species of woodrat. Woodrats prefer to build their middens on rocky slopes in scrublands and pinyon/juniper woodlands. Some middens were dated to over 50,000 years old, and show a record of the plant and animal communities that once existed in the woodrat's range (NPS 2008d).

There are 17 bat species known to be found in Glen Canyon (NPS n.d.b), including two rare species: the spotted bat (*Euderma maculatum*) and Townsend's big-eared bat (*Plecotus townsendii*). The largest bat likely to be seen at Glen Canyon is the pallid bat, which is commonly seen at dusk. Some bats, such as the big brown bat, may only be seen during migration. Other bat species known to be present in Glen Canyon include Yuma myotis (*Myotis yumanensis*), little brown myotis, fringed myotis (*Myotis thysanodes*), western pipistrelle, hoary bat, silver-haired bat, Allen's big-eared bat, big free-tailed bat (*Nyctinomops macrotis*), and Brazilian free-tailed bat (Bogan and Ramotnik 1995; NPS 2008d, n.d.b). Bats are able to lower their body temperature, metabolism, and breathing during the day to conserve energy as they roost alone or in colonies on the towering cliffs and canyon walls. Disturbing roosting bats or bats in torpor, which is similar to hibernation, may compromise their energy reserves and reduce their chances of survival (NPS 2008d). In 1994, baseline surveys for mammals in four riparian areas in Glen Canyon were conducted. The most abundant bat species observed during the surveys were Yuma myotis and pallid bat; both species are tolerant of arid environments, although Yuma myotis is closely tied to permanent sources of water (Bogan and Ramotnik 1995). Table 5 indicates which bat species were observed at the four riparian areas.

Predators in the area include bobcat, mountain lion, and coyote. These mammals avoid humans, but their scat and tracks in the area reveal their presence (NPS 2008d). Red, kit, and gray foxes are also present in the area, and can be found in various open and semiopen habitats, including grassland, savanna, shrubland, and woodland (NatureServe 2009; NPS n.d.b). Smaller predators and omnivores include ringtail, raccoon, American badger, long-tailed weasel, and skunks. A single sighting of black bear was recorded at Trachyte Creek (NPS n.d.b). In recent years river otters have colonized Lake Powell from source populations in the Escalante River and Green River (NPS 2008d).

Larger mammals like the mule deer are found locally in Glen Canyon but are seldom seen. Pronghorn antelopes exist on adjacent public lands, and may occasionally wander into Glen Canyon. Elk and bison are known from surrounding public lands and occasionally individuals wander into Glen Canyon. In 1941, bison were reintroduced from Yellowstone National Park to the Henry Mountains northwest of Glen Canyon. They are one of the few remaining genetically pure bison herds (NPS 2008d).

Mammal species generally more vulnerable to ORV activity include burrowing species such as kangaroo rats and other rodents that nest in open sandy sites and whose burrows are easily crushed (Spence n.d.). In addition to ORVs crushing habitat, engine noise can deafen a kangaroo rat and virtually eliminate its defensive hearing (Radle 2007). Bighorn sheep are also known to be intolerant of noise and ORV activities, and can abandon areas where such activity is common (Keller and Bender 2007).

TABLE 5: BAT SPECIES OBSERVED AT FOUR RIPARIAN AREAS IN GLEN CANYON NATIONAL RECREATION AREA

State	County	Area(s)	Species	Number Observed
Utah	San Juan	Lake Powell, north bank San Juan River, Wilson Creek	Yuma myotis	1
			Townsend's big-eared bat	1
Utah	Kane	Last Chance Creek	Pallid bat	4
			Allen's big-eared bat	1
			California myotis	2
			Yuma myotis	1
			Western pipistrelle	2
			Pale Townsend's big-eared bat	1
Utah	San Juan	East bank Lake Powell, Ribbon Canyon	Pallid bat	1
			Fringed myotis	1
			Yuma myotis	2
			Mexican free-tailed bat	1
Utah	Kane	East bank Escalante River, Cow Canyon	Big brown bat	1
			Yuma myotis	3
			Western pipistrelle	1
			Mexican free-tailed bat	1

Source: Bogan and Ramotnik 1995.

REPTILES AND AMPHIBIANS

Reptiles have adapted to survive in hot, arid climates, and spend the hottest parts of the day in the shade in order to regulate their body temperature. Habitat preferences vary by species, although reptiles will escape the heat and predators in shady areas under bushes and tree trunks and in crevices in areas with vegetation. Therefore, many reptiles are more active in the early morning, twilight, or night to avoid these threats. Lizards can be commonly seen during the day, but most snakes are more likely to be seen at night (NPS 2008c).

Recent (–2007) systematic surveys have documented the presence of 31 species of reptiles and amphibians in Glen Canyon, and one extirpated species (Drost et al. 2008). Lizards are common to the Colorado Plateau and Glen Canyon, including the desert spiny lizard, eastern fence lizard, common side-blotched lizard, sagebrush lizard, eastern collared lizard, Great Basin collared lizard, western whiptail and ornate tree lizard (NPS 2008c; NPS n.d.c). The ornate tree lizard has been found in riparian areas, with a preference for slickrock walls and boulders (NPS 2008c). Rare, special-status lizards include the desert night lizard (*Xantusia vigilis*) and western banded gecko (*Coleonyx variegatus*) (NPS n.d.c). The chuckwalla (*Sauromalus obesus*) is the largest lizard found in Glen Canyon. This species was historically found along the Colorado River in Glen Canyon as far north as Hite, but likely has a smaller distribution due to the destruction of much of its habitat by the creation of Lake Powell (NPS 2008c). The "Special-status Species" section of this chapter includes further discussion of the desert night lizard and chuckwalla.

Common snakes in Glen Canyon include the terrestrial garter snake in riparian zones, as well as gopher snake, striped whipsnake, and the common kingsnake (NPS 2008c; n.d.c). The common kingsnake is generally active in

the morning and late afternoon, but tends to be nocturnal in hot weather. The night snake is nocturnal is and active at dawn and dusk. At least four western rattlesnake subspecies are present, including the midget faded rattlesnake, the Grand Canyon rattlesnake, the Hopi rattlesnake, and the Great Basin rattlesnake (NPS 2008c). Rare snakes include the glossy snake (*Arizona elegans*), which is listed as a species of special concern in Arizona, and western ground snake (NPS n.d.c). Rattlesnakes are the only venomous snakes in Glen Canyon and, like most reptiles, avoid detection if possible (NPS 2008c).

Like all desert dwellers, amphibians have adapted to the hot, arid environment of the Colorado Plateau. In general, amphibians are most active during the warmer months of the year (May to October) and may become more active in the early morning, twilight, or night during those months to conserve energy and moisture. The canyon treefrog is common around the shores and side canyons of Lake Powell and can be found clinging to sandstone walls near water during the day. Canyon treefrogs are widely distributed throughout the Colorado Plateau and prefer intermittent or permanent streams with rocky bottoms. The northern leopard frog (*Rana pipiens*), once common along the Colorado River through Glen Canyon, is now irregularly distributed across the Colorado Plateau and requires a permanent water source, preferably with well-developed wetland vegetation. The northern leopard frog is disappearing from much of its historic range in North America. It inhabits eight side canyons off Lake Powell. The Great Basin spadefoot toad is common throughout Glen Canyon, especially along ephemeral sandy washes. Two species of true toads have also been documented: the Woodhouse's and the red-spotted. These species are most common along streams in side canyons, but can be found crossing the desert as they move between canyons and waterholes (NPS 2008a). The exotic bullfrog has recently colonized the Hite area along the Colorado River in 1998 (Drost et al. 2008). Based on personal observation by John Spence, chief scientist at Glen Canyon, for years there have been persistent reports of bullfrogs throughout Cataract Canyon by river runners.

Although tiger salamanders are known to occur in Glen Canyon, none were observed in a 2003 inventory of amphibians and reptiles of Glen Canyon. This species is found in the Colorado Plateau and historically along the San Juan River and in Navajo country. Tiger salamanders require permanent or semipermanent water for breeding. Adults are commonly underground, but can be seen migrating between breeding sites during rains or found around pools and under objects in wetter side canyons off Lake Powell (NPS 2008a).

Reptiles and amphibians, most of which occur throughout Glen Canyon and in ORV areas, are highly vulnerable to the impacts of ORV activity. ORVs could impact reptiles by running over and killing individuals; collapsing burrows, thereby reducing access to subterranean prey as well as escape and thermoregulatory locations; or altering the habitat by changing the plant community, thereby affecting the availability of prey, escape locations, and shady locations (Munger and Ames 1998). Amphibians can often be impacted by ORV activity in riparian zones, either through chemical contamination of breeding pools or through direct crushing of adults and tadpoles (Maxell and Hokit 1999). In addition, ORV noise has been shown to damage hearing sensitivity and predator detection in fringe-toed lizards, and cause behavioral changes in spadefoot toads that put the animal at risk (Brattstrom and Bondello 1983; Schubert and Smith 2000). See the "Wildlife and Wildlife Habitat" section in chapter 4 for more detailed regarding the impacts of off-road use on reptiles and amphibians.

Birds

There are 307 native and 9 nonnative bird species reported from Glen Canyon and immediately adjacent developed areas, including the City of Page. This diversity of species was unknown prior to the construction of the dam, golf courses, and sewage treatment ponds, and can be largely attributed to the colonization of Lake Powell by aquatic and migratory birds. Shorebirds, waterfowl, and other water-associated bird species frequently use Lake Powell for resting and foraging during migration and overwintering, representing 101 of the 316 bird species found in Glen Canyon (Spence, LaRue, and Grahame 2011). Species commonly observed along the shoreline and on the lake include loons, grebes, cormorants, herons, egrets, coots, ducks, gulls, terns, and shorebirds (Spence 1998; Spence and Bobowski 2003).

Desert shrubland and grassland communities and adjacent rocky slopes host a variety of wintering, migrant, and resident bird species including the northern mockingbird, lesser nighthawk, Say's phoebe, mourning dove, rock wren, horned lark, white-crowned sparrow, lark sparrow, and black-throated sparrow. Permanent residents of these areas include the common raven, loggerhead shrike, canyon wren, and house finch (NPS 2007a).

The diversity of small rodents, songbirds, fish, and reptiles, combined with the proximity of nesting cliffs, explains the large number and diversity of raptors and owls in the area. Permanent and summer resident species include red-tailed hawk, Cooper's hawk, great horned owl, turkey vulture, prairie falcon, and the special-status species peregrine falcon (*Falco peregrinus*), golden eagle (*Aquila chrysaetos*), and osprey (*Pandion haliaetus*) (NPS 2007a; NPS n.d.a). Peregrine falcons, delisted from the endangered species list in 1999, are common around Lake Powell and along the major rivers, occupying 80 to 90% of known nests in the area each year (NPS 2008b). Peregrine falcons nest on Lone Rock and occasionally forage over the ORV area (Spence n.d.). The Lone Rock Beach Play Area includes potential habitat for burrowing owl (*Athene cunicularia*), which is a sparse summer resident of deep sandy slopes and rock outcrops in the Wahweap area and a species of special concern in Arizona and Utah (NPS n.d.a; Spence n.d.).

In winter, the summer resident species are augmented by bald eagle (*Haliaeetus leucocephalus*), northern harrier, and merlin (NPS n.d.a). Winter residents generally arrive around Lake Powell in October and November and are found in the area through January and February. Bald eagles prefer wide, shallow bays and side canyons including Wahweap, Warm Creek, Halls Creek Bay, and Bullfrog Bay and are rarely seen below the Glen Canyon Dam in the winter. This avoidance of the downstream area is most likely due to human disturbance through recreational activities. High water dam releases may also force birds off the Colorado River (NPS 2007c).

Riparian zones are critically important for birds. Many species nest and forage in these areas, and a majority of bird species use riparian corridors at some point in the year, particularly during migration. Summer residents include Bullock's oriole, ash-throated flycatcher, blue-gray gnatcatcher, yellow warbler, lesser goldfinch, black-chinned hummingbird, yellow-breasted chat, and black-headed grosbeak. Permanent year-round residents include house finch, Bewick's wren, great-tailed grackle, and many upland species that forage in riparian zones (NPS 2007b, n.d.a).

Several bird species are sensitive to human disturbance, with the potential for the disruption of courtship activities, overexposure of eggs or young to weather, and premature fledging of juveniles. Repeated disturbance can eventually lead to nest abandonment. Ground-nesting species are at greatest risk from ORV activity, due to nest abandonment and direct mortality from nests and young being crushed (Switalski and Jones 2010). These species are most common in the upland desert shrub communities, where lark sparrows, horned larks, burrowing owls, and lesser nighthawks build nests on the ground or use rodent burrows. Loggerhead shrikes and black-throated sparrows build nests in low shrubs (Cornell Lab of Ornithology n.d.; NatureServe 2010), and thus they are also susceptible to disturbance from ORV activity.

SPECIAL-STATUS SPECIES

For the purposes of this plan/DEIS, "special-status species" are defined as species listed by the U.S. Fish and Wildlife Service (USFWS) as endangered, threatened, candidate, or candidate with conservation agreements; by the states of Arizona or Utah as sensitive species; or by Glen Canyon as species of concern. The terms "threatened" and "endangered" as defined by the 1973 Endangered Species Act describe species that are likely to become or are now in danger of extinction throughout all or a significant portion of their ranges. "Candidate" species are those species for which sufficient information on biological vulnerability and threats is available to

"Special-status species" are defined as species listed by the USFWS as endangered, threatened, candidate, or candidate with conservation agreements; by the states of Arizona or Utah as sensitive species; or by Glen Canyon as species of concern.

support issuance of a proposed rule to list, but for which the rule issuance has not occurred. "Conservation agreements" refer to conservation measures for species that are proposed for listing, are candidates for listing, or are likely to become candidates in the near future.

Species are placed on the Utah state-listed sensitive species list if they are federally listed or if they are state "wildlife species of concern." Wildlife species of concern are species for which credible scientific evidence exists to substantiate a threat to continued population viability. Arizona lists "wildlife species of concern" for species whose occurrence in Arizona is or may be in jeopardy. Rare plants are listed in Arizona under one of five categories (highly safeguarded, salvage restricted, export restricted, salvage assessed, and harvest restricted).

Glen Canyon "species of concern" are species that may be on state lists or species that are rare in Glen Canyon even though they may be common in nearby locations.

Not all special-status species will be present in the project area. The Park Service received a letter from the USFWS dated October 5, 2007 (see "Appendix A: Consultation and Coordination") that included a list of species that may be found in the Coconino County portion of the project area, along with the location of information for all special-status species in the five-county region. These lists were reviewed by NPS biologists and narrowed down to a list of special-status species that could be found within the boundaries of Glen Canyon. This list was narrowed further to those species that could be expected to exist in one of the specific locations, including the ORV areas and adjacent to GMP roads, that could be affected by the actions proposed in the various alternatives presented under this plan/DEIS. These species are listed in table 6.

Table 6: Special-status Species at Glen Canyon National Recreation Area

Common Name	Scientific Name	Status	State (UT, AZ, or both)	Potential Occurrence within Glen Canyon
Mammals				
Townsend's big-eared bat	*Corynorhinus townsendii*	State species of concern	Both	
Spotted bat	*Euderma maculatum*	State species of concern	Both	
Western red bat	*Lasiurus blossevillii*	State species of concern	Both	
Western small-footed myotis	*Myotis ciliolabrum*	State species of concern	Both	
Fringed myotis	*Myotis thysanodes*	State species of concern	Both	
Long-legged myotis	*Myotis volans*	State species of concern	Both	
Yuma myotis	*Myotis yumanensis*	State species of concern	Both	
Big free-tailed bat	*Nyctinomops macrotis*	State species of concern	Both	
Desert bighorn sheep*	*Ovis canadensis nelsoni*	State species of concern	Both	Parkwide
Silky pocket mouse	*Perognathus flavus*	State species of concern	UT	

Common Name	Scientific Name	Status	State (UT, AZ, or both)	Potential Occurrence within Glen Canyon
Kit fox*	*Vulpes macrotis*	State species of concern	UT	Parkwide
Reptiles				
Glossy snake*	*Arizona elegans*	State species of concern	AZ	Only one sighting near Wahweap; Warm Creek to Grand Bench region
Western banded gecko	*Coleonyx variegatus*	State species of concern	AZ	
Glen Canyon chuckwalla*	*Sauromalus obesus*	State species of concern	Both	Potential occurrence in vegetation complexes below 4500 feet elevation
Desert night lizard*	*Xantusia vigilis*	State species of concern	UT	Parkwide; Garfield and San Juan counties for one subspecies
Amphibians				
Northern leopard frog	*Rana pipiens*	State species of concern	Both	
Birds				
Southwestern willow flycatcher*	*Empidonax traillii extimus*	Federally endangered	—	Riparian areas; riparian forest vegetation along permanent water; Hite Boat Ramp area; Orange Cliffs region
California condor*	*Gymnogyps californianus*	Federally endangered	—	Parkwide
Brown pelican*	*Pelecanus occidentalis*	Federally endangered	—	Lakes and rivers parkwide
Mexican spotted owl*	*Strix occidentalis lucida*	Federally threatened	—	Parkwide including Orange Cliffs region; widespread but scattered
Yellow-billed cuckoo*	*Coccyzus americanus*	Federal candidate species	—	Riparian areas; desert riparian woodlands
Golden eagle*	*Aquila chrysaetos*	State species of concern	Both	Parkwide
Burrowing owl*	*Athene cunicularia*	State species of concern	Both	Parkwide
Peregrine falcon	*Falco peregrinus*	State species of concern	Both	
Pinyon jay*	*Gymnorhinus cyanocephalus*	State species of concern	Both	Pinyon-juniper vegetation complex; may occur in Orange Cliffs region

Common Name	Scientific Name	Status	State (UT, AZ, or both)	Potential Occurrence within Glen Canyon
Bald eagle*	*Haliaeetus leucocephalus*	State species of concern	Both	Lake Powell; Hite Boat Ramp area; and Orange Cliffs region
Belted kingfisher	*Megaceryle alcyon*	State species of concern	AZ	
Long-billed curlew*	*Numenius americanus*	State species of concern	Both	Lake Powell
Virginia's warbler	*Oreothlypis virginiae*	State species of concern	UT	
Lucy's warbler	*Oreothlypis luciae*	State species of concern	Both	
Osprey	*Pandion haliaetus*	State species of concern	Both	
American white pelican*	*Pelecanus erythrorhynchos*	State species of concern	UT	Lake Powell
Bell's vireo	*Vireo bellii*	State species of concern	Both	
Gray vireo*	*Vireo vicinior*	State species of concern	Both	Pinyon-juniper vegetation complex; may potentially occur in Orange Cliffs region
Great blue heron*	*Ardea herodias*	Glen Canyon species of concern	—	Lake Powell
Dusky flycatcher	*Empidonax oberholseri*	Glen Canyon species of concern	—	
Orange-crowned warbler	*Oreothlypis celata*	Glen Canyon species of concern	—	
Plants				
Brady pincushion cactus*	*Pediocactus bradyi*	Federally endangered	—	Kaibab limestone
Navajo sedge*	*Carex specuicola*	Federally threatened	—	One occurrence in park in Slickhorn Canyon
Jones' cycladenia*	*Cycladenia humilis* var. *jonesii*	Federally threatened	—	Chinle, Cutler, and Summerville formations; found in Escalante and Orange Cliffs regions
American spikenard	*Aralia racemosa*	State species of concern	Both	
Harrison's milkvetch	*Astragalus harrisonii*	State species of concern	UT	

Common Name	Scientific Name	Status	State (UT, AZ, or both)	Potential Occurrence within Glen Canyon
Copper Canyon milkvetch*	*Astragalus cutleri*	State species of concern	UT	Found adjacent to roads in Copper Canyon and Clay Hills Crossing areas; use Wilson Mesa region
Ferron's milkvetch	*Astragalus musiniensis*	State species of concern	UT	
Atwood's camissonia	*Camissonia atwoodii*	State species of concern	UT	
California sawgrass	*Cladium californicum*	State species of concern	UT	
Higgins biscuitroot	*Cymopterus higginsii*	State species of concern	UT	
Hole-in-the-Rock prairie clover	*Dalea flavescens* var. *epica*	State species of concern	Both	
Zion shooting star	*Dodecatheon pulchellum* var. *zionense*	State species of concern	UT	
Kachina daisy*	*Erigeron kachinensis*	State species of concern	UT	Hanging gardens habitat along canyon edges; may potentially occur in Orange Cliffs region
Alcove daisy	*Erigeron zothecinus*	State species of concern	UT	
Paria spurge*	*Euphorbia nephradenia*	State species of concern	UT	Tropic Shale and Entrada formations; no recorded evidence in park
Cataract gilia*	*Gilia imperialis*	State species of concern	UT	Warm Cliffs to Grand Bench region; in Tropic Shale, Carmel and Straight Cliffs formations
Tropic goldeneye*	*Heliomeris soliceps*	State species of concern	UT	Tropic Shale formation; in Warm Cliffs to Grand Bench region
Satintail grass	*Imperata brevifolia*	State species of concern	UT	
Western hophornbeam*	*Ostrya knowltonii*	State species of concern	Both	Clearwater Canyon in Orange Cliffs region
Alcove rock daisy*	*Perityle specuicola*	State species of concern	UT	Hanging gardens habitat along canyon edges; Orange Cliffs region
Howell's phacelia*	*Phacelia howelliana*	State species of concern	Both	Tropic Shale formation; no recorded evidence

Common Name	Scientific Name	Status	State (UT, AZ, or both)	Potential Occurrence within Glen Canyon
Nipple phacelia*	*Phacelia mammillarensis*	State species of concern	Both	Warm Cliffs to Grand Bench region
Alcove bog-orchid	*Platanthera zothecina*	State species of concern	Both	
Mojave indigo-bush	*Psorothamnus arborescens* var. *pubescens*	State species of concern	Both	
Whiting's indigo-bush*	*Psorothamnus thompsoniae* var. *whitingii*	State species of concern	Both	Wilson Mesa region
New Mexico raspberry*	*Rubus neomexicanus*	State species of concern	UT	Clearwater Canyon; Orange Cliffs region
Jane's globemallow*	*Sphaeralcea janeae*	State species of concern	UT	White Rim Sandstone formation; Orange Cliffs region
Rocky Mountain maple	*Acer glabrum*	Glen Canyon species of concern	—	
Bigtooth maple	*Acer grandidentatum*	Glen Canyon species of concern	—	
Desert mountain lilac*	*Ceanothus vestitus* var. *franklinii*	Glen Canyon species of concern	—	Wilson Mesa and Orange Cliffs regions
Red-osier dogwood	*Cornus sericea*	Glen Canyon species of concern	—	
Utah brittle-fern	*Cystopteris utahensis*	Glen Canyon species of concern	—	
Cotton top	*Echinocactus polycephalus*	Glen Canyon species of concern	—	
Ross's spurge	*Euphorbia aaron-rossii*	Glen Canyon species of concern	—	
Rice cutgrass	*Leersia oryzoides*	Glen Canyon species of concern	—	
American bugleweed	*Lycopus americanus*	Glen Canyon species of concern	—	
Dunebroom	*Parryella filifolia*	Glen Canyon species of concern	—	
Tompkins phacelia*	*Phacelia pulchella* var. *sabulonum*	Glen Canyon species of concern	—	Tropic Shale and Straight Cliffs formation; Warm Creek to Grand Bench region
Floating pondweed	*Potamogeton natans*	Glen Canyon species of concern	—	
Hoptree	*Ptelea trifoliata*	Glen Canyon species of concern	—	
Douglas fir*	*Pseudotsuga menziesii*	Glen Canyon species of concern	—	Orange Cliffs region

Common Name	Scientific Name	Status	State (UT, AZ, or both)	Potential Occurrence within Glen Canyon
Smooth sumac	*Rhus glabra*	Glen Canyon species of concern	—	
Blue-eyed grass	*Sisyrinchium demissum*	Glen Canyon species of concern	—	

Source: Spence 2012a; Sweatland pers. comm. 2010a.

*Species carried forward for analysis in chapter 4, including all federally listed species and state-listed species with the potential to be affected by the ORV Management Plan alternatives (Spence pers. comm. 2012b).

— = Species not listed in either Utah or Arizona.

Species-specific Information

There are several federally listed species and species of concern found in Glen Canyon (table 6); however, it is not likely that all the sensitive species in the area would be affected by the use and management of ORVs under the proposed alternatives.

Based on consultation with the USFWS, as well as conversations and research provided by John Spence, Glen Canyon ecologist/botanist, the following are special-status species carried forward for analysis in chapter 4, which includes all federally listed species at Glen Canyon, as well as state-listed species with the potential to be affected by the actions proposed under this plan/DEIS (Spence pers. comm. 2012b; Sweatland pers. comm. 2010a).

Mammals

Desert Bighorn Sheep (*Ovis canadensis nelsoni*) — Species of Concern (Arizona and Utah)

Desert bighorn sheep are medium-sized bovids with muscular bodies and thick necks (USFWS 2011). This species has adapted well to the desert environment and prefers rocky cliffs away from human activity (Singer et al. 2000). They are primarily diurnal (active chiefly in the daytime), but may be active at any time of the day or night (USFWS 2011). Desert bighorn sheep inhabit desert mountain ledges and grassy basins from elevations of 90 to 4,500 feet above sea level (27 to 1,371 meters) (AZGFD 2009). Areas of gentle terrain, such as valley floors, are important linkages between adjacent mountainous regions, thereby providing temporary access to resources (e.g., forage, water, lambing habitat) in neighboring areas, and allowing gene flow to occur between subpopulations (USFWS 2011). In the wild, grasses are important to the bighorn sheep. They also feed heavily on jojoba, and pincushion and saguaro cactus provide moisture (AZGFD 2009).

Bighorn sheep have large home ranges that allow them to move in response to variations in predation pressure and changes in resource availability. Rams and ewes tend to loosely segregate during much of the year, coming together primarily during the mating season (USFWS 2011), which typically peaks from September through November (AZGFD 2009). As parturition (labor) approaches, ewes seek secluded sites with shelter, unobstructed views, and steep terrain, which aids in predator evasion, whereas rams may be found in less steep or rugged terrain. Lambs are generally born between February and April, although some lambing may occur as late as August (USFWS 2011).

Unregulated hunting, habitat destruction and fragmentation, grazing, and disease decimated or eliminated bighorn sheep populations across the west in the 1800s (NPS 2008d). Glen Canyon supports one of the last relict desert bighorn sheep herds in Utah. The most critical areas for the sheep include the Red, White, and Gypsum Canyons branching off the northeastern portion of Lake Powell, as well as the Waterpocket Fold east of the Escalante River. These areas have been identified as possible lambing grounds (Singer et al. 2000).

Kit Fox (*Vulpes macrotis*) — Species of Concern (Utah)

The kit fox is the smallest member of the canid family in North America, reaching 15 to 20 inches (38 to 51 centimeters) in length, with a tail 9 to 12 inches (23 to 30.5 centimeters) long. They stand 11 to 12 inches (28 to 30.5 centimeters) high, and adults weigh approximately 3 to 4 pounds. The kit fox is generally pale grey or tan in color with a slightly darker back. This species is highly specialized and adapted to desert and semiarid areas of western North America. In Utah, kit foxes live in cold desert regions at elevations below 5,500 feet (1,676 meters). They can be found in the Great Basin area as well as in the southwestern and southeastern parts of the state, and generally inhabit sparsely vegetated flat areas in the desert (Utah DNR n.d.a). Shadscale, greasewood (*Sarcobatus vermiculatus*), and sagebrush are characteristic of kit fox habitat (NatureServe 2009; Utah DNR n.d.a). Kit foxes are nocturnal and emerge from their dens at sundown to hunt in thick vegetation. As opportunistic omnivores, their diet primarily consists of black-tailed jackrabbits, cottontails, and kangaroo rats (Utah DNR n.d.a).

Kit foxes live in dens dug in the desert soil and tend to select sites in barren areas with silty, clay soil that are higher than the surrounding terrain. They generally breed from late December to February, producing a liter of 4 to 5 pups in March and early April. The pups do not leave their den until they are at least a month old, and generally begin to hunt when they are about five months old. Recreational activities, such as off-road use, often disturb den sites, caving in den openings or leading to den abandonment. Habitat loss, fragmentation, and disturbance are the greatest threats to kit foxes (Utah DNR n.d.a). The resulting loss and fragmentation of habitat, and human disturbance to kit fox denning areas by recreational activities, especially off-road use, may pose a substantial threat to kit fox populations (Meaney, Reed-Eckert, and Beauvais 2006).

Reptiles

Glossy Snake (*Arizona elegans*) — Species of Concern (Arizona)

This medium-sized snake is tan or gray in color with dark-edged, tan or golden-brown blotches and reaches 42 inches (107 centimeters) in length. This species is found in Arizona across the northeastern plateaus, the southwestern and western deserts, and the southwestern valleys. It occurs at elevations ranging from sea level along the Colorado River to approximately 6,000 feet (1,830 meters) above sea level. Glossy snakes inhabit biotic communities ranging from Arizona's desert shrublands, through semidesert grassland, and into plains and Colorado Plateau grassland. They are typically found in flat, open, shrubby areas with sandy soil. This species is nocturnal and spends the majority of its time burrowing underground. Mating occurs in spring with a clutch of up to 23 eggs laid in the summer, which generally begin to hatch in August (Brennan 2008).

As described in the "Wildlife and Wildlife Habitat" section of this chapter, snakes are known to favor roads and trails as thermoregulation sites, which put them at risk of death due to being crushed by vehicles (Rosen and Lowe 1994; Rudolph 2000).

Glen Canyon Chuckwalla (*Sauromalus obesus*) — Species of Concern (Arizona and Utah)

Also known as the common chuckwalla, this species of lizard has a flattened body shape and lacks a mid-dorsal crest. The chuckwalla is the second largest lizard in the United States (SDNHM n.d.), and the largest lizard found in Glen Canyon (NPS 2011b), with males reaching up to 18 inches (46 centimeters) in total length. This species is distributed throughout the deserts of southern California, southern Nevada, southwestern Utah, and western Arizona in the United States and Sonora and Baja California in Mexico (SDNHM n.d.). It is found in desert communities of creosote/bursage, blackbrush, and salt desert scrub at elevations up to 4,500 feet (1,372 meters) (SDNHM n.d.; Utah DNR 2011). The Glen Canyon chuckwalla is herbivorous and browses on leaves, buds, flowers, and fruit. It is restricted to habitat with large rocks and boulders on rocky hillsides, outcrops, or lava beds, which provide cover and basking locales. Mating for this species occurs between April and July, with a clutch of as many as 16 eggs laid between June and August with eggs hatching in the late warm season (SDNHM n.d.). The

chuckwalla was historically found along the Colorado River in Glen Canyon as far north as Hite, but likely has a smaller distribution due to the destruction of much of its habitat by the creation of Lake Powell (NPS 2011b).

Major threats to this species include excessive collecting and habitat degradation. As described above, the damming of the Colorado River has substantially reduced or eliminated historical populations in the Glen Canyon area as a reduction of their habitat (Hammerson 2007). Additionally, off-road use can impact the chuckwalla and other lizards through direct mortality, disturbance, and habitat loss and fragmentation (Switalski and Jones 2010). This species is primarily found in the vicinity of Glen Canyon, Kane County; however, its distribution reaches Moab along the river. Much of this species' habitat in Glen Canyon was eliminated by the construction of the Glen Canyon Dam (Utah DNR 2011).

Desert Night Lizard (*Xantusia vigilis*) — Species of Concern (Utah)

The desert night lizard is a slim species averaging 1.0 to 1.8 inches (2.6 to 4.5 centimeters) in length. Its body is grey, olive, or dark brown with fine black speckles and smooth, granular scales (USGS 2003). This species is found in arid and semiarid rocky areas. Its typical habitat is characterized by concealing, protective vegetation, such as yuccas and agaves, as well as rock crevices, dead brush, and other debris. Two subspecies of the desert night lizard exist in Utah, the common night lizard (*Xantusia vigilis vigilis*) and the Utah night lizard (*X. v. utahensis*). The common night lizard is found on the Beaver Dam Slope in southwestern Washington County, whereas the endemic Utah night lizard is found exclusively in Garfield and San Juan Counties in southeastern Utah (Utah DNR 2011).

Habitat modification is one of the primary threats to the desert night lizard, and the specialized habitat requirements and life history characteristics of this species make it vulnerable to habitat disturbance. In particular, roads act as barriers to dispersal and increase mortality for this species (Utah DNR 2011).

Birds

Southwestern Willow Flycatcher (*Empidonax traillii extimus*) — Federally Endangered

The southwestern willow flycatcher is approximately 5.75 inches (15 centimeters) long, and weighs about 0.42 ounces (12 grams). This small migratory species occupies thickets, scrubby and brushy areas, open second growth, swamps, and open woodland from near sea level to over 8,500 feet (2,600 meters) elevation; however, it is primarily found in lower-elevation riparian habitats. The southwestern willow flycatcher breeds in dense growths of trees and shrubs in riparian ecosystems in the arid southwestern United States, and possibly extreme northwestern Mexico. The birds typically arrive on breeding grounds between early May and early June, with the breeding season lasting approximately from mid-June to mid-July (USFWS 2002a). The southwestern willow flycatcher formerly bred in Glen Canyon, but currently there are no confirmed nesting or breeding pairs in the area (NPS n.d.a). Two confirmed identifications of the willow flycatcher were made on the Colorado River below the Glen Canyon Dam, and a pair was observed courting in 1997 on the Escalante River. In addition, individuals have been recorded during migration at Clay Hills Crossing and upstream along the San Juan River (Spence, LaRue, and Grahame 2011). This species may occur in the Hite Boat Ramp area and Orange Cliffs region.

Threats to this species include loss and modification of breeding habitat. Destruction and modification of riparian habitats have been caused mainly by the reduction or removal of surface and subsurface water due to diversion and groundwater pumping, changes in flood and fire regimes due to dams and stream channelization, vegetation clearing, and changes in soil and water chemistry due to the disruption of natural hydrologic cycles (USFWS 2002a). In addition, reductions in the density and diversity of bird communities, including willow flycatchers, have been associated with livestock grazing and recreational activities (Riffell et al. 1996; Taylor 1986).

California Condor (*Gymnogyps californianus*) — Federally Endangered (Experimental Population)

Listed as endangered in 1967, California condors are among the largest flying birds in the world. Adults weigh approximately 22 pounds (10 kilograms) and have a wingspan of up to 9.5 feet (2.9 meters). This species requires suitable habitat for nesting, roosting, and foraging. Nest sites are located in cliff cavities, large rock outcrops, or large trees. A single egg is normally laid between late January and early April, and hatches after approximately 56 days. Roosting sites are often near feeding sites on cliffs or large trees, and foraging generally occurs in grasslands, in chaparral areas, or in oak savannahs (USFWS 1996). California condors are a rare local permanent resident in Glen Canyon. The captive-reared birds were released on the nearby Vermilion Cliffs beginning in 1996 and have on several occasions spent time in Glen Canyon. Most occurrences of this species have been below the dam at Navajo Bridge, Marble Canyon, south of Lees Ferry (Spence, LaRue, and Grahame 2011).

The California condor remains one of the world's rarest and most endangered vertebrate species. Despite intensive conservation efforts in the 1980s, the wild California condor population declined steadily until the last free-flying individual was captured in 1987. Following several years of successful captive breeding, condors were first released back to the wild in early 1992. Primary threats to this species include shooting, lead poisoning, and collisions with human-made objects (USFWS 1996). In addition, as described in the "Wildlife and Wildlife Habitat" section of this chapter, many raptors are intolerant of noise and human-associated disturbances (Richardson and Miller 1997).

Brown Pelican (*Pelecanus occidentalis*) — Federally Endangered

Listed as endangered in 1970, brown pelicans are the smallest members of the seven pelican species worldwide and inhabit the Atlantic, Pacific, and Gulf Coasts of North and South America. Adults measure up to 54 inches (137 centimeters) long, weigh 8 to 10 pounds, and have a wingspan between 6-1/2 and 7-1/2 feet. Pelicans eat primarily fish (e.g., herring and minnows) and require up to four pounds of fish a day. Pelicans generally fly over water at great heights, diving steeply into the water when they spot fish. Depending on the height of the dive, they may submerge completely or only partly into the water and come up with a mouthful of fish (USFWS 2008). Brown pelicans usually forage in shallow waters within 12 miles (20 kilometers) of nesting islands during the breeding season, and up to 47 miles (75 kilometers) from the nearest land during nonbreeding season (Shields 2002).

Brown pelicans nest in large colonies on the ground, in bushes, or in the tops of trees. Peak egg-laying usually occurs in March through May (USFWS 2008). The young are able to fly and begin to fend for themselves by 11–12 weeks of age. The brown pelican is a long-lived species; the oldest individual on record died at 43 years of age (Shields 2002). Brown pelicans are not known to breed within Glen Canyon. Within Glen Canyon, this species is considered a rare local transient with three known records: one on the Colorado River below the dam in June 1992, one on Lake Powell 0.5 mile above the dam in July 1987, and an extraordinary record of six in Hall's Creek Bay in October 1994 (Spence, LaRue, and Grahame 2011).

Despite its longevity and popularity, the brown pelican nearly disappeared from North America between the late 1950s and early 1970s. Extensive scientific investigations revealed the culprit to be human-made organochlorine pesticides (i.e., endrin and dichlorodiphenyltrichloroethane (DDT)) entering the marine food web. Reproduction soon improved and pelican numbers began to rise following the ban on the use of DDT in the United States in 1972 and a reduction in the use of endrin during the 1970s. Known threats to this species include habitat degradation, disturbance at roost and nest sites, pesticides and other contaminants/toxins, shooting and trapping, oil pollution, and collisions with stationary/moving structures or objects (e.g., aircraft, power transmission lines, vehicles) (Shields 2002).

Mexican Spotted Owl (*Strix occidentalis lucida*) — Federally Threatened

Mexican Spotted Owl

Listed as a threatened species in 1993, the Mexican spotted owl is mottled in appearance with irregular brown and white spots on its head, abdomen, and back. Although the spotted owl is often considered a medium-sized owl, it ranks among the largest owls in North America (USFWS 1995). This species is frequently associated with mature mixed-conifer, pine/oak, and riparian forests. It is also found in canyon habitat dominated by vertical-walled rocky cliffs in complex watersheds, including tributary side canyons. Owls are typically found in areas with some type of water source, such as perennial streams, creeks, reservoir emissions, small pools, springs, or ephemeral water (69 FR 53182–53183). They nest in tree cavities, broken-topped trees, and platforms, such as old raptor or squirrel nests (Cornell Lab of Ornithology n.d.). In Glen Canyon, the Mexican spotted owl is a rare permanent resident found in canyons containing deeply fissured cliffs (NPS n.d.a). Surveys conducted between 1992 and 1998 found this species in the canyon heads off the Big Ridge, Easter Canyon, several Escalante River tributaries, Millard Canyon, and in Miller's Canyon (NPS n.d.a). Breeding for the spotted owl has been confirmed in Glen Canyon (NPS 2007a) but breeding is often sporadic and nesting does not occur every year. In Arizona, it has been reported that eggs usually hatch in early May, with fledging generally occurring in early to mid-June (USFWS 1995). In 2004, designated critical habitat was established in Arizona, Colorado, New Mexico, and Utah, and identified in areas within Glen Canyon, including the Orange Cliffs region (USFWS 2004).

The primary threat to this species is habitat alteration. The danger of catastrophic wildfire was also cited as a potential threat for additional habitat loss (69 FR 53183). Additionally, both motorized and nonmotorized vehicles have the potential to degrade or destroy spotted owl habitat, particularly meadow and shrub habitats vital to the species' prey. Noise produced by vehicles and vehicle riders can also disturb spotted owls at important nesting and roosting sites (USFWS 1995).

Yellow-billed Cuckoo (*Coccyzus americanus*) — Federal Candidate Species

This medium-sized bird averages 12 inches (30 centimeters) in length with a slender, long-tailed profile and a fairly stout and slightly down-curved bill. Plumage is grayish brown above and white below (74 FR 57823). The yellow-billed cuckoo prefers open woodland with clearings and low, dense, scrubby vegetation; in Utah and Arizona, this species prefers desert riparian woodlands composed of cottonwood, willows, and dense mesquite (*Prosopis* spp.). Nests are typically placed in willows, and cottonwoods are used extensively for foraging (Hughes 1999). In addition, dense understory foliage is an important foraging habitat for this bird (74 FR 57823). Nesting occurs on horizontal branches or vertical forks of small trees and large shrubs, averaging 3 to 19 feet (1 to 6 meters) above ground (Hughes 1999). In Glen Canyon, the yellow-billed cuckoo is a rare, restricted transient in dense riverside tamarisk thickets. Specifically, the species has been recorded at Colorado River RM-14, Lees Ferry, and Clay Hills Crossing. Breeding may occur at Clay Hills Crossing on the San Juan River (NPS n.d.a; Spence, LaRue, and Grahame 2011).

Large declines in the distribution and abundance of the yellow-billed cuckoo have occurred as a result of pesticide use and the destruction of preferred riparian habitat (Hughes 1999). Threats to the yellow-billed cuckoo include habitat loss, overgrazing, and pesticide application. The principal causes of riparian habitat losses are conversion to agricultural and other uses, dams and river flow management, stream channelization and stabilization, and livestock grazing (74 FR 57823). Additionally, as described in the "Wildlife and Wildlife Habitat" section of this chapter, repeated noise disturbance from ORV activity can result in nest abandonment (Switalski and Jones 2010). As described above, yellow-billed cuckoos are known to use shrubs for nesting, which are particularly susceptible to damage by ORV passage because vehicles strip the protective bark and break branches and stems (Sowl and Poetter 2004).

Golden Eagle (*Aquila chrysaetos*) — Species of Concern (Arizona and Utah)

This large raptor averages 32 inches (81 centimeters) in length and has a wingspan of 6.5 feet (2 meters) (Gough et al. 1998). Its plumage is almost entirely brown, with a golden wash on the back of the head and neck. This species is generally found in open country and barren areas in hilly or mountainous regions. Preferred habitat includes cliff, desert, grassland/herbaceous, savanna, and woodland areas. Golden eagles nest on the rock ledges of cliffs or in large trees. In Utah, nesting typically occurs from late February to early March (NatureServe 2009). Breeding for this species has been confirmed in Glen Canyon (NPS 2007a).

The golden eagle is considered an uncommon, permanent resident throughout Glen Canyon. Habitat is widespread and nesting has been documented from several areas of Glen Canyon. Since 1990, one-day-a-month winter aerial surveys around Lake Powell have located between 3 and 25 individuals per survey. The golden eagle became particularly scarce the winter of 1997–1998, but recovered the following winter, with the highest count recorded of 25 birds. In the winter of 2000, the second-highest count, of 23 birds, was detected (NPS n.d.a). The golden eagle may occasionally forage over the Lone Rock Beach Play Area, because there is a territory on Castle Rock (Spence n.d.). Primary threats to this species include habitat alteration and loss. In addition, some populations of golden eagles are still threatened by illegal killing, poisoning, and egg-collecting (RSPB 2009). It is unlikely that off-road use would have substantial impacts on raptors (including the golden eagle) in this particular area because there are extensive areas around Lone Rock Beach that are off limits (Spence n.d.). However, as described in the "Wildlife and Wildlife Habitat" section of this chapter, many raptors are intolerant of noise and human-associated disturbances (Richardson and Miller 1997); therefore, the potential for some impacts still exists.

Burrowing Owl (*Athene cunicularia*) — Species of Concern (Arizona and Utah)

The burrowing owl averages a weight of 5.3 ounces (150 grams) and a length of 7.5 to 9.8 inches (19 to 25 centimeters), with a wingspan of 21.7 inches (55 centimeters). This species generally inhabits dry, open areas with no trees and short grass (Cornell Lab of Ornithology n.d.). In Glen Canyon, the burrowing owl is considered uncommon and is known to exist in desert scrub habitats, including blackbrush, shadscale, and sagebrush (NPS 2007a). The burrowing owl is considered diurnal because it can often be seen foraging during the day. It hunts by walking, hopping, or running along the ground, or by flying from a perch (Cornell Lab of Ornithology n.d.). Burrowing owls eat mainly terrestrial invertebrates, but also consume a variety of small vertebrates, including small mammals, birds, reptiles, and amphibians (Utah DNR n.d.b).

Breeding is confirmed in Glen Canyon, where this species is considered a summer resident (NPS 2007a; Spence, LaRue, and Grahame 2011). Mating begins in early spring, and egg laying typically occurs between mid-March and early May (Poulin et al. 2011). As its name indicates, this owl nests in a mammal burrow, usually that of a prairie dog, ground squirrel, badger, or armadillo (Cornell Lab of Ornithology n.d.; Utah DNR n.d.b). If a mammal burrow is not available the owl will sometimes excavate its own nest burrow. Three to 11 (usually 5 to 9) eggs are incubated by the female parent for 27 to 30 days (Utah DNR n.d.b).

The burrowing owl is federally protected by the Migratory Bird Treaty Act in the United States, Canada, and Mexico, and is considered by the USFWS to be a bird of conservation concern at the national level (Burrowing Owl Conservation Network n.d.). It was once distributed broadly throughout western North America, but has been declining in numbers throughout all historic ranges over the last 30 years. The greatest threat to burrowing owls is habitat destruction and degradation, caused primarily by land development and agricultural activity (Burrowing Owl Conservation Network n.d.; Poulin et al. 2011). Other sources of disturbance and mortality include pesticides and other contaminants/toxins, and noise disturbances at nest and roost sites (Poulin et al. 2011). Collision with vehicles is also considered a major source of mortality (Cornell Lab of Ornithology n.d.).

Pinyon jay (*Gymnorhinus cyanocephalus*) — Species of Concern (Arizona and Utah)

The pinyon jay occurs throughout much of the western United States, and is a common bird of the pinyon-juniper forests of Utah. Pinyon jays are often found in loose flocks that consist of multiple breeding pairs and the offspring of those pairs from previous nesting seasons. Each flock has an established home range, but may become somewhat nomadic and move long distances when food is scarce (Utah DNR n.d.b).

The pinyon jay is a common widespread permanent resident in pinyon-juniper woodland of Glen Canyon and may occur in the Orange Cliffs region. It is most frequently seen in more open stands as in Hans, Waterhole, and Andy Miller Flats and the bench at the base of the Kaiparowits Plateau. It was not observed in the dense woodlands on the summit of the Kaiparowits Plateau during the series of trips there until May 2000. The only breeding records are a raucous group of about 40 juveniles on the southwest rim of the Kaiparowits Plateau on May 24, 2000, and a flock with begging juveniles at Hans Flat on July 13, 1999 (NPS n.d.a).

The primary threats to pinyon jay population viability are loss and degradation of habitat, livestock grazing, and fire suppression. Specifically, widespread die-off of pinyon pine in the southwestern United States, together with large-scale thinning of pinyon-juniper woodlands in an attempt to reduce fuel loads are known current threats (Wiggins 2005).

Bald Eagle (*Haliaeetus leucocephalus*) — Species of Concern (Arizona and Utah)

This large bird of prey weighs 6.6 to 14 pounds (3 to 6.3 kilograms), has a total length of 30 to 37.8 inches (71 to 96 centimeters), and a wingspan of 66 to 96 inches (168 to 244 centimeters). Quality of foraging areas for this raptor is defined by diversity, abundance, and vulnerability of the prey base, structure of aquatic habitat, such as the presence of shallow water, and absence of human development and disturbance (Buehler 2000). The bald eagle typically breeds in forested areas adjacent to large bodies of water where fish and waterfowl prey are available (Buehler 2000). Wintering areas are commonly associated with open water as well, though other habitats may be used if food resources, such as rabbit or deer carrion, are available (Utah DNR n.d.c). Often, areas with considerable shoreline development or human activity have nests located farther from the shoreline than nest sites in less developed areas (Buehler 2000).

Within Glen Canyon, the bald eagle is considered a common and widespread winter resident along the Lake Powell shoreline, primarily distributed along the open bays (NPS n.d.a). Bald eagles prefer wide, shallow bays and side canyons including Wahweap, Warm Creek, Halls Creek Bay, and Bullfrog Bay and are rarely seen below the Glen Canyon Dam in the winter. The Park Service has monitored wintering bald eagle populations in Glen Canyon since 1991 (NPS 2007c). The highest count of 50 bald eagles was recorded in January 2003; the count ranged from seven to 28 between 1991 and 2002 (NPS n.d.a, 2007c). Birds start arriving around Lake Powell in October and November and are found through January and February. The species is occasionally seen along the Colorado River where heavy recreational use likely limits its occurrence (NPS n.d.a). Bald eagles may occur in the Hite Boat Ramp area and Orange Cliffs region.

The bald eagle was listed as endangered under the Endangered Species Act in most of the lower 48 states until 1994 when its status was changed to threatened. In 2007, the USFWS removed the bald eagle from the Endangered Species List throughout its range. However, the species is classified as a Critically Imperiled S1 species by the Utah Natural Heritage Program due to its extreme rarity and vulnerability to extirpation as a breeding bird within the state. Similarly, protective management actions continue in Arizona, which are coordinated by the Southwestern Bald Eagle Management Committee, and implemented through the Arizona Game and Fish Department (AZGFD n.d.). Additionally, the bald eagle retains federal protection under the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act, and Utah State Code (Utah DNR 2011). Despite the continuing recovery of populations in recent decades, fewer than ten nesting pairs were known in Utah in 2005 (Utah DNR n.d.c). In general, bald eagles avoid areas with nearby human activity and development (Utah DNR n.d.c). Primary threats to this species

include degradation of breeding and wintering habitat, disturbance at nest and roost sites, collisions with stationary/moving structures or objects, and pesticides and other contaminants/toxics (Buehler 2000).

Long-billed Curlew (*Numenius americanus*) — Species of Concern (Arizona and Utah)

This aquatic bird reaches a height of 18 to 26 inches (45 to 66 centimeters), with a wingspan of 36 to 40 inches (91 to 101 centimeters). Its long, thin, down-curved bill can be more than 8 inches (20 centimeters) in length (TPWD 2009). Mating season for this species is typically from mid-April through September (TPWD 2009), and one clutch of four eggs on average is laid per season (Dugger and Dugger 2002). Nests are built on the ground in flat, open areas with clumps of grass, and are vulnerable to predation and human disturbance (TPWD 2009; Utah DNR 2011). During the breeding season, this species prefers prairies and pastures with short grass, and seeks seashores, lakes, rivers, mudflats, and salt marshes after breeding (TPWD 2009). In general, long-billed curlews rely on grassland and wetland habitats to survive (Utah DNR 2011). In Glen Canyon, this species is considered an uncommon, restricted migrant and is found along the Lake Powell shoreline and at sewage treatment settling ponds. Spring passage is from mid-April to mid-May, and fall passage is from late June to early September. Between 1974 and 2000, bird records from the greater Grand Canyon region reveal that the peak number of long-billed curlew reported in Glen Canyon was 20 in Warm Creek Bay in 1999 and five additional birds (recorded the same day) in the Wahweap area (NPS n.d.a; Spence, LaRue, and Grahame 2011).

Primary threats to this bird include loss of breeding habitat and habitat modification. Specifically, habitat fragmentation has provided predators with travel corridors, which increases predation on ground-nesting birds (Utah DNR 2011). Additionally, as described in the "Wildlife and Wildlife Habitat" section of this chapter, ground-nesting birds are at greatest risk from ORV activity, due to nest abandonment and direct mortality from nests and young being crushed (Switalski and Jones 2010).

American White Pelican (*Pelecanus erythrorhynchos*) — Species of Concern (Utah)

This large waterbird is 50 to 65 inches (127 to 165 centimeters) long and has an enormous bill with an extensible pouch (Evans and Knopf 2004). The American white pelican is a diurnal and nocturnal forager; however, capture rates are higher during day (Utah DNR n.d.d). It forages mainly on fish in shallow wetlands. Unlike the brown pelican, the white pelican dips its head under water to scoop up fish (rather than diving). Several pelicans may fish cooperatively, moving into a circle to concentrate fish, and then dipping their heads under simultaneously to catch fish (Cornell Lab of Ornithology n.d.).

White pelicans are most commonly seen at foraging and adjacent loafing sites, where they are tolerant of human observers if not approached too closely. At breeding colonies, by contrast, they are shy and, if approached, prone to desert or to leave eggs and young exposed to predators (Evans and Knopf 2004). However, in Utah, the only breeding colonies of the American white pelican are located in the northern portions of the state, specifically within the Utah Lake/Great Salt Lake ecological complex (i.e., Gunnison Island) (Utah DNR 2011).

This species is considered an uncommon restricted migrant on Lake Powell. Groups up to 300 have been noted within Glen Canyon. This pelican is sparse in winter; four have been recorded: one at Bullfrog in 1995, one in Wahweap Bay in 1994, one below Glen Canyon Dam in 1995, and one at Wahweap/Page Sewage Treatment Plan in 2000. Fall migrants have been seen as late as December when eight were seen at Antelope Island in 1998 (Spence, LaRue, and Grahame 2011).

Overall, American white pelicans are highly sensitive to human intrusions into breeding colony, which cause desertions, especially during courtship and early incubation. Loud and close passes by motor boats and low flying airplanes can cause upflights from colony. Also, feeding and loafing flocks are dispersed by approach of motor boats. Historically, pelicans were shot for sport or trophies; shooting was reported in the 1970s and 1980s as the

greatest single source of mortality observed from band returns. Other threats to the American white pelican include pesticides and other contaminants, as well as habitat degradation (Evans and Knopf 2004).

Gray vireo (Vireo vicinior) — Species of Concern (Arizona and Utah)

The species breeds on arid slopes dominated by mature pinyon-juniper or juniper woodlands in southwestern Utah (Utah DNR n.d.b). It is an uncommon widespread summer resident and probable breeder in open pinyon-juniper woodland covered slopes generally at the lower elevational limits of the woodland. There are no breeding records. A key component within these areas appears to be the presence of a deciduous shrub or small tree, typically Utah serviceberry (*Amelanchier utahensis*) and/or singleleaf ash (*Fraxinus anomala*). The majority of the birds in Glen Canyon are found along Fiftymile Bench at the base of the Kaiparowits Plateau and along the Chinle, Moenkopi, and Cutler formation slopes and canyons of the Andy Miller Flat and Waterhole Flat area (NPS n.d.a). The species may also occur in the Orange Cliffs region.

Habitat loss through fragmentation and clearing of pinyon-juniper woodlands, cowbird brood parasitism, and predation are threats to this species. Disturbances such as grazing and off-road activities may have a negative impact on populations (Winter and Hargrove 2004).

Great Blue Heron (*Ardea herodias*) — Glen Canyon Species of Concern

The great blue heron is one of the most widespread and adaptable wading birds in North America. It stands about 63 inches (160 centimeters) tall, 38 to 54 inches (97 to 137 centimeters) in length, with a mass of 4.6 to 5.5 pounds (2.1 to 2.5 kilograms). During the breeding season, this species forages in wetlands, water bodies and water courses, but can also be found occasionally in upland areas. Although the heron is primarily a fish eater, wading along the shoreline of oceans, marshes, lakes, and rivers, it also stalks upland areas for rodents and other animals, especially in winter. Nesting occurs in trees, bushes, on the ground and on artificial structures, usually near water (Vennesland and Butler 2011).

In Utah, the great blue heron is the most commonly encountered heron, found statewide along shorelines of lakes and rivers, as well as in marshes. During March and April, nests are built colonially in the tops of trees growing along water's edge. Typically four eggs are laid each year (Utah DNR n.d.e). The great blue heron is considered an uncommon widespread migrant and winter resident on Lake Powell and along the San Juan and Colorado Rivers from July through March. It is less common the remainder of the year. While it bred formerly in Glen Canyon, the only recent nesting attempts have been in 1998–2005 when one to four pairs began nesting at Lee's Ferry and (in 1998 only) unsuccessfully as a single attempt 243 feet (74 meters) above the river on a ledge at Colorado River RM-13.0, and every year since at least 1992 (and probably earlier) in upper Hall's Creek Bay. Attempts to breed in Hall's Creek Bay are often unsuccessful because of rapid lake rises in May–June drowning nests and recreational disturbances (NPS n.d.a). Recently, sporadic breeding of heron was documented during a summer 2013 survey that confirmed the presence of two colonies and 21 nests along the Colorado River below the Glen Canyon Dam (Nealon 2013).

Breeding colonies are vulnerable to disturbance and habitat loss, and climate change and increasing predator populations may bring new challenges.

Plants

Brady Pincushion Cactus (*Pediocactus bradyi*) — Federally Endangered

Listed as endangered in 1979, the Brady pincushion cactus is a small, semiglobose cactus that occupies areas with a substrate of Kaibab limestone chips over Moenkopi shale and sandstone soil (NatureServe 2009; USFWS 1985). The vegetation where this small cactus grows is generally open and sparse, characterized by low shrubs, grasses,

and annuals (USFWS 1985). Associated plants include shadscale, snakeweed (*Gutierrezia sarothrae*), and Mormon tea (NatureServe 2009). Brady pincushion cactus is known from a geographical area of about 17,000 acres in Coconino County, Arizona. It grows on the benches and terraces in the Colorado Plateau near Marble Canyon (USFWS 1985).

This cactus is protected by the Convention on International Trade in Endangered Species and by the Arizona Native Plant Law (USFWS 1985). The limited distribution and small number of populations make this species vulnerable to extinction. ORV traffic, pesticide application, illegal collecting, and herbivory by native animals are known current threats (USFWS 2002b).

Navajo Sedge (*Carex specuicola*) — Federally Threatened

Listed as threatened in 1985, Navajo sedge is a perennial herb known to exist in the project area (NPS 2009b; USFWS 1987). This slender plant reaches approximately 10 to 18 inches (25 to 45 centimeters) in height, and has pale green leaves clustered near the plant's base. Flowering and fruit set occur from spring through summer, but most reproduction appears to be vegetative (USFWS 1987). Navajo sedge occupies silty soils of shady seep/spring pockets on Navajo Sandstone at 5,710 to 5,984 feet (1,740 to 1,834 meters) elevation in the Navajo Nation, and on Cedar Mesa sandstone at 3,772 feet (1,150 meters) in Glen Canyon (NPS 2009b; USFWS 1987). It coexists with other hanging garden and wetland/riparian species such as monkey flower (*Mimulus eastwoodiae*), helleborine (*Epipactis gigantea*), water bentgrass (*Agrostis semiverticillata*), and common reed (*Phragmites communis*) (USDA 2011). In Glen Canyon, the single population is known from hanging garden habitats in Slickhorn Canyon along the San Juan River. Populations are also known from side canyons of the Arizona portion of the Navajo Nation. Designated critical habitat has been established on the Navajo Nation outside Glen Canyon (NPS 2009b).

Water is vital to the survival of Navajo sedge; therefore, any change in the water table level will have an effect on the populations in Glen Canyon (USFWS 1987). Populations occupying low-lying, accessible habitat are vulnerable to domestic livestock grazing. ORVs could also negatively impact Navajo sedge habitat (USDA 2011). However, the single population in Glen Canyon, which is in a hanging garden in Slickhorn Canyon, would not be affected by off-road use.

Jones' Cycladenia (*Cycladenia humilis* var. *jonesii*) — Federally Threatened

Listed as threatened in 1986, this herbaceous perennial grows 4 to 6 inches (10 to 15 centimeters) tall. It generally occurs between 4,390 to 6,000 feet (1,338 to 1,829 meters) in elevation in plant communities of mixed juniper, desert scrub, or wild buckwheat / Mormon tea. Jones' cycladenia is rhizomatous (having a long underground stem system that cannot be seen above ground), and produces pink or rose-colored, trumpet-shaped showers from mid-April to early June (USFWS 2008). It grows only on alluvium of gypsiferous and saline soils on the Chinle, Cutler, and Summerville Formations. This species has recently been found to be widespread in suitable habitat (Last 2009) on the Colorado Plateau. In Glen Canyon, populations are known to exist in the Purple Hills, in Moody Canyons, Orange Cliffs region, and along the Escalante River in Garfield County, Utah. The Park Service conducts annual monitoring of Jones' cycladenia in Glen Canyon (NPS 2009b).

Jones' cycladenia is vulnerable to human-caused threats because of the relatively small number of populations and because the arid climate and harsh soils make this ecosystem a fragile one, slow to recover from surface disturbance (USFWS 2000). Threats include off-road use; oil, gas, and mineral exploration; and livestock grazing. Although these threats have been managed to reduce human-caused impacts, they remain an ongoing and long-term concern (USFWS 2008).

Copper Canyon Milkvetch (*Astragalus cutleri*) — Species of Concern (Utah)

This short-lived perennial forb often flowers as an annual and averages 4 to 14 inches (10 to 35 centimeters) in height. Its stems are few to several, erect to spreading, and form bushy clumps from a branched root crown (AZGFD 2004; Roth 2001). The flowering and fruiting period for this plant is from mid-April to early June (Roth 2001). Copper Canyon milkvetch inhabits warm desert shrub communities from approximately 3,803 feet (1,160 meters) in elevation (AZGFD 2004). It grows in selenium-rich clays and alkaline soils with level to moderate slopes (Roth 2001) on the Shinarump and Chinle Formations (Roth 2009). This extremely rare species is restricted to a few locations in San Juan County, Utah, and is known from only two locations inside Glen Canyon, Clay Hills Crossing and Copper Creek. Copper Canyon milkvetch is not currently monitored in Glen Canyon (NPS 2009b).

Burros were blamed for the disappearance of the species from the Copper Canyon area from 2000 to 2003. *Astragalus* species are generally considered toxic to livestock but can become addictive once grazed. Other threats include competition with annual invasive plant species such as *Bromus rubens*, *Schismus arabicus*, and *Erodium cicutarium*, which are all abundant in the Copper Canyon area (Roth 2009). In addition, Copper Canyon milkvetch has been previously affected by ORV activity in Glen Canyon near Clay Hills Crossing (Sweatland pers. comm. 2010a).

Kachina daisy (*Erigeron kachinensis*) — Species of Concern (Utah)

This perennial herb with lax stems reaches up to 20 centimeters high and produces flowers with white or pinkish rays surrounding a yellow disk bloom from late April to August (NatureServe 2009). The typical habitat for the Kachina daisy are low elevation seeps and hanging gardens to high elevation mesic sandstone outcrops in aspen and ponderosa pine communities (NatureServe 2009). This plan is endemic to the Colorado Plateau in Garfield and San Juan Counties in Utah, and in Montrose County, Colorado (UNPS 2009). Potential threats to this species include mining, energy development, and water projects, which could affect water supplies to its habitat (NatureServe 2009). Based on Glen Canyon staff observation, this species is found within Glen Canyon in hanging gardens habitat along canyon edges and potentially in the Orange Cliffs region.

Paria Spurge (*Euphorbia nephradenia*) — Species of Concern (Utah)

This annual herb reaches 4 to 9.8 inches (10 to 25 centimeters) in length and produces small flowers inside yellow-green, cup-shaped structures. Its flowers bloom between June and August (NatureServe 2009). Typical habitat for Paria spurge includes desert shrubland and grassland communities between 3,800 and 4,800 feet (1,158 and 1,463 meters) in elevation. This plant mainly grows on dark clay hills, blow sand, and stabilized dunes from Tropic Shale and Entrada Formations. This species is endemic to the Colorado Plateau in Emery, Garfield, Kane, and Wayne Counties in Utah, and in Colorado (UNPS 2009). In general, potential threats to this species include mineral exploration and human-related activities including road construction (NatureServe 2009).

Cataract Gilia (*Gilia imperialis*) — Species of Concern (Utah)

This annual herb has intricately branched clusters of flowers and can reach over 9.8 inches (25 centimeters) in height. This species is distinguished from *G. latifolia* by a later phenology, lasting from June to October, and by several morphological traits and distribution. Habitat type includes shadscale and other mixed desert shrub communities, especially in wash bottoms and at the bases of ledges (UNPS 2009). Cataract gilia is endemic to Utah and can be found growing mainly on Tropic, Carmel, and Straight Cliffs Formations near roads (NPS 2009b; Sweatland pers. comm. 2010a) at 3,800 to 5,200 feet (1,160 to 1,585 meters) in elevation (NPS 2009b; UNPS 2009). Known from only three locations, this species is considered uncommon in Glen Canyon and is found on clayey soils (NPS 2009b).

Tropic Goldeneye (*Heliomeris soliceps)* — Species of Concern (Utah)

Tropic goldeneye is an annual herb with a deep taproot that averages 6 to 16 inches (15 to 40 centimeters) in height. Its long stems contain yellow flowers that bloom from May through June. Preferred habitat for this species includes mat saltbush communities on gumbo clay knolls at 4,593 to 4,823 feet (1,400 to 1,470 meters) in elevation (NatureServe 2009). Endemic to Kane County, Utah, tropic goldeneye is restricted to Tropic Shale Formations and is considered rare in Glen Canyon (NatureServe 2009; NPS 2009b). Based on Glen Canyon staff observation, this species is threatened by ORV activity.

Western hophornbeam (*Ostrya knowltonii*) — Species of Concern (Arizona and Utah)

Western hophornbeam is a small tree 10 to 40 feet (3 to 12 meters) tall with a 6 to 18 inch (15.2 to 45.7 centimeter) diameter. The trunk is usually short and divided into a number of slender, crooked branches to form a round-topped crown. It is found in southeastern Utah, northern Arizona, southeastern New Mexico (in the Guadalupe and Sacramento mountains in Eddy County), and northern Trans-Pecos Texas. It is not a common tree and its occurrence is sporadic even in these areas (Tesky 1994). In Arizona, this species has been reported in Coconino and Yavapai Counties; in Utah, it has been reported in Garfield, Grand, Kane, and San Juan Counties (NatureServe 2009). Based on Glen Canyon staff observation, this species is found within Clearwater Canyon and potentially the Orange Cliffs region. This species is threatened in unprotected areas by water diversion and development (NatureServe 2009).

Alcove rock-daisy (*Perityle specuicola*) — Species of Concern (Utah)

The alcove rock-daisy is a woody-based perennial herb reaching approximately 20 to 27 inches (50 to 70 centimeters) long. The leaves are tiny and inconspicuous and the flower heads have disk flowers that are yellow. The species flowers from July to September (NatureServe 2009). The species is endemic to Garfield, Grand, and San Juan Counties, Utah. Its habitat consists of desert shrub and hanging garden communities in narrow, protected canyons, alcoves, and at cliff bases in Navajo Sandstone and the Cedar Mesa Formation (UNPS 2009). Based on Glen Canyon staff observation, this species is found within Glen Canyon in hanging gardens habitat along canyon edges and may occur in the Orange Cliffs region. Overall threats to this species include recreational activities; camping and road construction may also be threats (NatureServe 2009).

Howell's Phacelia (*Phacelia howelliana*) — Species of Concern (Arizona and Utah)

Howell's phacelia is an annual herb reaching approximately 9 inches (23 centimeters) in height, with blue-purple flowers growing on one side of the flowering stalks in curved clusters (NatureServe 2009; UNPS 2009). The flowering period for this plant is April to June. This species is endemic to the Colorado Plateau and is found in Grand, Kane, San Juan, and Wayne Counties in Utah, as well as in Arizona (UNPS 2009). Howell's phacelia is associated with Tropic Shale Formations (Sweatland pers. comm. 2010a) and is restricted to clay and basalt hills (NPS 2009b). Howell's phacelia inhabits salt and warm desert shrub and pinyon/juniper communities at 3,700 and 5,000 feet in elevation (UNPS 2009). Potential threats to this species include industrial development and other changes in land use (NatureServe 2009). Based on Glen Canyon staff observation, this species is also threatened by ORV activity.

Nipple Phacelia (*Phacelia mammillarensis)* — Species of Concern (Arizona and Utah)

Nipple phacelia is an annual herb with pale blue to white flowers, and is endemic to the Tropic Shale and Kaiparowits Formations east of Glen Canyon City, Utah. This plant is one of very few that is capable of surviving on the colluvial soils of the region (NatureServe 2009). In Glen Canyon, this species is considered occasional and is widely scattered in desert shrubland habitats, specifically in Kane County (NPS 2009b). Since 1979, primary threats to Nipple phacelia include the use of ORVs and potential industrial development (NatureServe 2009).

Whiting's Indigo-bush (*Psorothamnus thompsoniae* var. *whitingii*) — Species of Concern (Arizona and Utah)

Whiting's indigo-bush is an armed shrub ranging from 9.8 to 31.5 inches (25 to 80 centimeters) in height. Its leaflets are linear to narrowly elliptic or oblong, with flowers containing indigo or purple-pink petals (UNPS 2009). This species is endemic to the Navajo Basin and is found only in San Juan County, Utah, and Coconino County, Arizona (NatureServe 2009; UNPS 2009). Whiting's indigo-bush can be found in sandy soils at 3,800 to 5,000 feet in elevation from late May to June (UNPS 2009). In Glen Canyon, this rare species inhabits desert shrub communities and bottomlands, specifically at Clay Hills Crossing (NPS 2009b).

New Mexico raspberry (*Rubus neomexicanus*) — Species of Concern (Utah)

The New Mexico raspberry is a small shrub, approximately 3 to 6 feet (1 to 2 meters) tall, with small white flowers found singly or in pairs. Its fruit is a red berry, approximately 0.6 inch (15 millimeters) thick (Latimer 2005). The species distribution is Utah, New Mexico, Arizona, and northern Mexico (Latimer 2005). In Arizona, it is found in Coconino and Yavapai counties, at 5,000 to 9,000 feet in moist canyons (Latimer 2005). Based on Glen Canyon staff observation, this species is found within Glen Canyon in Clearwater Canyon in the Orange Cliffs region. According to Glen Canyon's strategic plan, New Mexico raspberry is likely to be stable (NPS 2007e).

Jane's globemallow (*Sphaeralcea janeae*) — Species of Concern (Utah)

Jane's globemallow is a perennial herb, approximately 12 to 35 inches (30 to 90 centimeters) tall, and produces a cluster of orange flowers from May to June (NatureServe 2009). The species is endemic to San Juan and Wayne Counties, Utah (UNPS 2009). Its habitat consists of warm, salt, and mixed communities on the Shinarump and Moenkopi formations and White Rim and Organ Rock members of the Cutler Formation (NatureServe 2009). Based on Glen Canyon staff observation, this species is found within Glen Canyon in the White Rim Sandstone formation in the Orange Cliffs region. Overall threats to this species include mining activities (NatureServe 2009).

Desert mountain lilac (*Ceanothus vestitus* var. *franklinii*) — Glen Canyon Species of Concern

This variety of *Ceanothus* is shorter than var. *vestitus* (8 to 20 inches [20 to 50 centimeters] versus 39 to 79 inches [100 to 200 centimeters]), is more intricately branched, and usually has blue rather than white flowers. The species is endemic to Utah and is found in Grand, San Juan, and possibly Garfield Counties. Its habitat consists of pinyon-juniper, blackbrush, skunkbrush, and serviceberry communities at 5,400 to 6,200 feet elevation (UNPS 2009). Based on Glen Canyon staff observation, this species is found within Glen Canyon in the Wilson Mesa and Orange Cliffs regions.

Tompkin's phacelia (*Phacelia pulchella* var. *sabulonum*) — Glen Canyon Species of Concern

Tompkin's phacelia is a rare annual forb/herb (USDA n.d.) endemic to Utah, and is restricted to the Tropic and Straight Cliff Shale Formations (NatureServe 2009; NPS 2009b). Most of the known locations for this species are in eastern Kane County, where it is common on gravelly benches and sandy wash bottoms in shadscale and greasewood communities (NatureServe 2009). Based on the observation of Glen Canyon staff, threats to this species include ORV activity.

Douglas fir (*Pseudotsuga menziesii*) — Glen Canyon Species of Concern

Douglas fir is a medium-sized evergreen tree with a short pyramidal symmetrical crown at the top of a clear straight trunk. The average size of this tree in Utah is 130 feet (40 meters) tall, and 36 inches (91 centimeters) in diameter (Utah State University 2013). Relict Douglas-fir stands, which prefer cooler, moist climates, exist in north-facing shaded alcoves associated with springs (NPS 2013b). Based on Glen Canyon staff observation, this species is found

within Glen Canyon in the Orange Cliffs region. Threats to this species include disease, grazing pressure, and development.

Critical Habitat

Provisions of the Endangered Species Act require the consideration of both species populations and designated critical habitat for species listed or proposed for listing. "Critical habitat" is defined as a specific geographic area that is essential for the conservation of an endangered or threatened species and that is designated as such in the recovery plan for that species, or in subsequent legislation.

Glen Canyon supports designated critical habitat for Mexican spotted owl and four endangered fish species: the Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), bonytail chub (*Gila elegans*), and humpback chub (*Gila cypha*). As described in chapter 1, it is not expected that off-road use would adversely impact these fish species, because none occur in the designated ORV areas within the scope of this plan/DEIS. Therefore, Colorado pikeminnow, razorback sucker, bonytail chub, and humpback chub are not analyzed in chapter 4.

Glen Canyon supports designated critical habitat for Mexican spotted owl.

Critical habitat units for the Mexican spotted owl are designated in portions of Apache, Cochise, Coconino, Graham, and Pima Counties in Arizona; Carbon, Emery, Garfield, Grand, Iron, Kane, San Juan, Washington, and Wayne Counties in Utah; and several counties in New Mexico and Colorado. Glen Canyon lies in Unit CP-13, which is in Wayne, Garfield, Kane, and San Juan Counties, Utah. It is primarily in the Waterpocket Fold landform extending to Lake Powell. Canyons and steep-sloped, mixed-conifer habitats are included in this unit, as well as foraging and dispersal habitat. Unit CP-12 designates critical habitat adjacent to Glen Canyon in the vicinity of the Kaiparowits Plateau and the Cockscomb, in Kane and Garfield Counties. Additionally, Unit CP-14 lies adjacent to Glen Canyon in Wayne, Garfield, San Juan, and Grand Counties and designates critical habitat in the Orange Cliffs region. In addition, this unit includes the Dark Canyon primitive and wilderness areas of the BLM and U.S. Forest Service, respectively (69 FR 53214). Also included in this unit is a significant area in Canyonlands National Park, which is considered one of the major population centers of the Mexican spotted owl on the Colorado Plateau (NPS 2004a). In determining which areas to designate as critical habitat for a species, the USFWS considers those physical and biological attributes that are essential to species conservation (i.e., constituent elements). The owl's primary constituent elements, which exist in mixed conifer, pine/oak, and riparian forest types, that provide for one or more of the owl's habitat needs for nesting, roosting, foraging, and dispersing are in areas defined by the following:

1. **Primary constituent elements related to forest structure**:
    a. A range of tree species, including mixed-conifer, pine/oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees, 30% to 45% of which are large trees with a trunk diameter of 12 inches (0.3 meters) or more when measured at 4.5 feet (1.4 meters) from the ground;
    b. A shade canopy created by the tree branches covering 40% or more of the ground; and
    c. Large dead trees (snags) with a trunk diameter of at least 12 inches (0.3 meters) when measured at 4.5 feet (1.4 meters) from the ground.
2. **Primary constituent elements related to maintenance of adequate prey species**:
    a. High volumes of fallen trees and other woody debris;
    b. A wide range of tree and plant species, including hardwoods; and
    c. Adequate levels of residual plant cover to maintain fruits, seeds, and allow plant regeneration.

3. **Primary constituent elements related to canyon habitat include one or more of the following**:
    a. Presence of water (often providing cooler and often higher humidity than the surrounding areas);
    b. Clumps or stringers of mixed-conifer, pine/oak, pinyon/juniper, and/or riparian vegetation;
    c. Canyon wall containing crevices, ledges, or caves; and
    d. High percent of ground litter and woody debris. (69 FR 53211)

SOUNDSCAPES

The natural soundscape encompasses all the natural sounds that occur in parks, including the physical capacity for transmitting those natural sounds and the interrelationships between park natural sounds of different frequencies and volumes.

According to NPS *Management Policies 2006* and Director's Order 47: Sound Preservation and Noise Management, an important component of the Park Service mission is the preservation of natural soundscapes associated with national park units (NPS 2000, 2006a). Natural soundscapes exist in the absence of human-caused sound. The natural soundscape is the aggregate of all the natural sounds that occur in parks (such as waves on the shoreline, birds calling, wind blowing, or the sound of thunder), together with the physical capacity for transmitting natural sounds. Natural sounds are intrinsic elements of the environment and part of "the scenery and the natural and historic objects and the wild life" protected by the NPS Organic Act. They are vital to the visitor experience of many parks and provide valuable indicators of the health of various ecosystems. Natural sounds are necessary for ecological functioning and occur within and beyond the range of sounds that humans can perceive. Many mammals, insects, and birds decipher sounds to find desirable habitat and mates, avoid predators and protect young, establish territories, and to meet other survival needs.

The Glen Canyon soundscape is composed of both a natural and human-caused components. Human-caused sounds at Glen Canyon largely are attributable to motor engines and include all types of watercraft, conventional and nonconventional motor vehicles, aircraft, and electronic devices such as radios and horns. As discussed in chapter 1, soundscapes was identified as an impact topic for further analysis in this plan/DEIS because of the potential for noise from motor vehicles travelling off-road to interfere with non-motorized recreation or disturb wildlife. Human sounds are not unexpected or necessarily inappropriate at the developed areas, but are part of the overall soundscape in an area where water activities, picnicking, camping, sightseeing, and other recreational uses occur.

SOUNDSCAPE TERMINOLOGY

Whereas sound may be described as an auditory sensation characterized by variations in pressure that move through air or water, noise is generally defined as an unwanted or intrusive sound (NPS 2010b). For example, sounds are described as noise if they interfere with an activity or disturb the person or organism hearing them.

Sound is measured in a logarithmic unit called a decibel (dB). Sound pressures described in decibels are called sound pressure levels and are often defined in terms of frequency-weighted scales (A, B, C or D). The A-weighted decibel scale is commonly used to describe noise levels because it reflects the frequency range to which the human ear is most sensitive (1,000–5,000 Hertz) (Caltrans 2009). Sound levels measured using an A-weighted decibel scale are generally expressed as "dBA." Throughout this section, all noise levels are expressed in A-weighted decibels. Several examples of sound pressure levels in the A-weighted scale (dBA) measured in national parks are listed in table 7.

TABLE 7: SOUND PRESSURE LEVELS MEASURED IN NATIONAL PARKS

Sound	dBA
Threshold of Human Hearing	0
Haleakala National Park: Volcano Crater	10
Canyonlands National Park: Leaves Rustling	20
Zion National Park: Crickets (5 meters)	40
Whitman Mission: Conversational Speech (5 meters)	60
Yellowstone National Park: Snowcoach (30 meters)	80
Arches National Park: Thunder	100
Yukon–Charley Rivers National Park: Military Jet (100 meters above ground level [AGL])	120

Source: NPS 2010b.

Definitions of terms that are commonly used in this "Soundscapes" section are provided below.

Acoustic Zone: Areas of like vegetation, topography, elevation, and climate are considered acoustic zones, based on the assumption that similar animals, plants, physical processes, and other sources of natural sounds occur in similar areas with similar attributes.

Audibility: Audibility is the ability of animals with normal hearing (including humans) to hear a given sound. The main factors that affect audibility are the hearing ability of the animal, other simultaneous interfering sounds or stimuli, and the frequency content and amplitude of the sound.

Existing Ambient Sound Level (L_{50}): This term refers to the sound level of all sounds in a given area, and includes all natural sounds as well as all mechanical, electrical, and other human-caused sounds. The existing ambient sound level will be characterized by the L_{50} exceedance level (i.e., the median).

Natural Ambient Sound Level (L_{nat}): The sound level of all natural sounds in a given area, excluding all mechanical, electrical and other human-caused sounds, is considered the natural ambient sound level. The L_{nat} will be characterized by the L_{50} exceedance value calculated during the times when no human-caused sounds are audible.

Equivalent Sound Level (L_{eq}): This term refers to the logarithmic average (i.e., on an energy basis) of sound pressure levels over a specific time period. "Energy averaged" sound levels are generally much higher than arithmetic averages because they are logarithmic values. Typically, L_{eq} values are calculated for a specific period (e.g., 1-hour and 12-hour periods); L_{eq} values are computed from all the 1-second L_{eq} values for the specific period. L_{eq} must be used carefully in quantifying sound levels because occasional loud sound events may heavily influence/increase the L_{eq} value, even though sound levels for that period of time are typically lower.

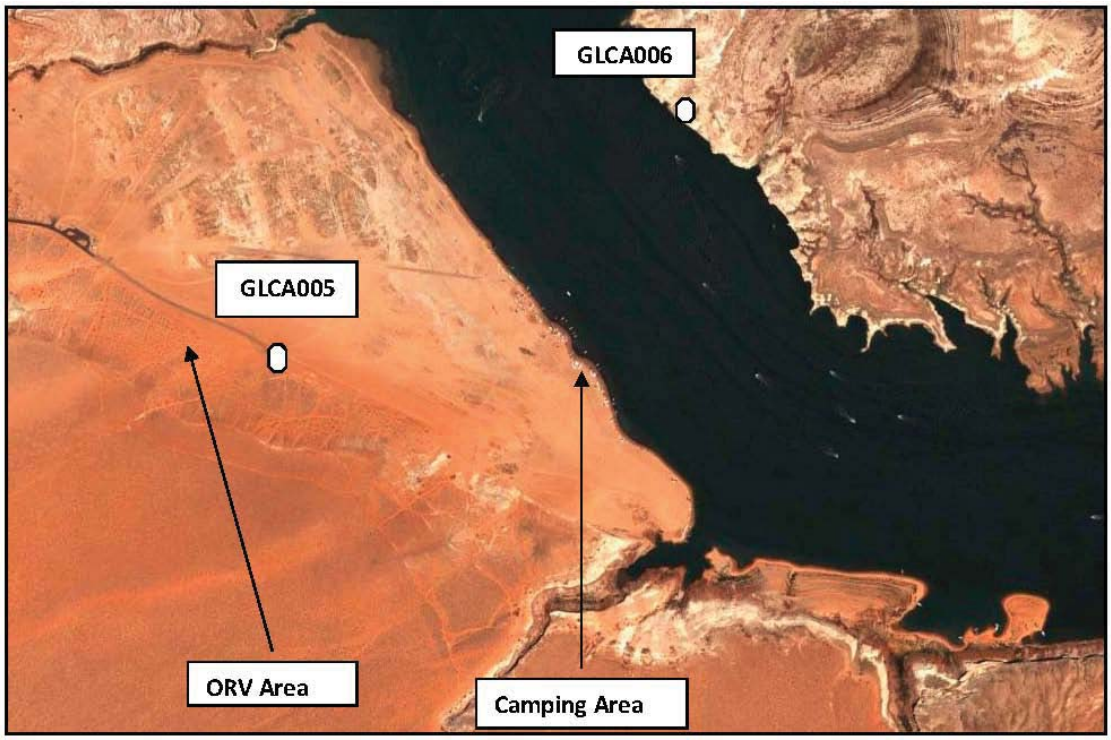
L_x (Exceedance Percentile): This metric represents the sound pressure level (L), in decibels, exceeded x% of the time for the specified measurement period. For instance, L_{90} is the sound pressure level exceeded 90% of the time.

Noise-free Interval (NFI): NFI refers to the length of the interval between noise events during which only natural sounds are audible.

Existing Sound Levels

2007 Glen Canyon Off-road Vehicle Sound Study

In 2007, the Park Service conducted a sound monitoring project to collect acoustic data in the Lone Rock Beach area on Lake Powell, as referenced above, in order to characterize and describe ORV sounds in that area to understand how ORVs may impact the natural soundscape of Glen Canyon. Sound levels were recorded by acoustic monitors deployed at Lone Rock Beach Play Area on the west side of the bay (designated GLCA005) as well as on the east side of Lone Rock Beach (GLCA006), as shown in figure 14. Continuous sound monitoring was conducted at GLCA005 from August 16 to August 21, 2007, and from August 29 to September 3, 2007. Continuous sound monitoring was conducted at GLCA006 from August 17 to August 20, 2007, and from August 30 to September 2, 2007.



Note: ORV Area is the Lone Rock Beach Play Area.
Source: Ambrose and Florian 2008.

Figure 14: Lone Rock Beach Acoustic Monitoring Sites

This study found that sound levels at the Lone Rock Beach Play Area regularly exceeded 75 dBA at 50 feet from the sound source, and occasionally exceeded 90 dBA at 50 feet (Ambrose and Florian 2008). At this location, human-caused sounds were audible, on average, 90.5% of the time, and it was noted that ORV sounds were the loudest and most common sounds at the site. Specifically, ORVs and other vehicles were audible 54.7% of the day (ORVs alone were audible 31.7% of the day), whereas watercraft (boats and personal watercraft) were audible 21.8% of the day (Ambrose and Florian 2008). Average sound levels at the site ranged between 24 and 45 dBA, with the major contributor being ORV sounds.

On the east side of Lone Rock Bay, watercraft (boats and personal watercraft) were the loudest and most common sounds. Such sources were audible, on average, 57.2% of the day, whereas ORVs and other vehicles were audible 32.1% of the time (Ambrose and Florian 2008). Average sound levels at this site ranged between 26 and 51 dBA, with the main contributor being watercraft sounds (Ambrose and Florian 2008).

The loudest events at monitoring sites GLCA005 and GLCA006 were calculated, using measured data, for a standard reference distance of 50 feet and presented in the ORV study report (Ambrose and Florian 2008). The loudest events at GLCA005 were most frequently attributed to ORVs (up to 101.6 dBA at 50 feet). In contrast, the loudest events at GLCA006 were attributed to motor boats (up to 102.8 dBA at 50 feet), which is logical given the proximity of GLCA006 to Lake Powell. This study also found that, of the ORVs used in Glen Canyon and recorded during the measurement period, those with modified or performance exhaust systems tended to be two to four times louder than ORVs with stock exhausts.

2010 Glen Canyon National Recreation Area and Rainbow Bridge National Monument Acoustic Inventory

An acoustic study was conducted at Glen Canyon and Rainbow Bridge National Monument (Rainbow Bridge) in 2010 to determine sound levels and sound sources in the primary land cover groups in summer and winter during daytime and nighttime (Ambrose and Florian 2011). The objective of the study was to collect and analyze acoustic data in the primary land cover types of Glen Canyon and Rainbow Bridge sufficient to develop an acoustic baseline for frontcountry and backcountry areas.

The acoustic study measured sound levels and sources at seven locations, three frontcountry sites and four backcountry sites, including areas of high visitor use and low visitor use. The study also used data collected as part of two other acoustic studies related to Glen Canyon, the 2007 ORV study at the Lone Rock Bay area (as discussed above) and an airport study related to the Cal Black Memorial Airport, increasing the number of locations to 11.

Areas with like vegetation, land cover, topography, elevation, and climate are generally considered acoustic zones because they often exhibit similar acoustical characteristics, including sound sources (birds, insects, mammals), sound levels, and propagation and attenuation properties. Measurement locations were selected to represent four land cover groups in Glen Canyon and Rainbow Bridge: cliff/canyon; desert shrubland/grassland; pinyon/juniper; and developed. Lake areas were not specifically addressed, although several monitors were close to water. Two levels of human use were considered, low and high. Low-use areas included isolated lakeside camping areas, low-use motorboat areas, trails, and other areas with regular human use but relatively low numbers; high-use areas were busy, developed areas such as marinas, visitor centers, and high-density camping areas. The 11 acoustic measurement locations, as well as their primary land cover type and level of human use, are listed in table 8 and mapped in figure 15.

TABLE 8: ACOUSTIC MEASUREMENT LOCATIONS

Site Number	Site Name	Latitude	Longitude	Elevation (meters)/(feet)	Primary Land Cover(s)	Visitor Use Level*
GLCA006	Lone Rock Bay East	37.01984	111.5285	1,111/3,645	Rock / sand / lake	High*
GLCA007	Wahweap Marina	36.9941	111.48994	1,129/3,704	Developed / desert shrub	High
GLCA008	Rainbow Bridge	37.07777	110.96253	1,155/3,789	Canyon / rock / shrub	High*
GLCA009	Iceberg Canyon	37.30342	110.73644	1,130/3,707	Canyon / rock / lake	High*
GLCA010	Warm Creek Rd	37.10004	111.50516	1,226/4,022	Desert shrub / bare soil	Medium
GLCA011	Sewing Machine Rd	37.92109	110.3122	1,490/4,888	Desert shrub / bare soil	Low
GLCA012	Hans Flat	38.22666	110.15087	1,999/6,558	Pinyon / juniper / bare soil	Low
GLCA016	Lake Canyon	37.43071	110.65193	1,109/3,638	Canyon / riparian	Low
GLCA017	Moki Canyon	37.47441	110.58277	1,137/3,730	Canyon / desert shrub	Low
GLCA018	Forgotten Canyon	37.54443	110.58262	1,132/3,713	Canyon / desert shrub	Low
GLCA019	Hansen Creek	37.56828	110.68369	1,128/3,700	Rock / desert shrub	Low

Source: Ambrose and Florian 2011.
*Visitor use in these areas varied by season.

A total of 13,617 hours of acoustical data were collected for the Glen Canyon and Rainbow Bridge acoustic inventory; in addition, 354 hours of data collected as part of the ORV study in 2007 (Ambrose and Florian 2008) and 4,230 hours of data from the Cal Black Memorial Airport study in 2010 (Ambrose and Florian 2011, 2013) were analyzed. Sound levels (L_{nat} and L_{50}) for summer and winter seasons and day and night periods for 11 measurement locations in Glen Canyon and Rainbow Bridge are shown in tables 9 and 10. Backcountry area sound levels were very low, often as low as the acoustic systems could measure, whereas sound levels in developed and high visitor use areas were notably higher and reflect almost continuous human-caused sounds in those areas.

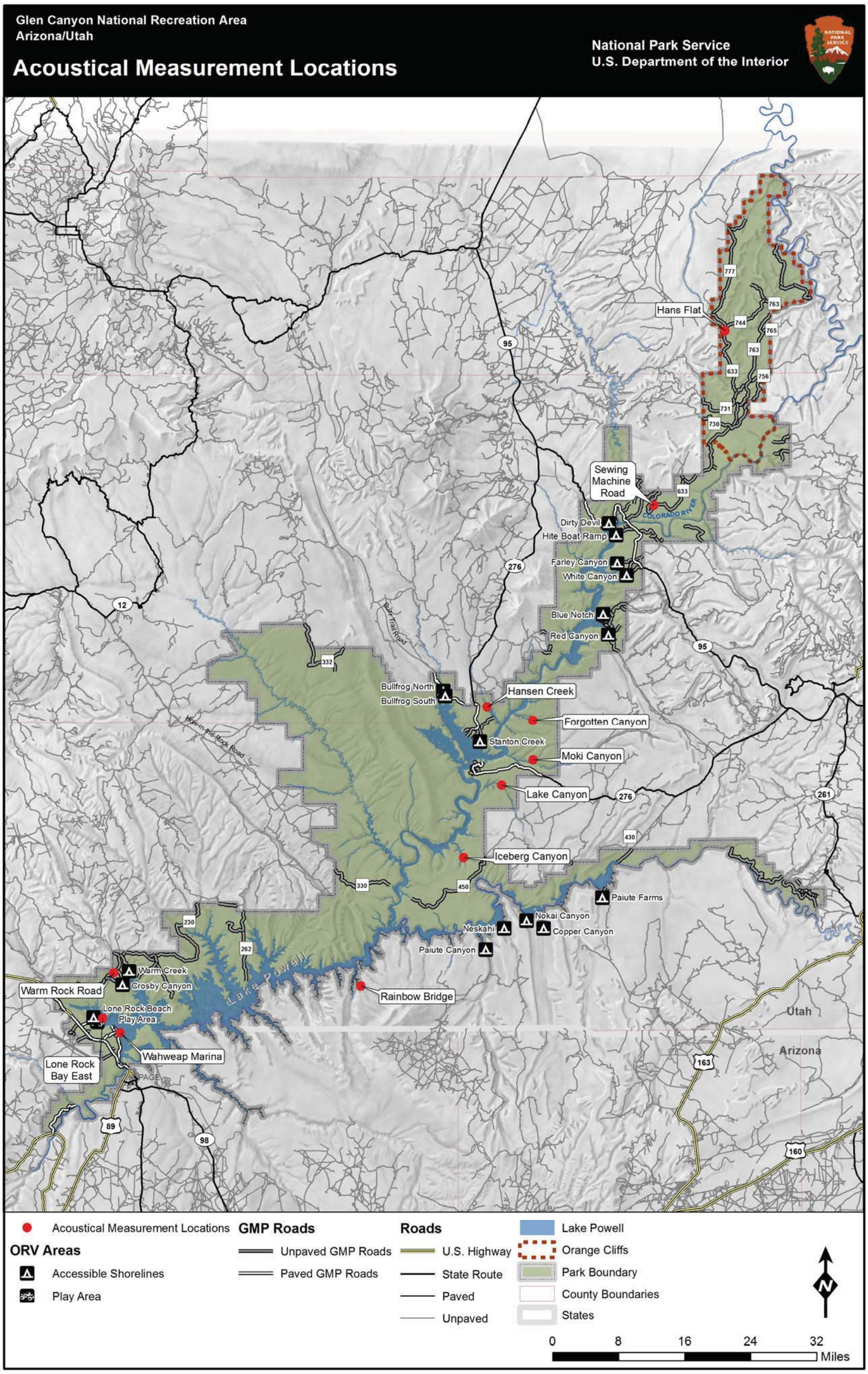


FIGURE 15: ACOUSTICAL MEASUREMENT LOCATIONS

TABLE 9: NATURAL AMBIENT SOUND LEVELS (L_{NAT}), DAY AND NIGHT, SUMMER AND WINTER, 2010

Site Number	Site Name	Summer		Winter	
		Day	Night	Day	Night
GLCA006*	Lone Rock Bay East	41.4*	31.4*	19.8	19.6
GLCA007*	Wahweap Marina	35.9*	31.9*	28.2*	24.6*
GLCA008	Rainbow Bridge	18.7	24.9	20.9	21.1
GLCA009*	Iceberg Canyon	25.0*	22.1	14.8	14.1
GLCA010	Warm Creek Road	18.4	18.6	15.8	14.5
GLCA011	Sewing Machine Rd.	20.8	23.7	15	14.2
GLCA012	Hans Flat	23.0	16.0	17.0	14.0
GLCA016	Lake Canyon	20.7	40.3	ND	ND
GLCA017	Moki Canyon	19.4	18.6	ND	ND
GLCA018	Forgotten Canyon	19.2	23.5	ND	ND
GLCA019	Hansen Creek	20.9	39.4	ND	ND

Source: Ambrose and Florian 2011, 2013.

*Human-caused sounds were audible > 75% of the time. In these situations where human-caused sounds are audible >75% of the time, L_{nat} computations are less reliable.

ND = no data available.

TABLE 10: EXISTING AMBIENT SOUND LEVELS (L_{50}), DAY AND NIGHT, SUMMER AND WINTER, 2010

Site Number	Site Name	Summer		Winter	
		Day	Night	Day	Night
GLCA006	Lone Rock Bay East	51.3	35.6	26.8	22.3
GLCA007	Wahweap Marina	46.4	36.4	39.5	28.1
GLCA008	Rainbow Bridge	22.8	32.2	21.5	21.3
GLCA009	Iceberg Canyon	35.8	26.9	19.2	14.1
GLCA010	Warm Creek Road	23.0	20.6	19.5	14.6
GLCA011	Sewing Machine Road	22.5	27.0	15.3	14.1
GLCA012	Hans Flat	24.6	16.2	18.5	14.0
GLCA016	Lake Canyon	23.6	42.4	ND	ND
GLCA017	Moki Canyon	21.9	19.2	ND	ND
GLCA018	Forgotten Canyon	20.5	25.1	ND	ND
GLCA019	Hansen Creek	24.5	20.2	ND	ND

Source: Ambrose and Florian 2011, 2013.

ND = no data available.

In developed, high-density areas such as Wahweap Marina, human-caused sounds were audible nearly 100% of the time during both summer and winter seasons, daytime and nighttime. Human-caused sounds were audible over 90% of the time during summer daytime hours in high-use lake areas (e.g., Iceberg Canyon), and were less audible in these areas during summer nighttime and winter periods. Aircraft sounds were common throughout Glen Canyon and Rainbow Bridge, most often high-altitude commercial jet aircraft.[5] In developed areas and high visitor use areas, watercraft sounds, vehicle sounds, and other ground-based, human-caused sounds often masked aircraft sounds. (Note that no winter data were available at four locations: GLCA016, Lake Canyon; GLCA017, Moki Canyon; GLCA018, Forgotten Canyon; and GLCA019, Hansen Creek). Table 11 exhibits common sound sources and the percentage of time each was audible for high-use and low-use areas. Classification (high versus low use) of location varied by seasonal use, as shown in table 12.

TABLE 11: COMMON SOUND SOURCES AND PERCENTAGE OF TIME AUDIBLE IN DEVELOPED / HIGH-USE AREAS AND BACKCOUNTRY / LOW-USE AREAS, SUMMER AND WINTER SEASONS

Sound Source	Developed / High-use Areas		Backcountry / Low-use Areas	
	Summer Mean (%)	Winter Mean (%)	Summer Mean (%)	Winter Mean (%)
Jet Aircraft	11.6	18.1	19.1	27.9
Propeller Aircraft	2.5	3.3	2.4	2.6
Helicopter Aircraft	0.0	0.2	0.0	0.0
Vehicles	26.5	41.4	1.8	0.8
Watercraft	35.3	7.7	3.9	0
Trains	0.0	0.0	0.0	0.0
Motors	11.8	21	6.0	4.0
Grounds Care	0.0	0.8	0.0	0.0
People	20.1	8.0	1.7	0.1
Domestic Animals	1.3	0.7	0.0	0.0
Building Sounds	7.6	15.7	0.0	0.0
Construction Sounds	0.0	0.4	0.0	0.0
Other Human Sounds	0.0	0.0	0.0	0.0
Unknown Human Sounds	0.0	0.0	0.1	0.1
Wind	15.5	15.6	40.5	29.4
Water	25.7	33.5	8.9	33.6
Mammals	0.4	0.4	1.3	0.0
Birds	12.2	22.5	27.8	5.4
Amphibians	1.0	0.0	0.0	0.0
Insects	27.7	0.8	66.4	0.4
Animal Sounds	0.7	0	1.4	0.4
Other Natural Sounds	0.0	0.0	0.1	0.0

Source: Ambrose and Florian 2011.

[5] Except at Rainbow Bridge during summer months, where air tour aircraft were common.

TABLE 12: CLASSIFICATION (HIGH USE OR LOW USE) OF MEASUREMENT LOCATION BY SEASON

Developed / High-use Areas			
Summer		Winter	
GLCA006	Lone Rock Bay East	GLCA006	Lone Rock Bay East
GLCA007	Wahweap Marina	GLCA007	Wahweap Marina
GLCA008	Rainbow Bridge		
GLCA009	Iceberg Canyon		
Backcountry / Low-use Areas			
Summer		Winter	
GLCA010	Warm Creek Road	GLCA008	Rainbow Bridge
GLCA011	Sewing Machine Road	GLCA009	Iceberg Canyon
GLCA012	Hans Flat	GLCA010	Warm Creek Road
GLCA016	Lake Canyon	GLCA011	Sewing Machine Road
GLCA017	Moki Canyon	GLCA012	Hans Flat
GLCA018	Forgotten Canyon		
GLCA019	Hansen Creek		

Source: Ambrose and Florian 2011.

Twenty-one hours of continuous audio data were analyzed to determine NFI metrics, including the percentage of time non-natural sounds were audible, the percentage of time natural sounds were audible, mean maximum NFI, and mean NFI.[6] NFI analysis results indicate that NFI periods were essentially nonexistent in the high-density developed areas, such as Wahweap Marina. In low-density developed areas, such as Rainbow Bridge, NFI periods were similar to medium- and low-use areas, with human-caused sounds present but much less so than in high-density developed areas. Table 13 presents the NFI metrics for day and night periods in low-use backcountry areas.

TABLE 13: NOISE-FREE INTERVAL METRICS (MEAN), DAY AND NIGHT PERIODS, IN LOW-USE BACKCOUNTRY AREAS

Period of Day	Nonnatural Sounds (%)	Natural Sounds Only (%)	Mean Max. NFI (minutes)	Mean NFI (minutes)
Day	29.1	71.0	16.8	7.3
Night	22.0	78.0	19.2	7.4

Source: Ambrose and Florian 2011.

As a recreation area, Glen Canyon's noise metrics (including sound levels and the audibility of human sounds) are greatly affected by the number of visitors in a given area and the type of activity that the visitors partake in. Visitors to the lake area use various types of watercraft, including kayaks, houseboats, and speedboats, some of which are

[6] Continuous audio data were not available for 2007 measurement locations (GLCA006, Lone Rock Bay East, and GLCA007, Wahweap Marina). Human-caused sounds were audible nearly 100% of the time at these two locations.

extremely loud. In such high-use areas, existing sound levels in the summer average about eight times as loud[7] as in low-use areas (50 dBA versus 20 dBA). Similarly, the percentage of time that human-generated sounds were audible in high-use areas was roughly four times higher than in low-use areas.

The study notes that visitor use of Glen Canyon backcountry areas appears to be relatively less than in backcountry areas of nearby national parks (e.g., Grand Canyon National Park, Zion National Park). Given the low number of backcountry visitors, opportunities to experience natural sounds, remoteness, and solitude at Glen Canyon are high. Visitor use at the lake is also relatively low during winter, as evidenced by low sound level measurements of about 14 dBA near the lake in winter months (as low as could be measured by the equipment).

The highest level of visitor activity in Glen Canyon occurs during the summer at Lake Powell, with watercraft as the primary sound source (watercraft sounds frequently mask the aircraft sounds that are also common on the lake). High-altitude commercial jet aircraft are the most common source of sound in areas away from the lake (i.e., more than 3 miles [5 kilometers] from the lake). The primary reason for visitation at Rainbow Bridge is the naturally occurring bridge formation. Lake levels have been low in recent years, resulting in an approximately one-half mile (1 kilometer) distance between the dock and bridge. Given the distance of the separation and the no-wake boat speed rules, watercraft were not a common sound source at the monument (2.1%). The most common sound sources at the monument included people talking and walking, high-altitude commercial jets, and air tour aircraft.

There were few and short periods of natural sound only in the developed and high use areas of Glen Canyon and Rainbow Bridge (mean NFI was 1.04 minutes), such as the marinas and some lake areas during summer months. Mean noise-free periods in low-use backcountry areas and lake areas in winter, however, were longer than in nearby parks. The mean daytime NFI was 7.3 minutes and the mean nighttime NFI was 7.4 minutes in these areas of Glen Canyon and Rainbow Bridge, compared to a mean NFI of 3.2 minutes for four backcountry sites in Grand Canyon National Park (Ambrose and Florian 2005). High-altitude commercial jets were the main sound source responsible for shortening these NFI periods.

VISITOR USE AND EXPERIENCE

In 1972, Glen Canyon was established "to provide for public use and enjoyment and to preserve the area's scientific, historic, and scenic features." The unique area encompassed in the recreation area stretches for hundreds of miles from Lees Ferry in Arizona to southern Utah. The clear deep blue water of Lake Powell set against the red and orange sandstone cliffs has creates a scenic landscape that has contributed to drawing over 3 million visitors each year from all over the world to recreate at Glen Canyon. Visitation to Glen Canyon has fluctuated in the past several years, averaging about 1.9 million visitors annually during the past seven years (2003–2009), with a recent peak of 2.2 million visitors in 2011 (figure 16). However, between 1992 and 2002, Glen Canyon experienced an average of 2.7 million visitors annually (NPS 2011d).

[7] Since sound is measured using a logarithmic scale, increasing sound levels are not linear. An increase of 10 dBA is generally perceived by humans as twice as loud; an increase of 20 dBA is perceived as four times as loud, an increase of 30 dBA is perceived as eight times as loud, etc.

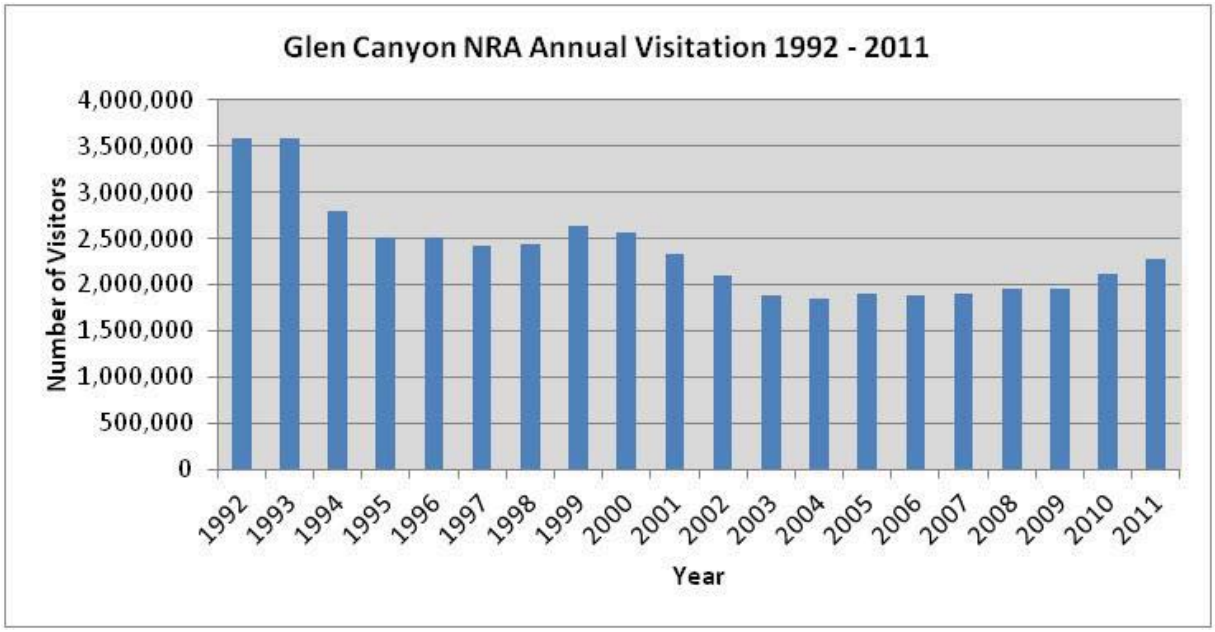


FIGURE 16: ANNUAL VISITATION 1992–2011

The recreational features of Glen Canyon include Lake Powell, its 96 major side canyons, and the related natural, cultural, and geologic resources.

Glen Canyon includes more than 1.25 million acres of opportunities for water-based and backcountry recreation. The recreational features of Glen Canyon include Lake Powell, its 96 major side canyons, and the related natural, cultural, and geologic resources. With 160,000 surface acres and 1,960 miles of shoreline, Lake Powell is a premier global destination for water-based recreation enthusiasts. A variety of recreational opportunities exist on and around the lake, including powerboating, waterskiing, fishing, riding tour boats, sailing, kayaking, and using houseboats and personal watercraft. The lake occupies only about 13% of Glen Canyon. The remaining 87% of Glen Canyon offers backcountry experiences in a desert setting that is extraordinarily rugged and beautiful. Opportunities exist for hiking and backpacking in the surrounding canyon areas, most of which are only accessible by visitors arriving via 4-wheel-drive vehicles or watercraft. Visitors can enjoy camping opportunities ranging from remote and undeveloped campsites to fully developed campgrounds. Other recreational opportunities offered at Glen Canyon include sightseeing, photography, and scenic auto touring. Visitors can experience archeologically and culturally significant sites throughout Glen Canyon. A 2007 visitor survey analyzed visitor use during the spring and summer seasons. According to the 2007 visitor survey, the most common activities in Glen Canyon included sightseeing (54% [spring] / 58% [summer]), visiting the visitor center / ranger stations (35% / 32%), motorized boating (32% / 53%). Swimming/diving was an additional common activity during the summer season, at 59% of all visitors surveyed. Visitors stated that sightseeing and motorized boating were the most important reasons for visiting Glen Canyon (NPS 2007f).

RECREATIONAL AREA ROAD SYSTEM

Planning for the Glen Canyon system began soon after Congress established Glen Canyon National Recreation Area in 1972. During the development of the 1979 Glen Canyon GMP, the issue of road access and circulation was thoroughly reviewed.

As a result of the GMP planning effort, 86.3 miles of unpaved roads were closed. Most of the roads that were closed were primitive unimproved tracks associated with early mineral prospecting, sheep and cattle grazing, or social exploration and were not in public use at the time of GMP planning. A few roads were closed to protect proposed wilderness areas or to preserve the integrity of the Natural Zone of Glen Canyon.

The GMP left open approximately 365 miles of unpaved roads and approximately 75 miles of paved roads to allow for public use and circulation through Glen Canyon (NPS 1979). The roads designated through the GMP (paved and unpaved GMP roads) are the only roads in Glen Canyon authorized for public travel.

Glen Canyon has undertaken several extensive road inventories since the development of the GMP. A road inventory was conducted in 1984 in response to the unauthorized expansion of Glen Canyon's designated road network. This inventory resulted in two actions: the first was a decision to physically close all unauthorized Glen Canyon roads. Authorized Glen Canyon roads were deemed to be only those roads illustrated in the GMP (NPS 1989 memorandum). All other roads were closed; closure generally was accomplished by placing orange Carsonite stakes on all unauthorized roads, or by placing obstructions such as boulders on the road. The second action was the development of a specific three-digit road numbering system for Glen Canyon National Recreation Area. This road numbering system remains in place today.

Another extensive road inventory took place in 2006. The inventory was required under NPS facility asset management program, which required that parks account for the condition of all facilities, including roads and trails. The inventory specifically found that the majority of roads in the Orange Cliffs and Hite areas were in very poor condition; were located in rough and occasionally impassable terrain; were subject to infrequent, if any, maintenance; and possessed no improvements (culverts, signs, gates, ditches, etc.). The inventory found that roads had been blocked off by natural events (slides, washouts, etc.), had deteriorated due to disuse to the point that they could no longer be located, and/or their alignment and location had been altered due to changes in the terrain and mistakes in original road alignment mapping efforts.

These findings are typical of inventories and site visits to unpaved GMP roads in Glen Canyon, especially in the Hite and Orange Cliffs region. The desert landscape of Glen Canyon is a dynamic, ever-changing environment. Primitive and infrequently maintained roads tend to be unstable. Natural events may block or obliterate a road and the road is rapidly reclaimed by nature. County road crews may alter the road alignment around a new obstacle to make the road passable.

Based on road inventories and site visits conducted as part of this EIS planning process, NPS updated the road network maps that are a part of this plan.

Off-road Vehicle Recreation Trends

The term "off-road vehicle" applies to a wide range of vehicle types. Under federal regulations, any vehicle driven off a road or parking area onto natural terrain is defined as an ORV (see the "Terminology" section in chapter 1). Nationwide the popularity of off-road use has been increasing for decades. From 1982 to 2000/2001, driving motor vehicles off-road became one of the fastest-growing activities in the country, growing in number of participants by more than 100% during this time period (Cordell et al. 2004). The most recent data, compiled from the National Survey on Recreation and the Environment, reported that nearly one in four Americans age 16 and older participated in ORV recreation (Cordell et al. 2005). This figure represented a 42% growth in off-road use from 1999/2000 to 2003/2004 (Cordell et al. 2005).

Arizona and Utah have experienced rapid growth in ORVs. In Arizona, the number of ATVs titled or registered with the state's motor vehicle division increased 347% from 1998 (51,453 vehicles) to 2006 (230,000 vehicles) (McVay and Racki 2008).The number of ATVs registered in Utah increased 233% between 1998 and 2008 (Burr et al. 2008).

The largest community in the planning area is Page, Arizona, with a population of 6,800 people. The four Utah counties that encompass Glen Canyon have a total population only of 27,875. The entire Glen Canyon is buffered by large federal and Tribal holdings. The BLM alone administers more than 9.3 million acres that surround Glen Canyon. The BLM administers over 9.3 million acres of federal holdings adjoining Glen Canyon and provides numerous riding opportunities for the off-road recreationist. In Utah, between the Richfield and Monticello Field Offices, the BLM allows ATV use on 7,000 miles of roads and routes, and cross-country travel across 10,700 acres of federal lands (figure 17).

Off-road Use at Glen Canyon

Few major roads lead to the interior of Glen Canyon. To the north, two state highways (State Routes 276 and 95) transect Glen Canyon, whereas U.S. Highways 89 at Page and 163 at Mexican Hat provide access to the southern portions of Glen Canyon. Most of Glen Canyon's interior roads are in fair to poor condition; are seldom maintained; are subject to rapid degradation due to passing storms; and often require high-clearance, 4-wheel-drive vehicles for safe passage. Although these are the conditions often sought by ORV recreationists, in most instances one must first travel across miles of BLM-administered roads before reaching the boundary of Glen Canyon. These factors (the geographic isolation and the difficult access conditions) have resulted in limited interest in and use of Glen Canyon for off-road use. Glen Canyon has previously allowed off-road use at several accessible shoreline areas, but they are limited in size. Lone Rock Beach, one of the largest and the most popular of the off-road areas, is approximately 400 acres. Many of the areas are only 100 to 200 acres, depending on lake levels.

Deriving an accurate estimate of the use of these areas is difficult because the locations are remote, isolated, and undeveloped, and are dispersed across a large area. The available data suggests a total estimated annual historic use that may have been as high as 40,000 vehicles, but this use was concentrated in three areas: Lone Rock Beach, Stanton Creek, and Bullfrog North and South.

Visitation has historically been very low at the other accessible shoreline areas. The Farley, Dirty Devil, and Crosby Canyon areas may have received several thousand annual visitors when lake levels were higher, but present conditions have resulted in lighter visitation to these areas.

Recreational Opportunities in Glen Canyon

The regions in Glen Canyon[8] are Warm Creek–Grand Bench, Escalante, Wilson Mesa, Hite, and Orange Cliffs (figure 18) and Ferry Swale–Vermilion Cliffs in Arizona. Each region offers unique recreational opportunities, ranging from boating and camping to hiking and sightseeing. Several areas allow off-road use. The previously designated accessible shorelines areas in Glen Canyon are intended to provide public motor vehicle access to the Lake Powell shoreline for the purposes of recreational use in a primitive setting. Glen Canyon's 1979 GMP identified 20 such ORV locations (NPS 1979). In 1988 Glen Canyon developed a management plan that revised this to 12 accessible shoreline areas (NPS 1988).

[8] Five of these regions (Warm Creek–Grand Bench, Escalante, Wilson Mesa, Hite, and Orange Cliffs) were created by the project's interdisciplinary team (IDT) during the planning process to describe the Glen Canyon road system, and are based on topography and the road network.

Ferry Swale–Vermilion Cliffs Region

General Description

Located just west of Page, Arizona, is the Ferry Swale–Vermilion Cliffs region (figure 19). The area extends west along U.S. Highway 89 to the top of the Vermilion Cliffs and is crossed by a network of primitive roads that are used for recreation, access to grazing leases, and the maintenance of utilities. The area is recognizable by the 3,000-foot escarpment of the Vermilion Cliffs, which dominates the horizon to the west of Page. The area is characterized by blows and deposits and shallow, undeveloped soils over Navajo Sandstone. The primary vegetation is blackbrush interspersed with various grasses and other low-growing shrubs. The BLM administers a section of the Vermilion Cliffs National Monument area as wilderness.

Off-road use is growing in the Ferry Swale area. The area is popular with local residents from Page and is easily accessed directly from U.S. Highway 89. The BLM and Glen Canyon coordinate activities in this area, including the development of ORV staging areas, shared law enforcement resources, and the placement of informational kiosks to explain ORV-related rules and regulations.

Roads and Off-Road Use

Three unpaved GMP roads enter the area from U.S. Highway 89, crossing through a small section of Glen Canyon before entering the abutting lands administered by the BLM. These roads have not been designated with NPS road numbers.

These roads cross blackbrush-dominated areas of deep sand and slickrock. The roads are lightly traveled but remain popular with a subset of locals from Page. Over the years, new routes extending from existing GMP roads have been established by users. Some of these routes connect Glen Canyon to existing BLM routes and roads while others do not.

On the south side of the Colorado River are Page, Arizona, and the Glen Canyon headquarters. Paved GMP roads in this area include U.S. Highway 89, which spans the Colorado River into Page. State Route 117 enters Glen Canyon from U.S. Highway 89 at the southernmost point of Glen Canyon.

Other roads that provide access to Page, and thus to the Ferry Swale–Vermilion Cliffs area, include State Route 98 and Coppermine Road.

Warm Creek to Grand Bench Region

General Description

The Warm Creek area (figure 20) stretches from Big Water, Utah, along the southern tip of the Kaiparowits Plateau, and up to the Hole-in-the-Rock Road and the Escalante region to the north. The Wahweap area is the most easily accessible section of Glen Canyon and includes a marina, boat launches, and a restaurant/lodge. The Glen Canyon Dam area, located 5 miles south of Wahweap, includes the Carl Hayden Visitor Center.

The Lone Rock Beach Play Area is located on the western shore of Lake Powell, approximately 2 miles northwest of Wahweap. The play area is the only location in Glen Canyon where off-highway vehicles (OHVs) and street-legal ATVs (in addition to conventional motor vehicles) are allowed to be operated off-road. The area is intended as a location where motor vehicle operators can challenge themselves, develop riding skills, operate at high speeds, perform jumps and hill climbs, and so on. Adjacent to the north of the play area is Lone Rock Beach, which includes recreational activities such as swimming, fishing, boating, off-road use, and camping.

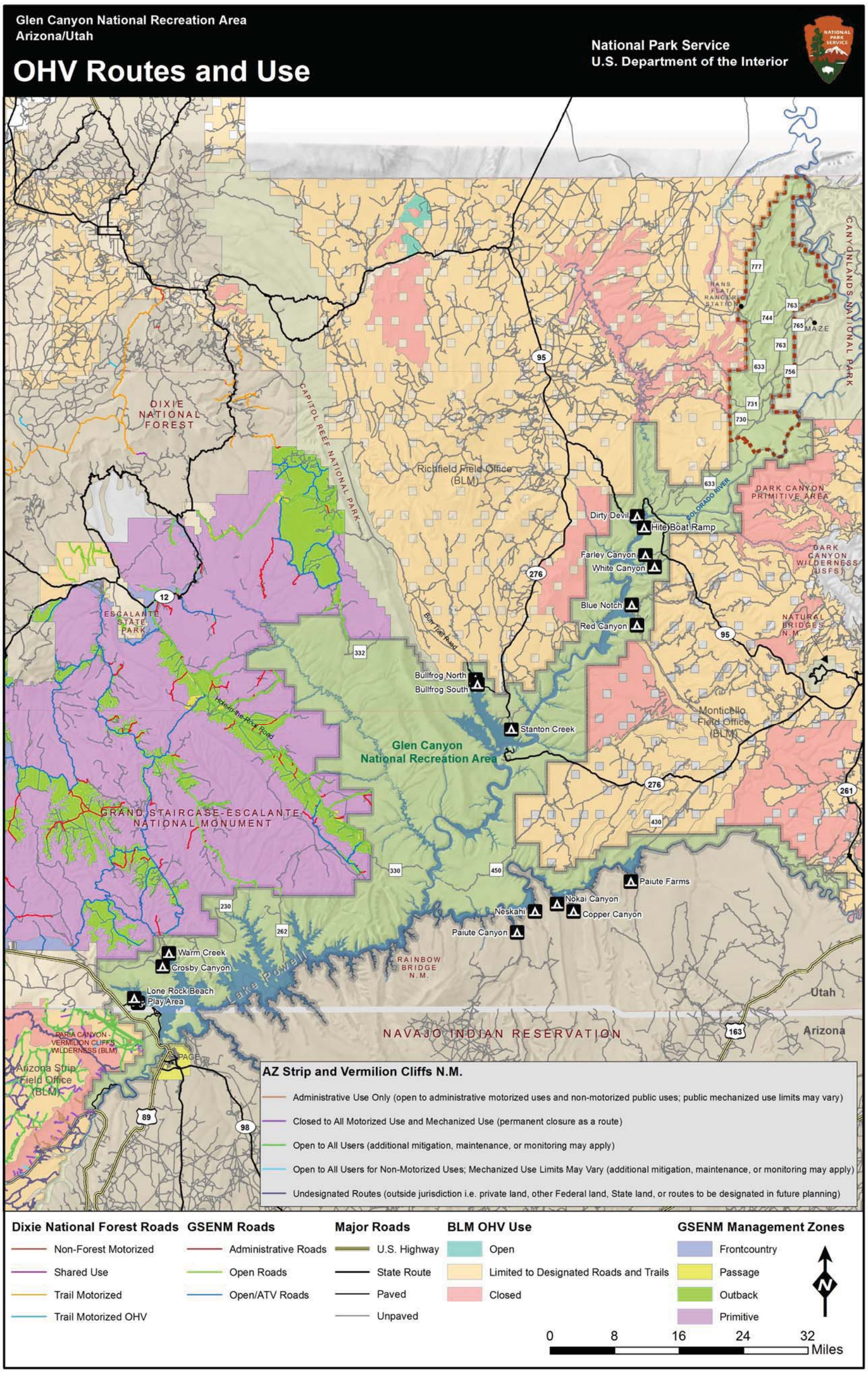


FIGURE 17: OHV USE IN ADJACENT BLM LANDS

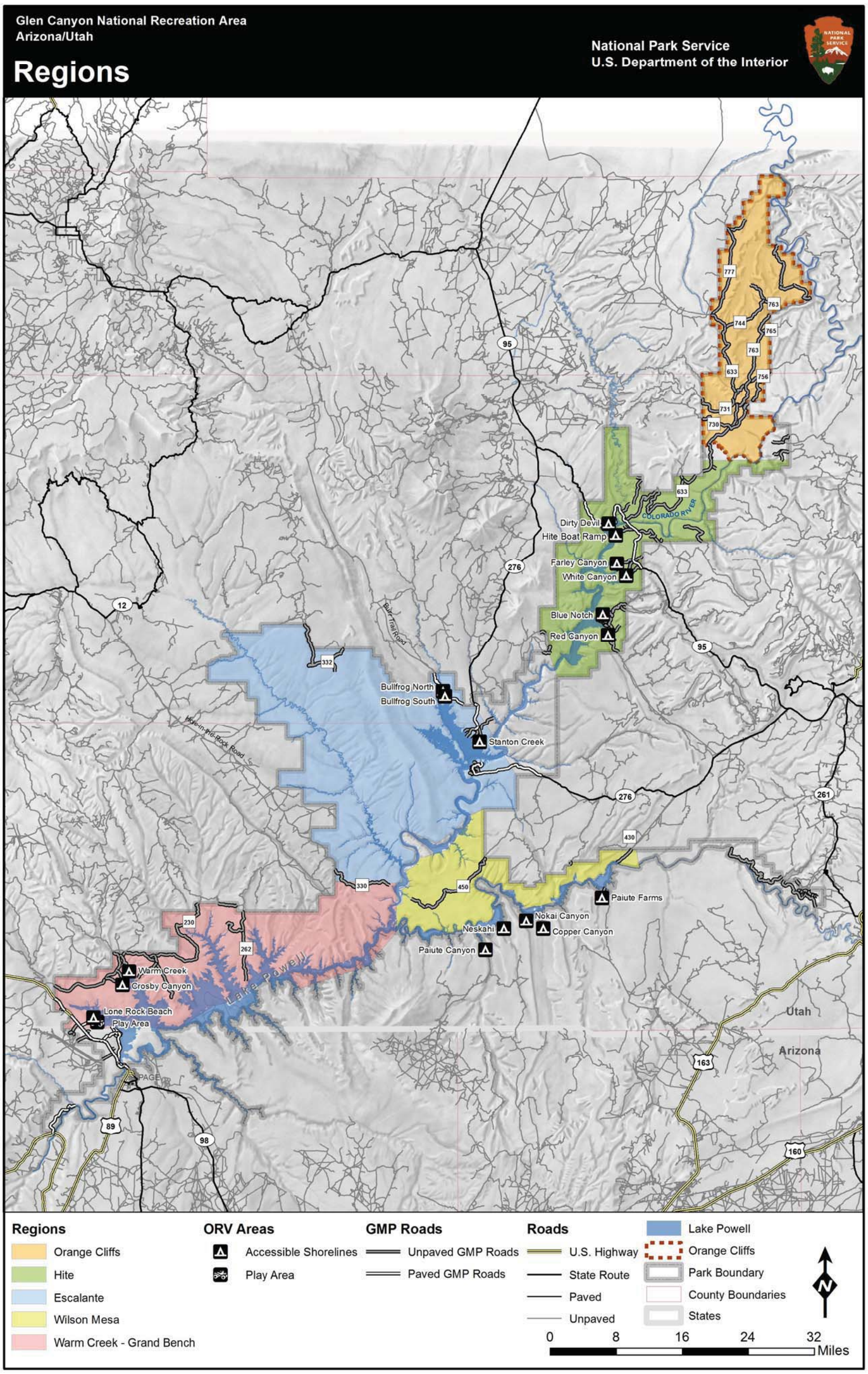


FIGURE 18: GLEN CANYON RECREATION AREA REGIONS

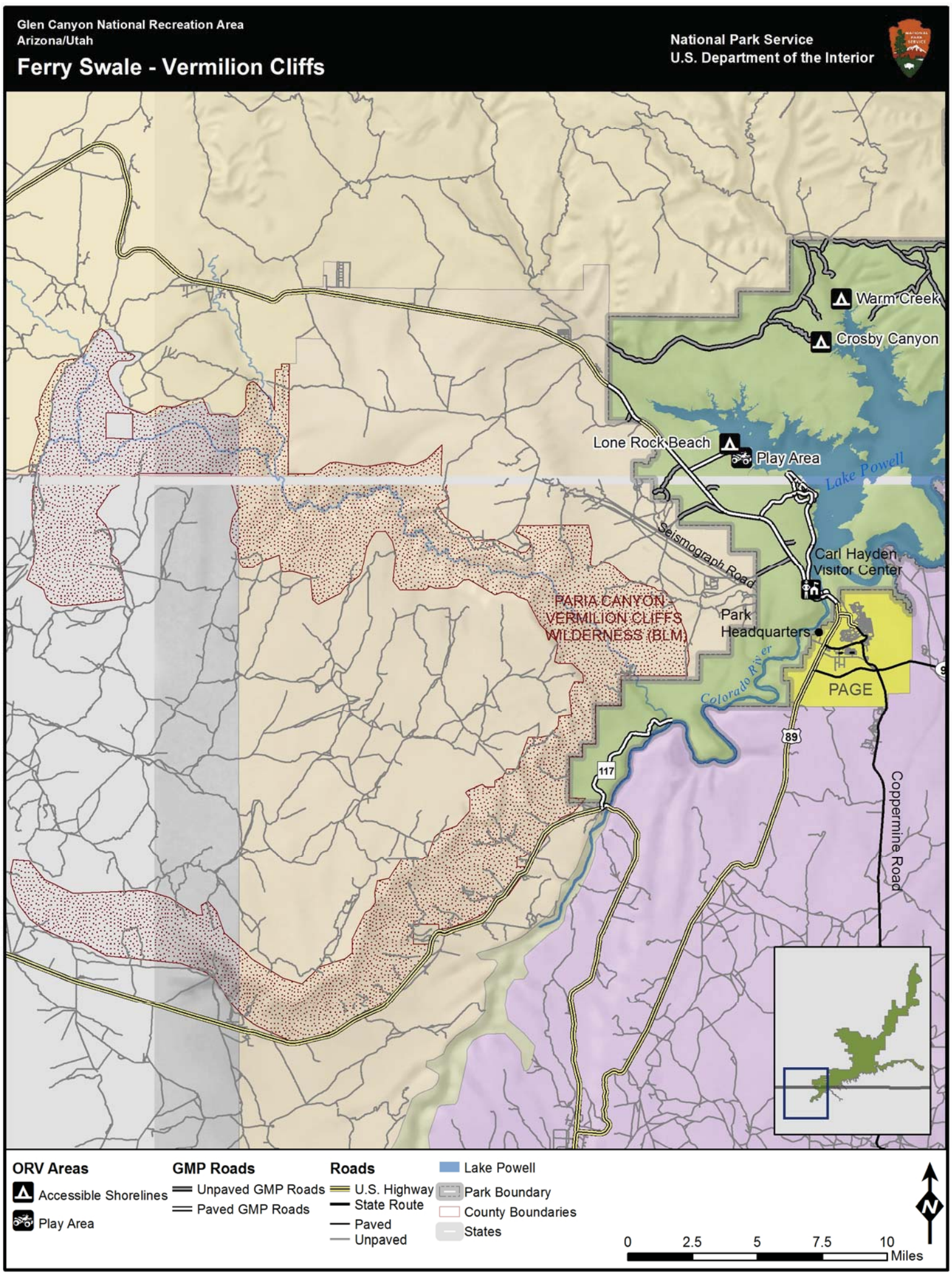


FIGURE 19: FERRY SWALE–VERMILION CLIFFS REGION

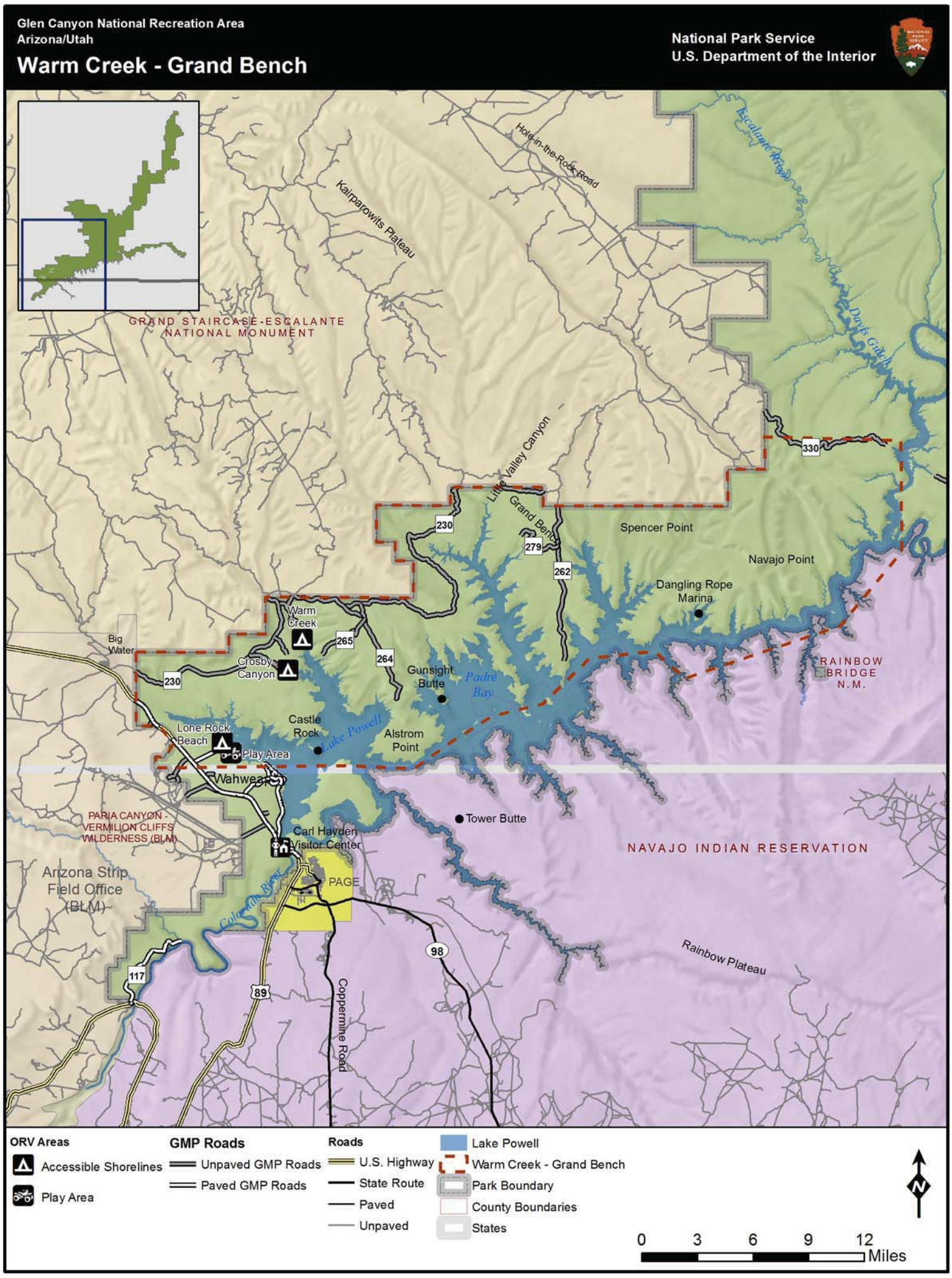


Figure 20: Warm Creek to Grand Bench Region

Further upstream is the Padre Bay area, which offers extraordinary views of Lake Powell. Alstrom Point, accessed by NPS 264, is a high mesa (500 feet above Lake Powell) providing expansive views of Lake Powell and Padre Bay and formations including Gunsight Butte, Castle Rock, and Tower Butte. The area is a destination for day users, sightseers, photographers, and the occasional overnight camping party. The Grand Bench, accessed by NPS 262, is extremely remote and difficult to access due to the degraded roadbed crossing at Little Valley Canyon. Dangling Rope Marina, accessible only by water, is located north of Grand Bench.

The viewshed of the Warm Creek area includes some of the most dramatic aesthetic features of Glen Canyon. The most visible feature in this region is the Kaiparowits Plateau, a giant upland rising abruptly from the Escalante and Colorado River drainages. With an elevation of approximately 7,500 feet, its southernmost tip at Navajo and Spencer Points provides a dramatic panorama of the entire canyon country and Lake Powell. Southwest of the plateau, the Warm Creek area is characterized by the sharply defined high cliff faces alternating with talus slopes and benches of shale and mudstone within Grand Staircase–Escalante. These forms give rise to numerous high mesas, plateaus, and buttes.

South of Lake Powell is the Rainbow Plateau. The Rainbow Bridge National Monument is located 49 miles upstream of the Glen Canyon Dam and has a courtesy dock. Rainbow Bridge is the largest natural bridge in the world. Carved by water from a fin of red Navajo Sandstone, the bridge is 290 feet tall and 270 feet across and is considered sacred in tribal culture as a symbol of the deities responsible for creating clouds, rainbows, and rain.

Roads and Off-road Use

Warm Creek Road (NPS 230), an unpaved GMP road, connects with several roads that lead into Grand Staircase–Escalante and locations north, including the town of Escalante, Utah. These roads include Tibbett Canyon (BLM 325), Smoky Hollow (BLM 330) (figure 21), Smoky Mountain (BLM 300), and Croton (BLM 340) roads.

Figure 21: Smoky Hollow

The proximity to Page, Arizona, makes the area popular with local ATV owners and tourists who are interested in the relatively easy access the Warm Creek Road provides to the Glen Canyon and Grand Staircase–Escalante backcountry. The Warm Creek Road is well maintained and passable by 2-wheel-drive vehicle during most of the year, although driving conditions can degrade rapidly following heavy rains. The unpaved GMP road to Grand Bench (NPS 262) in particular is extremely difficult to traverse, as are often some of the roads diverging from Warm Creek and leading into Grand Staircase–Escalante.

NPS has experienced some illegal off-road driving in this area, particularly along the section of Warm Creek Road that crosses flat areas of Tropic Shale just beyond Big Water. A section of state land between the Glen Canyon boundary and the town of Big Water is a hot spot for local off-road enthusiasts, and is crisscrossed with the tracks of ATVs and other vehicles. The impacts associated with this off-road activity have spilled into Glen Canyon via the Warm Creek Road.

Alstrom Point is accessible via unpaved GMP road NPS 264. The area is a popular destination for day users, sightseers, photographers, and the occasional overnight camping party. The point provides panoramic and expansive views of Lake Powell and the surrounding region, and drivers have left the main roadway to seek the most advantageous view, resulting in a spiderweb of unauthorized roads and minor resource impacts.

Alstrom Point

Additional unpaved GMP roads in this area include NPS 330, NPS 279, NPS 262, and NPS 265. Only one paved GMP road is located in this area: the upper portion of U.S. Highway 89 once it exits the Ferry Swale area.

Accessible Shoreline Areas

Lone Rock Beach: Lone Rock Beach (figure 22), Glen Canyon's principal ORV area, is located on the western shore of Lake Powell, 2 miles south of Big Water, Utah, and 12 miles north of Page, Arizona, at the Utah/Arizona border. Also approximately 2 miles northwest of Wahweap, Lone Rock Beach includes recreational activities such as swimming, fishing, boating, and camping. There is limited hard-surfaced road, with the majority of access to Lake Powell on sandy roads or beach. Lone Rock Beach is the primary access to Lake Powell for the nonboating public.

Accessible by U.S. Highway 89 and Lone Rock Road, beyond the entrance station is a recreation vehicle dump station, parking area, and rest area. Along the shoreline is a primitive camping area. Further inland and to the south is the Lone Rock Beach Play Area, separated from the camping area by a post and cable fence. Restrooms and outdoor showers are available just outside the play area.

Lone Rock Beach (figure 22) is the most popular of the off-road use areas in Glen Canyon. According to NPS visitation statistics, in 2007 there were 12,445 overnight camping groups on the beach, and nearly 23,000 motor vehicles entering Lone Rock Beach. Entrance records indicate that a small percentage of visitors recreate using ATVs at Lone Rock. Since 2003, the number of ATVs recorded entering Lone Rock has ranged from 1,065 (2004) to 498 (2007).

FIGURE 22: LONE ROCK BEACH

Crosby Canyon and Warm Creek: Crosby Canyon and Warm Creek are two accessible shoreline areas that provide access to Warm Creek Bay. Both are located close to Page, Arizona, and offer a more primitive setting compared to nearby Lone Rock Beach. Neither shoreline contains any facilities and both sites have been closed since 2003, when lake elevations dropped drastically during a prolonged drought, to control illegal off-road driving beyond the designated areas.

Access to Crosby Canyon is by NPS 231 off the Warm Creek Road (NPS 230). The Crosby Canyon Road is an infrequently graded, 4-wheel-drive road that follows the drainage bottom. The area is subject to flash flooding. Warm Creek is accessed by an unmarked and active ephemeral desert wash channeling through the Dakota, Morrison, and Entrada Formations.

Crosby Canyon (figure 23) had received a moderate amount of use before closing in 2003. Originally there were two main camping areas along the road. Evidence of these sites exists in the form of old fire rings and trash. Currently, some illegal use occurs as individuals drive past a road closure sign and down along the lakeshore. A prominent vehicle track is visible and extends for miles below the high water mark and along the lakeshore. There is limited evidence of illegal off-road use beyond this track.

Warm Creek has always experienced minimal use, and therefore has been lightly impacted by activity. At higher lake elevations, a campsite was available on a small knoll surrounded by steep cliffs. Currently, two barbed-wire livestock fences across the wash bottom preclude access to the site and there is little evidence of recent visitor use of the area.

Based on measurements taken during an October 2008 site visit, lake elevations would need to recover to approximately 3,670 feet before the natural topographic conditions and lakeshore would result in a confined use area for both Crosby Canyon and Warm Creek.

FIGURE 23: CROSBY CANYON

Escalante Region

General Description

Extending north from the Kaiparowits Plateau to the Purple Hills and the southern end of the Waterpocket Fold (part of Capitol Reef National Park) is the Escalante region (figure 24). The Escalante River and its tributaries have incised, deep, narrow canyons in the apricot-hued sandstones. The Escalante River is the core of this proposed wilderness area. The Escalante and its tributaries offer unparalleled hiking opportunities, and the side canyons offer some of the most beautiful scenery in the southwest. High above the river, the windswept slickrock and sand benches offer grand vistas and unbroken solitude.

Halls Crossing, located in the southeastern part of the Escalante region, includes a marina, campground, and boat launch. The John Atlantic Burr Ferry serves as a continuation of State Route 276 from Halls Crossing to Bullfrog Bay. The Bullfrog visitor center, which includes a medical clinic, is located on Utah State Route 276 just past the entrance station. Bullfrog also includes a restaurant/lodge, campsites, and marina. The Bullfrog Creek area includes two accessible shoreline areas — Bullfrog North and Bullfrog South — located off the Burr Trail north of the developed area. Past visitor use had been very high, but since 2003 these shoreline sites have been closed to vehicles due to low lake levels; therefore, public access and use is difficult

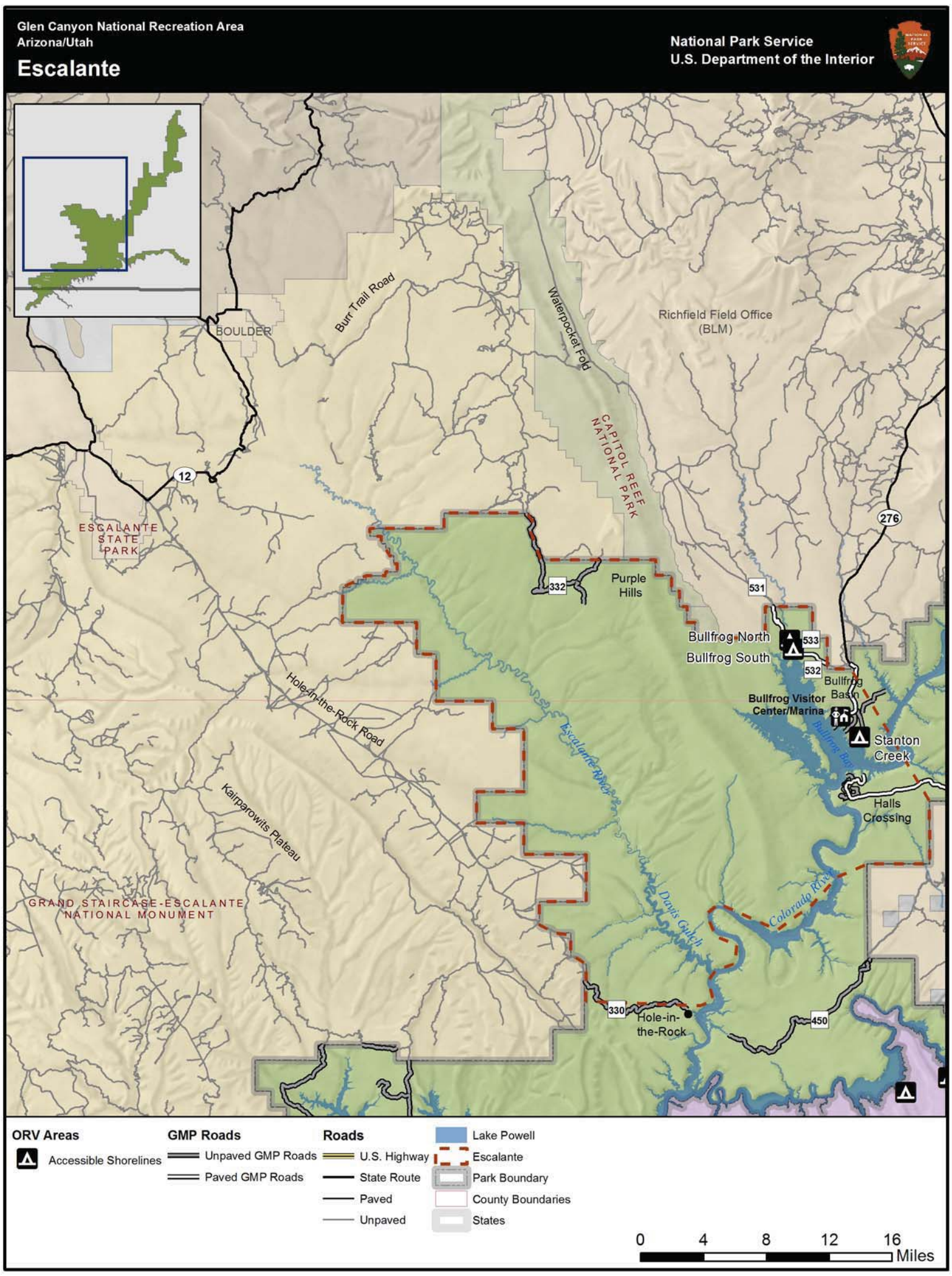


Figure 24: Escalante Region

Roads and Off-road Use

The unpaved Hole-in-the-Rock Road (NPS 330) is the primary artery into the Escalante region. The Hole-in-the-Rock Road is a popular scenic and historical driving route for local residents, tourists, and those hiking the Escalante River area. The road is a historically and culturally significant route through the Escalante region. Listed on the National Register of Historic Places (National Register), Hole-in-the-Rock is the location where, in 1880, Latter-day Saints settlers used pickaxes, shovels, and blasting powder to work their way down to the Colorado River through the only known natural breach in the 2,000-foot vertical cliff. The road generally is increasingly difficult to drive as it approaches Glen Canyon. The road deteriorates for the last 5 miles past the Davis Gulch crossing and generally is passable to 4-wheel-drive, high-clearance vehicles only from this point to the road terminus.

The Burr Trail is a 68-mile route winding through federally owned lands from the town of Boulder, Utah, down through Grand Staircase–Escalante into Capital Reef National Park and then across BLM administered land to the Bullfrog visitor use area in Glen Canyon. The road is paved on its upper end and graded dirt on the lower end. The condition of the graded section is subject to deterioration, and a high-clearance vehicle may be required. During inclement weather the Burr Trail may be impassable even to 4-wheel-drive vehicles.

The 7.7-mile segment of the Burr Trail in Glen Canyon is designated as the Notom–Bullfrog Road (NPS 531) and is a paved GMP road to the crossing at Bullfrog Creek, where it becomes a graded dirt road (unpaved GMP road). The Burr Trail is the only established Revised Statute (RS) 2477 right-of-way in Glen Canyon (U.S. v. Garfield County, 122 F. Supp. 2d 1201—Dist. Court, D. Utah 2000).

In the far northern section of the Escalante region is Moody Canyon Road (NPS 332), a 12-mile road located in the Purple Hills. The road enters Glen Canyon from the Burr Trail to the north and crosses 12 miles of natural soils before terminating at the Glen Canyon boundary. The road is isolated and seldom used but offers access to hunters and hikers and is categorized as an unpaved GMP road.

State Route 276 enters Glen Canyon in the Bullfrog area, continuing into Glen Canyon as a paved GMP road to the Bullfrog Visitor Center/Marina. Four small (approximately a quarter of a mile) unpaved GMP roads continue from the Visitor Center/Marina, continuing to the Stanton Creek accessible shoreline locations. State Route 276 enters Glen Canyon again west from Carl Black Memorial Airport where it becomes a 7-mile paved GMP road to the Hails Crossing section of Glen Canyon. Small unpaved roads stem from this unpaved GMP road, providing access to the water.

Accessible Shoreline Areas

Bullfrog Creek: Three accessible shoreline areas in the Bullfrog developed area have been popular vehicle-accessible campsites in the past. In 2002, 9,680 vehicles entered the Bullfrog North and South campsites. These areas have been closed since 2003 due to low lake levels. The gentle topography in this area has magnified the impact of low lake levels as vast areas of soft and deep sand are exposed, and the distance required to reach the lakeshore has been increased. This situation is noticeable particularly at the Bullfrog South site. Because of these conditions, public access, public use, and NPS operational duties (such as servicing toilets and conducting routine patrols) has become difficult, resulting in the closure of these areas. Based on geographic information system (GIS) analysis, lake elevations may need to recover to as high as 3,670 feet before the Bullfrog sites reasonably could be reopened to public use.

Stanton Creek: Stanton Creek is accessed from Utah State Route 276 close to Bullfrog Marina. Due to the closure of the Bullfrog North and South sites and the relatively easy access to Stanton Creek, Stanton Creek has become a popular accessible shoreline area. At Stanton Creek, vehicle counts ranged from 5,716 in 2002 to 3,953 in 2007. The area is managed for both day and overnight use for recreation opportunities of semi-isolation where shoreline

campsites have been used as boat anchorage. Camping use zones exist in the western portion of the site. Toilets and trash containers are maintained in the area.

Wilson Mesa Region

General Description

Wilson Mesa is a large, prominent topographic feature located on the south shore of Lake Powell opposite Hole-in-the-Rock and the Escalante River (figure 25). The primary route on Wilson Mesa is the Hole-in-the-Rock Trail Road (NPS 450), also referred to as Cottonwood Canyon Road. Cottonwood Canyon Road is the only road that traverses Wilson Mesa and it is isolated, is extremely difficult to negotiate the terrain, and requires a high-clearance, 4-wheel-drive vehicle. There are numerous obstacles and steep ascents and descents in sections of the road, including the sections up Grey Mesa and Iceberg Canyon. Driving the road is popular with a small subset of 4-wheel-drive enthusiasts, but the area remains infrequently visited due to its isolation and difficult driving conditions.

Roads and Off-road Use

Cottonwood Canyon Road (unpaved GMP road NPS 450) is the continuation of the Hole-in-the-Rock Road from the Escalante region. The road is accessed from State Route 276 at the Cal Black Memorial Airport, approximately 10 miles east of Halls Crossing and 75 miles west of Blanding, Utah. It can also be accessed farther west from State Route 276. The road travels southwest for a distance of approximately 30 miles from the Cal Black Memorial Airport to its terminus at Cottonwood Canyon. Only the last 11.8 road miles are in Glen Canyon; the remaining road miles cross BLM-administered lands.

Unpaved GMP road NPS 430 traverses Glen Canyon in this region for approximately 2.5 miles, continuing from BLM-administered land to the confluence of the San Juan River with Lake Powell. A prominent feature on Wilson Mesa is the Rincon. Located between Long and Iceberg Canyons, the Rincon is the remnant of a former channel of the Colorado River. Aleson Arch, a 100-foot-long span, is on the landform between Iceberg Canyon and the Rincon.

Accessible Shoreline Areas

Paiute Farms: Paiute Farms is the site of an abandoned marina development on the Navajo Nation. The marina was developed by Utah Navajo Industries in the 1980s but all structures were removed after a severe flash flood damaged many of the facilities in 1989. Many of the unpaved service roads on the marina site can be driven on. The area is located primarily in Moenkopi and Chinle Formations and is extensively overgrown with tamarisk. Both formations are composed of thin-bed mudstone and siltstone, varying in color from purple to grey for the Chinle, and red to pale brown for the Moenkopi. Access to the area is provided by Paiute Farms Road which runs along the Paiute Farms Wash on the Navajo Nation. The marina site is still frequented by residents of nearby communities and it is the access point to a prominent waterfall on the San Juan River just downstream from the Clay Hills Crossing raft take-out area.

Nokai and Copper Canyon: Nokai is an accessible shoreline located where the Nokai Wash intersects with Zahn Bay on the San Juan arm of Lake Powell. Copper Canyon is located just upstream on the San Juan Arm. Access to these areas is poor along primitive 4-wheel-drive roads leading from State Route 163, making visitation low. The areas are located primarily in the Moenkopi and Chinle Formations and can be described as canyon country with steep Wingate escarpments forming physical barriers around the areas. These steep sandstone cliffs limit vehicle access to 4-wheel-drive vehicles. Only a limited area is available for camping at each site and these areas are utilized primarily by local residents from nearby communities of the Ojeto Chapter on the Navajo Nation. No facilities are present at Copper Canyon or Nokai.

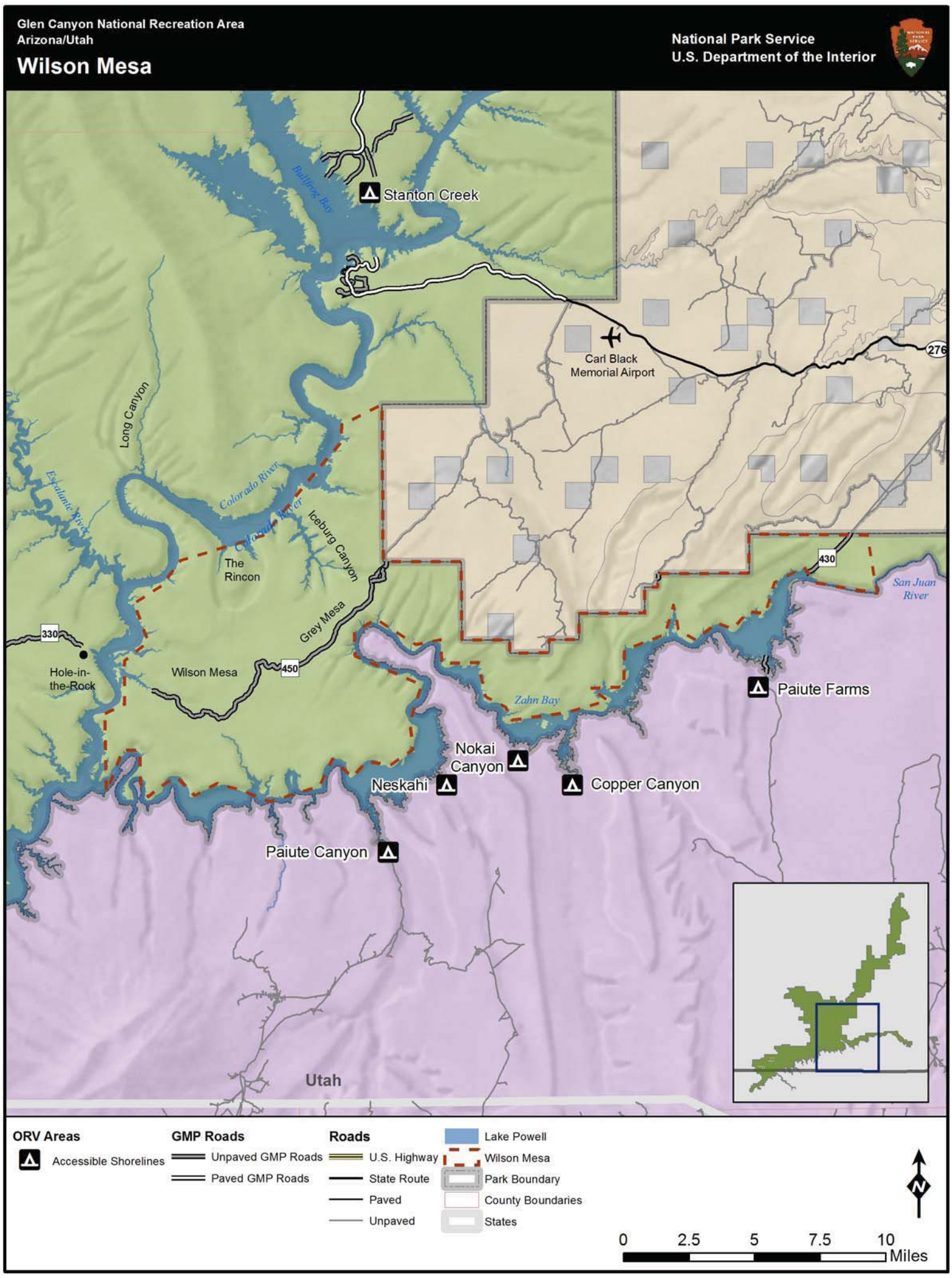


FIGURE 25: WILSON MESA REGION

Paiute Canyon and Neskahi: These areas are located downriver from Nokai on the San Juan Arm. The areas are similarly characterized primarily by Moenkopi and Chinle Formations, and the Shinarump Formation at the Neskahi site, making the area relatively unstable. Sloughing occurs and is observable in the form of mounded peninsulas and islands that jut into the river. The area can be described as canyon country with steep Wingate escarpments forming physical barriers around the areas. These steep sandstone cliffs limit vehicle access to 4-wheel-drive vehicles which travel on rugged roads across the Navajo Mountain Chapter of the Navajo Nation. Paiute Canyon (figure 26) is accessible via a 5-mile, primitive, 4-wheel-drive road off the Wetherill Trail, itself located approximately 50 road miles from State Route 98. Only a very small area is available for vehicle camping and the areas are used primary by nearby residents. Although there is evidence of recent use, it appears that the use is extremely limited. The Neskahi site is not directly accessible by road and provides no opportunities for vehicle access. It appears the area is accessed by cross-country travel along the shoreline at low water levels.

Figure 26: Paiute Canyon

Hite Region

General Description

The uplake area around Hite, Utah, begins on the east side of Lake Powell, extending roughly from Good Hope Bay north to the Orange Cliffs boundary at Clearwater Canyon. The Hite region is located at the northernmost part of Lake Powell (figure 27). The region is best accessed by State Route 95, also known as Bicentennial Highway, from both the north and south. The State Route 95 steel arch bridge provides the only road crossing of the Colorado River for 300 miles between the Glen Canyon Dam west of Page, Arizona (139 miles away by boat), and U.S. Highway 191 at Moab, Utah. State Route 95 also crosses the Dirty Devil River at the northern tip of Lake Powell.

Hite offers a stunning example of the geologic record that is a signature feature of southern Utah's canyon country. The views from the Hite overlook off State Route 95 are particularly dramatic, with distant views of the towers and buttes of the Orange Cliffs Special Management Unit (Orange Cliffs Unit) and sweeping views of the white, undulating Cedar Mesa Sandstone and its contact with the deep red, multilayered Organ Rock Formation. Looking north, Hite is characterized by an impressive, white Cedar Mesa Sandstone bench that outcrops at lake level and extends upriver past the mouth of the Dirty Devil River, the steel arch bridge across State Route 95, and up the inner gorge of the Colorado River. Looking southeast across the river from the overlook offers a fine example of the Organ Rock cliffs and talus slopes with views of the Hite developed area, which includes launch facilities, primitive camping, a small store, and a ranger station. Looking southwest from the State Route 95 entrance to the Hite developed area, the deep red rock layer of the Organ Rock Formation frames a dramatic view of the Henry Mountains and a row of massive Navajo Sandstone fins perched atop the Kayenta Formation and sheer, deep-orange-colored Wingate cliffs. Heading east toward Natural Bridges National Monument, the Cedar Mesa Sandstone and the White Canyon complex is the dominant feature at road grade, whereas towering on the southwest side of State Route 95 is the Red Rock Plateau.

Roads and Off-road Use

Red Canyon and Blue Notch Roads lead to small, accessible shoreline areas on Good Hope Bay. Red Canyon Road (NPS 650) begins at State Route 276 and heads northwest across BLM-administered lands into Glen Canyon. The road travels approximately 22 miles across BLM lands before entering Glen Canyon. The segment of the road in Glen Canyon is known to be subject to flash flooding and the road is in extremely poor condition. Blue Notch Road (NPS 651) travels from Utah State Route 95 west to Good Hope Bay. The road crosses BLM lands for approximately 10 miles before entering Glen Canyon. Blue Notch is an intermittently maintained, 4-wheel-drive road that can range from poor to fair condition. The road traverses slopes composed of clay soils and can be extremely hazardous when wet. Travel becomes increasingly difficult once the road enters Glen Canyon due to the numerous wash crossings. Good Hope Bay is one of the largest bays in Lake Powell, featuring fishing and plenty of room for water sports.

Three short roads lead to White and Farley Canyons, two accessible shoreline areas; all three are unpaved GMP roads. The Farley Canyon Road (NPS 630) is a maintained gravel road in fair condition. Farley Canyon is one of the few accessible shoreline areas that is used for boat launching, and is a short drive (3 miles) from Utah State Route 95. Two roads lead into White Canyon, NPS 656 and 657. Both roads travel approximately 3.25 miles over natural surfaces and are in fair condition. Travel can become difficult below the high water mark at 3,700 feet elevation due to dense stands of tamarisk and deep silt. Currently there is no access to Lake Powell from the White Canyon roads. The White Canyon accessible shoreline area lies at the base of the steep Moenkopi Cliffs along the Lake Powell shoreline and is closed to vehicular traffic. White Canyon is a colorful, two-level canyon that lends itself to exceptional hiking adventures, especially in the section known as the Black Hole. Its eastside tributaries also have many enchanting stretches of narrows.

Brown's Rim Road (NPS 632) off Utah State Route 95 runs east from Hite toward the Dark Canyon area. The road can be traveled east across BLM and U.S. Forest Service lands, or back in a loop to a junction with State Route 95. This unpaved road travel is approximately 5 miles long, is in fair condition, and is occasionally maintained by the county. NPS 633 connects State Route 95 to Clearwater Canyon. One additional unpaved GMP road enters Glen Canyon from the southern boundary, in the Dark Canyon area.

One paved GMP road is located in this area. State Route 95 enters Glen Canyon just north of White Canyon. The road leads across NPS 632 near the Hite Marina and continues up and across the Dirty Devil River, passes the Dirty Devil accessible shoreline area, and north out of the Glen Canyon boundary into BLM administered lands. The road is approximately 15 to 20 miles long.

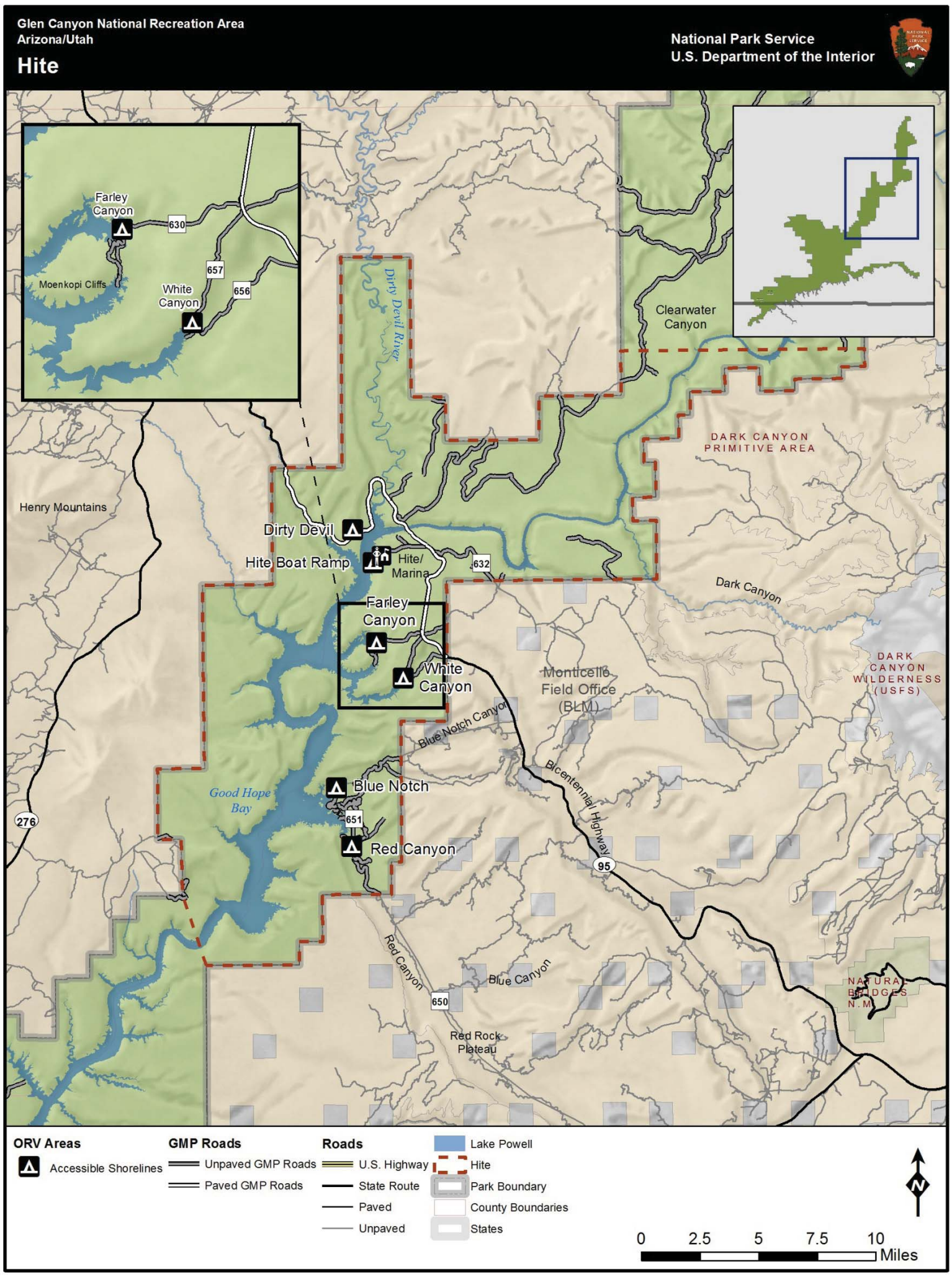


Figure 27: Hite Region

The Hite Marina is located at the uppermost part of the lake, 139 miles upstream from the Glen Canyon Dam. The paved launch ramp can be used at higher lake levels and there are no on-water services; all marina facilities were moved down lake during the extended drought period in the early 2000s. When the lake is at or above 3,606 feet, smaller boats can launch from an old road bed just down lake from the paved launch ramp. Hite also has a campground, overnight lodging, and a gas station / convenience store.

Accessible Shoreline Areas

Dirty Devil: The Dirty Devil accessible shoreline area is a small area between Utah State Route 95 and the lakeshore on the Dirty Devil arm near the Hite developed area. The site includes three isolated areas divided by canyons formerly filled with the waters of Lake Powell. The northern area is the largest and lacks shoreline access. This area is accessed by 4-wheel-drive vehicles for camping. The center area is smaller, and historically provided shoreline access where boats could launch; it once was used as a swimming beach. The southern portion is the smallest and served as a boat ramp and received heavy camping pressure. The area provides a dispersed primitive camping experience with visitor facilities, including toilets and trash containers, to protect resources and provide for appropriate visitor experience.

The Dirty Devil shoreline was a popular camping location when Lake Powell was at full pool. Due to low water levels, the Dirty Devil area no longer provides access to Lake Powell, although the site remains open to camping. Based on measurements recorded during an October 2008 site visit, lake elevations would need to recover to a minimum of 3,650 feet before lake access would be possible.

The Dirty Devil area is located at the base of steep cliffs, capped by the Wingate formation and underlain by exposed strata of the Chinle, Moenkopi, and White Rim Formations. The shoreline area consists of broad exposures, ridges, and low hills of exposed Cedar Mesa slickrock overlain in the northern portion by limited aeolian gravel-bearing caps. The southern portion is characterized by the weathered colluvial covering from the steep cliffs above, where these deposits have filled the Cedar Mesa canyons.

Hite Boat Ramp: Hite is located just off of paved GMP road State Highway 95, approximately 50 miles southwest of Hanksville, Utah. The Hite Boat Ramp accessible shoreline is a remote area adjacent to the confluence of the Colorado and the Dirty Devil Rivers, 8 miles from State Highway 632. The Hite developed area includes a small ranger station, gas station, boat storage, sanitary dump/potable water station, fish clearing station, and primitive RV and shoreline camping. Boat launching is available at north and south boat ramps, which are currently open, however four-wheel drive vehicles are recommended. The north ramp is concrete and the south ramp is gravel (NPS n.d.h).

In 2005, there were 59,405 visitors to the Hite region (DCP 2008e). Similar to Dirty Devil, Hite Boat Ramp was a popular visitation location when Lake Powell was at full pool, however Hite Boat Ramp continues to provide access to the lake. Prior to the 2001 drought, uplake visitation, including Hite Boat Ramp, showed steady increases. From 2000 to 2005, the annual visitation dropped from 147,694 to 59,405 (DCP 2008e).

Blue Notch and Red Canyon: Blue Notch and Red Canyon are located in San Juan County along Good Hope Bay, off Lake Powell. Blue Notch is located approximately 10 miles west of State Highway 95 on NPS 651, and is accessible by an intermittently maintained, primitive, 4-wheel-drive road. Red Canyon is approximately 20 miles from State Highway 276 on NPS 650, a seldom-maintained, primitive road located along a canyon bottom that is subject to flash flooding.

Because of their isolation and difficult access routes, visitation to both areas has remained low. A limited number of Glen Canyon visitors use the Blue Notch area because access to this site is more practical than to Red Canyon. Blue Notch can be used during low water. An October 2008 site visit found little evidence of litter or other problems related to overuse. When the main road approached the high water mark, social trails were evident as area users drove to locations along the lake's edge that are not designated ORV routes or areas. Beyond these social trails

toward the lakeshore, evidence of illegal off-road use such as hill climbs or exploration routes was limited to a few instances.

Reliable counts of visitation to the Red Canyon area are difficult to obtain, but aerial inspection during the summer of 2009 did not reveal any use of the area. No facilities are available at either shoreline area.

Farley Canyon: Farley Canyon is accessed off State Highway 95 by NPS 630, a maintained gravel road. A large, gravel-surface parking lot with two vault toilets and a wayside panel are located along the road just above the 3,700-foot lake elevation. Measurements taken during a site visit in October 2008 found the main, well-traveled road continuing approximately 325 yards beyond the parking area to 3,650 feet in elevation before ending. At this point, the road becomes several prohibited social trails. The location where the roadbed terminated provided evidence of heavy use in the past, based on the presence of old fire rings and litter.

Farley Canyon remains a popular camping and fishing location. There is evidence of moderate levels of ongoing use of the area, including unauthorized off-road use. Illegal tracks lead cross-country in what is an apparent attempt by some individuals to reach the old White Canyon shoreline site. Visitation records from the late 1980s report up to 250 vehicles present on a Memorial Day weekend. At lower lake elevations, the topography confines the size of the use area and a smaller number of users can be present at one time. The lake elevation was 3,624 feet at the time of the October 2008 site visit. The topography restricted the useable lakeside area to a few cars.

White Canyon: The White Canyon drainage cuts through the deep-red Moenkopi and banded Cutter Formations. The accessible shoreline area lies at the base of the steep Moenkopi Cliffs along the Lake Powell shoreline. White Canyon proper is a narrow drainage that is cut into the Cedar Mesa portion of the Cutter Formation. The canyon walls are steep (up to 300 feet) within a few miles of the Lake Powell shoreline.

Access to White Canyon is by NPS 656 and 657 off Utah State Route 95. Due to the level, open terrain in the eastern portion of the White Canyon area, the 1988 Accessible Shoreline EA/DCP (NPS 1988) closed roads to vehicular travel to protect resources. At lake elevations below 3,650 feet, there is no access to Lake Powell. The high water area from 3,650 feet to 3,700 feet in elevation is dominated by a dense stand of tamarisk and deep silt, requiring a 4-wheel-drive vehicle for passage. A deeply incised channel prevents vehicles from proceeding down the wash and accessing the lakeshore.

A number of old fire rings identify the previous use area. Site visits conducted in 2008 and 2009 found limited evidence of use or illegal off-road use. On-site signs are used to convey user restrictions and distribute site-specific information. There are no facilities at the site.

Orange Cliffs Region

General Description

The Orange Cliffs Unit extends from Clearwater Canyon to the northernmost boundary of Glen Canyon (figure 28). The Colorado River is located in the southern part of the region. The Green River is located east of the region, just outside Glen Canyon. These rivers offer a variety of water sport opportunities: rafting, motorized boating, row boating, etc. At the south end of the Orange Cliffs region is the famous Cataract Canyon on the Colorado River. East of Cataract Canyon, bordering Glen Canyon, is the BLM Dark Canyon Primitive Area.

Orange Cliffs

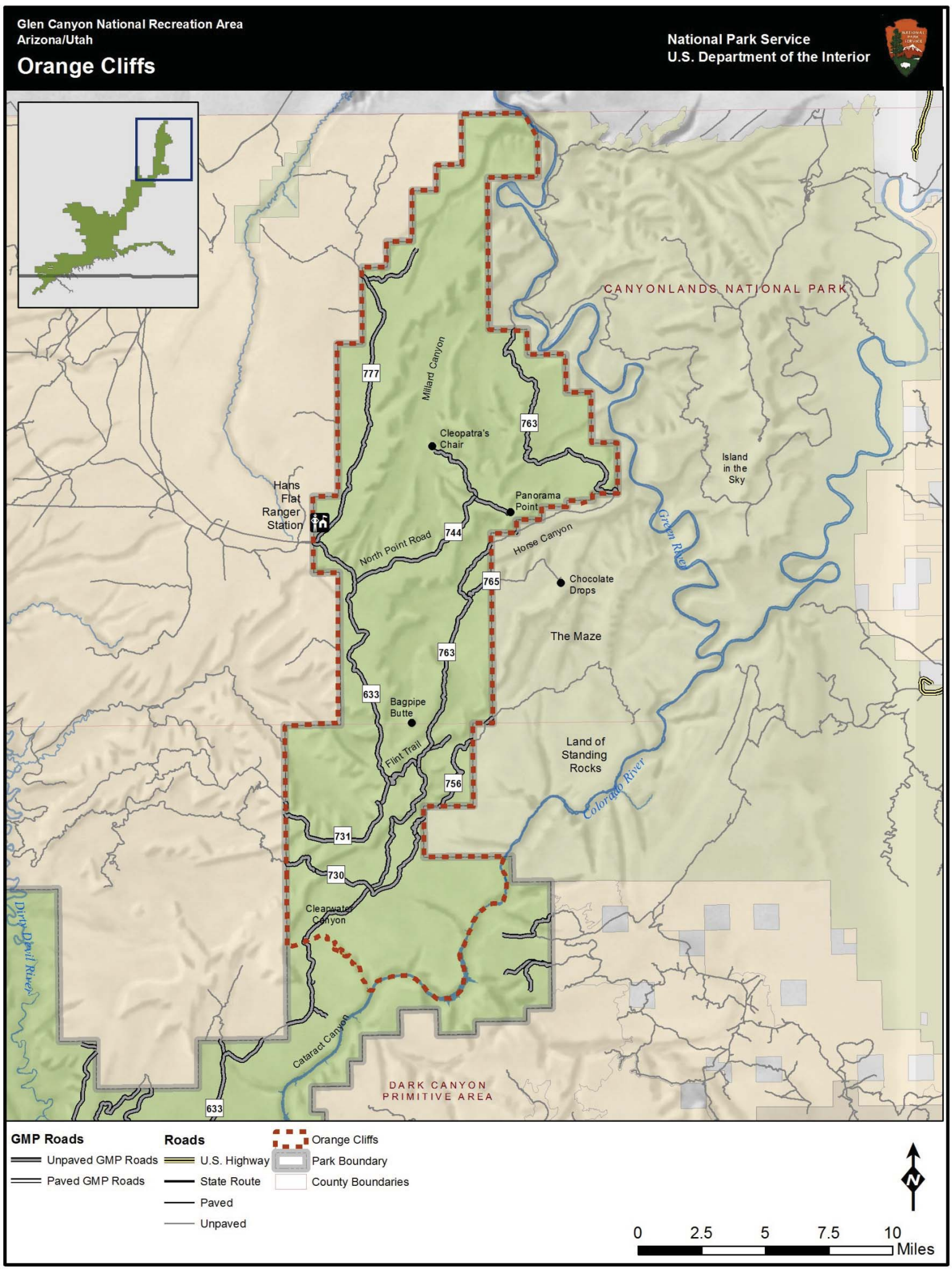


FIGURE 28: ORANGE CLIFFS REGION

The Orange Cliffs contains a scenic row of Wingate Sandstone cliffs, from the top of which one can view the vast and spectacular panoramas of Canyonlands National Park. The canyon of the Green and Colorado Rivers, the Maze, Horse Canyon, the Land of Standing Rocks, the Needles, Island in the Sky, and the cliffs far to the east of the Colorado River are visible. The foreground view of Millard Canyon is stunning, with the sandstone cliff face plunging abruptly downward over 1,000 feet and the canyon receding from sight to the north for 7 miles in a nearly straight line. This region also affords scenic views of various landforms, including Cleopatra's Chair, Bagpipe Butte, and the Chocolate Drops.

For the visitor, the beauty of the landscape is complemented by the area's isolation and solitude. Orange Cliffs is one of the least-visited areas in Glen Canyon; approximately 2,500 visitors pass through the Hans Flat Ranger Station in a year. Access to the area is provided by two main roads, the Flint Trail and the North Point Road. The Flint Trail (NPS 633) extends from Utah State Route 95 at Hite to the Hans Flat Ranger Station, located on the west side of the Orange Cliffs region. Hans Flat and the Orange Cliffs also can be accessed from the west by a 46-mile drive down a graded dirt road from State Route 24. Just east of Hans Flat is the North Point Road (NPS 744), which leads to two scenic views: Cleopatra's Chair and Panorama Point.

Roads and Off-road Use

Numerous unpaved GMP roads in the Orange Cliffs lead to scenic viewpoints and designated camping locations. The majority of the roads are in poor condition, and only the Flint Trail may be maintained more than once a year. Many of the roads are unimproved and subject to washouts, cross natural soils and bare slickrock, and require high-clearance, 4-wheel-drive vehicles for safe passage. Speed of travel is limited by natural conditions at the time of the visit, and may be no more than 5 to 10 miles per hour (mph) for extensive periods of travel time. The roads are often difficult to negotiate and can be even more difficult to follow as the movement of desert sands and rockslides obscure or even block routes.

The Flint Trail is the most commonly used road in the Orange Cliffs, and is sometimes signed as the "Orange Cliffs Road" (figure 29). This 55-mile-long road is the easiest road to negotiate. The road receives occasional grading and has some good sections. The road traverses slopes of clay soils that can be extremely hazardous when wet. The most well-known section of the Flint Trail is the drop off, the section of steep road and hairpin turns that leads from Gordon Flats down to the Maze area. The Flint Trail can be closed in winter months due to adverse driving conditions.

Figure 29: Orange Cliffs Road

There are no paved GMP roads in the Orange Cliffs region.

Accessible Shoreline Areas

Because the Orange Cliffs region does not contain any segments of Lake Powell, there are no accessible shoreline areas in Orange Cliffs.

CULTURAL RESOURCES

Cultural resources are aspects of a cultural system that are valued by or significantly representative of cultural groups or that contains significant information about those groups. These resources are typically tangible entities but may include cultural practices. Tangible cultural resources are categorized for NPS management purposes as archeological resources, historic and prehistoric structures, cultural landscapes, ethnographic resources, and museum collections. Section 106 of the National Historic Preservation Act of 1966 (NHPA) (16 USC 470 et seq.) specifically directs each federal agency to consider the effects of their undertakings on tangible cultural resources that fit the definition of historic properties.

The commitment of the Park Service to the preservation of cultural resources is further articulated in the Glen Canyon National Recreation Area Resource Management Plan, Cultural Component (NPS 1987b), Glen Canyon National Recreation Area Archaeological Resources Protection Plan (NPS 1996b), and the Ruins Projection Plan, Glen Canyon National Recreation Area (NPS 2004b). The first document outlines policies and procedures for the implementation of Glen Canyon's cultural resource management program, the second identifies a protection strategy for archeological sites, and the third document tightly focuses on the steps deemed necessary to arrest the deterioration of the Glen Canyon archeological resource base.

More than 2,500 cultural resource sites have been recorded in Glen Canyon.

More than 2,500 cultural resource sites have been recorded in Glen Canyon, the majority of which are from the prehistoric time period (NPS 2004b). However, only about 2% of Glen Canyon has been intensively surveyed or tested for cultural resources (NPS 2004b). As would be expected, the developed areas such as Hite, Halls Crossing, and Bullfrog have received the most attention. Most of the surveys have been in these areas. A partial listing of past archeological investigations in Glen Canyon at 20 shoreline areas that were accessible by automobile (including the 12 shorelines that are currently accessible) is included in the Accessible Shoreline DCP/EA (NPS 1988).

For the purposes of this plan/DEIS, cultural resources have been divided into five types, including archeological resources, historic and prehistoric structures, cultural landscapes, ethnographic resources, and museum collections. Historic and prehistoric structures, cultural landscapes, and museum collections have been dismissed as a topic for evaluation (see chapter 1); archeological resources and ethnographic resources are described below.

ARCHEOLOGICAL RESOURCES

Archeological resources consist of "any material or physical evidence of past human life or activities which are of archeological interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research" (NPS 1998). Archeological resources include both prehistoric and historic time periods and can be found in both terrestrial and underwater settings. Sporadic archeological investigation of the canyonlands of the Colorado Plateau began in 1869 with John Wesley Powell's exploration of the Colorado River (Jennings 1966). Interest in the area continued throughout the 1920s and 1930s, with continuing study underwritten by the American Museum of Natural History and the Peabody Museum (NPS 2004b).

Systematic archeological investigation of the area that would become the Glen Canyon National Recreation Area began in the late 1950s. This project, which lasted eight years, was in response to the construction of the Glen Canyon Dam across the Colorado River in Arizona (Jennings 1966). The scope of the archeological survey work included the main stem of the Colorado River and its tributaries between the towns of Hite, Utah, and Page, Arizona (Jennings 1966). This work is summarized in a series of reports published by the University of Utah and in reports and bulletins prepared by the Museum of Northern Arizona (NPS 2004b). It is estimated that this effort resulted in the identification of about 2,000 archeological sites (Geib 1996; Jennings 1966). Subsequent large-scale surveys of Glen Canyon were conducted by Northern Arizona University (NAU) in the 1980s (Geib 1996). This work resulted in the identification of 489 archeological sites, 20 of which were subjected to limited testing (Geib 1996, 12). Numerous management- and project-related archeological surveys and excavations have been conducted at Glen Canyon since the 1960s (NPS 2004b, 4-7).

These combined studies have resulted in the identification of over 2,500 sites (Baker pers. comm. 2012a). Summary data provided by NPS indicate that 1,937 sites have been classified as prehistoric Native American in origin (Baker pers. comm. 2012b). Cliff dwellings, granaries, open habitation sites, lithic and ceramic scatters, and rock art panels are examples of prehistoric sites located within the boundaries of Glen Canyon (NPS 1996b; Geib 1996; Jennings 1966).

A total of 129 historic sites have been inventoried in Glen Canyon.

A total of 129 historic sites have been inventoried in Glen Canyon, including Anglo-American mining–related resources, ferry/ford sites, sites associated with Latter-day Saints colonization, the remains of protohistoric/historic Numic-speaking peoples like the Paiutes, and Navajo camp sites and residential structures (Baker pers. comm. 2012b; Geib 1996; Jennings 1966). Glen Canyon has stewardship of seven National Register–listed archeological sites (Baker pers. comm. 2012a) (table 14). A further 874 sites have been determined to be eligible for the National Register by Glen Canyon in consultation with the Utah State Historic Preservation Office (SHPO). A small subset of 72 sites has been recommended as eligible for the National Register and SHPO has not yet been consulted, whereas 1,214 sites are unevaluated. Baker (pers. comm. 2012b) indicates that many of the unknown and unevaluated sites in the Glen Canyon inventory were identified prior to the construction of the dam and filling of Lake Powell.

TABLE 14: NATIONAL REGISTER OF HISTORIC PLACES LISTED PROPERTIES

Name	National Register Information System Number	Remark
Charles H. Spencer (Hulk)	089001593	Paddle wheel steam boat ca. 1911
Davis Gulch Pictograph Panel	075000166	Ancestral Puebloan pictograph site ca. 1050-1240 AD
Defiance House	078000347	Ancestral Puebloan dwelling ca. 1250-1285 AD
Hole-in-the-Rock	075000165	Dug-out road constructed by The Church of Jesus Christ of Latter-day Saints pioneers ca. 1880
Hole-in-the Rock Trail	082004792	Trail utilized by Latter-day Saints pioneers in settlement of the San Juan basin ca. 1879-1880
Lee's Ferry Historic District	076000374	Contains several historically significant archeological sites associated with Non-Native American settlement of the southwestern United States ca. 1776-1930
Lonely Dell Ranch Historic District	078000277	Latter-day Saints pioneer subsistence farm/ranch ca. 1873-1909

ASMIS = Archeological Sites Management Information System.

Culture History

In order to understand the significance of cultural resources it is necessary to place them in their historical contexts. This task is usually one of the first undertaken by archeologists when studying a region. The history of archeological inquiry into the Glen Canyon region reaches back to the late 1860s and early 1870s and continues to the present day; consequently, a rich vein of chronological information exists about the early Native American occupation of Glen Canyon. This information is given below in summary form.

The cultural history of the Colorado Plateau, including Glen Canyon, is based in part on the pioneering work of A.V. Kidder and many subsequent archeologists, including such luminaries as Julian Steward and Jesse Jennings (Geib 1996; Jennings 1966). Kidder systematized the chronology of the ancestral Puebloan people of the region based on work conducted at the Pecos ruins in New Mexico during the first decades of the 20th century. Kidder's temporal sequence, with modifications, is still used by southwestern archeologists today (Geib 1996; Jennings 1966). Our understanding of the cultural chronology of the Glen Canyon region has benefited from the advent of chronometric dating in the 1950s. Radiocarbon dating of carbonized plant remains and perishable items has had a major impact on our understanding of preceramic Archaic chronology and lifeways in the region (Geib 1996).

The human occupation of the Glen Canyon region began many millennia prior to the development of agriculture by the ancestral Puebloans. The archeological evidence suggests that the region was first occupied during the late Pleistocene period by dispersed, mobile groups of hunter-gatherers. Subsistence focused on the pursuit of large game, including many now-extinct forms of megafauna (Geib 1996). This period is generally known as the Paleo-Indian. The beginning date for the period is a matter of dispute (Meltzer 2009). However, it is conservatively estimated that Native Americans have occupied the Colorado Plateau for at least 10,000 years (Geib 1996). Evidence of Paleo-Indian presence in Glen Canyon is limited to surface finds of fluted, lanceolate projectile points assigned to the Clovis and Folsom clusters (NPS 2004b; Geib 1996). The Paleo-Indian occupation of Glen Canyon is generally believed to date from about 11,000 to 9,000 before the present (BP). The terminal date coincides with the end of the Pleistocene, when climate change brought about the disappearance of many genera of big game animals and a reordering of biotic communities on a continental scale (Meltzer 2009). Geib (1996) suggests that the Paleo-Indian big game–hunting lifeway probably did not persist in Glen Canyon past 9,000 BP.

The Archaic period in the Glen Canyon region lasted from about 9000 BP to 2400 BP (Geib 1996). The archeological evidence indicates that Native Americans developed broad-based hunting and gathering strategies that took advantage of small game and plant resources early in this period (NPS 1987b). Archaic-period open habitation sites, rock shelters, and lithic scatters are among the most frequently identified archeological resources in Glen Canyon. Hunting and gathering remained the basis of the Native American subsistence economy throughout the Archaic period. The introduction of agriculture in about 2400 BP marks the end of the Archaic period in the Glen Canyon region (Geib 1996).

The archeological testing of 74 sites in the Glen Canyon region produced a robust assemblage of 180 radiocarbon dates, sufficient to divide the Archaic period into a series of seven subperiods: Initial Archaic (ca. 9000 to 8000 BP), Early Archaic (8000 to 6300 BP), Early-Middle Transition (6300 to 5600 BP), Middle Archaic (6300 to 4400 BP), Middle-Late Transition (4400 to 3800 BP), Late Archaic (3800 to 2900 BP), and Terminal Archaic (2900 to 2400 BP) (Geib 1996) (table 15). Given the limitations of surface survey it is often difficult to assign specific sites to one of the subperiods based on diagnostic artifacts, which are often lacking. The careful reader will also notice little change in the suite of temporally diagnostic artifacts across several of the divisions.

TABLE 15: GLEN CANYON REGIONAL ARCHAIC CHRONOLOGY

Archaic Period Subdivisions	14 Carbon Years BP*	Calibrated Years BC*	Diagnostic Projective Points—Examples	Diagnostic Perishable Artifacts
Terminal Archaic	2400–2900	400–1045	Gypsum points; Elko points	Split-twig figurines, plain-weave sandals
Late Archaic	2900–3800	1045–2200	Gypsum points; Elko eared; McKean lanceolate	Split-twig figurines, plain-weave sandals
Middle-Late Transition	3800–4400	2200–2980	San Rafael side-notched; McKean lanceolate	Split-twig figurines, plain-weave sandals
Middle Archaic	4400–5600	2980–4400	Sudden side-notched; Hawken side-notched	Plain-weave sandals
Early-Middle Transition	5600–6300	4400–5260	Sudden side-notched; Hawken side notched	Plain-weave sandals
Early Archaic	6300–8000	5260–6840	Elko corner side-notched; northern side-notched	Open-twined sandals replaced by plain-weave sandals
Initial Archaic	8000–9000	6840–8030	Pinto; Elko corner side-notched	Open-twined sandals, fine warp-faced sandals

Source: Geib 1996.

* "BP" refers to uncalibrated radiocarbon dates before present ("present" by accepted convention is AD 1950); "cal AD" and "cal BC" denote calibrated calendar ages according to standard Western usage.

Nevertheless, Geib's fine-grained chronological model allows for inferences to be made about changing population densities, settlement patterns, and subsistence systems across a substantial portion of the region's prehistoric past (Geib 1996). For example, there is evidence to suggest that Native American population density increased during the Early and Late Archaic subperiods, although it seems to have suffered a hiatus during the Middle Archaic. Geib (1996) reflects at length on the apparent reduction in population density and site visibility during the Middle Archaic, suggesting that changes in settlement patterns may account for the pattern rather than out-migration from Glen Canyon.

The period from 400 BC to AD 500 goes by a variety of names, including the Early Agriculture, Preformative, and Basket Maker II periods (NPS 1987b, 2004b; Geib 1996; Jennings 1966). As such, it represents the first in the sequence of ancestral Puebloan cultures believed to have experimented with increased sedentism and agriculture. It is likely that Native American people used both mobile hunter-gatherer and nascent sedentary agriculturalist lifeways during this period (NPS 1987b).

The Formative period (AD 500 to AD 1300) includes two of the Colorado Plateau's best-known Native American archeological complexes: Fremont and Anasazi. Both of these complexes occupied Glen Canyon and are regarded as Ancestral Puebloans (NPS 1987b). This period was characterized by sedentary and semi-sedentary settlement patterns; craft specialization, including pottery production; and agriculture (NPS 1987b). Archeologists believe that the Fremont occupation of Glen Canyon occurred between AD 400 and 1000 (Smiley et al. 2010). The Ancestral Puebloans resided in Glen Canyon during the Pueblo II and III stages, from AD 1050 to 1300. Interestingly, Smiley et al. (2010) point out that sites associated with the Fremont culture are limited to the Escalante River Basin, whereas Anasazi sites are widespread in Glen Canyon. The temporal and spatial aspects of settlement during this period continue to be a major archeological research domain in Glen Canyon (Geib 1996).

The Pueblo II (ca. AD 1000 to 1170) occupation has been well documented in Glen Canyon (NPS 1987b; Jennings 1966). It appears that southwestern Native American populations increased in size during this stage, resulting in the

use of the canyonlands. Sites of this age in Glen Canyon frequently consist of small, one to three living rooms and storage structures. Large sites with many living rooms, storage structures, and kivas are absent from the resource base.

Pueblo III (AD 1150 to 1300) represents the final temporal division associated with the Ancestral Puebloan occupation of Glen Canyon (Jennings 1966). Sites belonging to this stage are typically larger, with more cultural features and higher artifact densities. Three large, highly visible architectural sites, Defiance House (State Site No. 42SA00598), Three-roof Ruin (State Site No. 42KA00207), and Widow's Ledge (State Site No. 42SA00633) date to this period (NPS 1987b).

Information concerning the late prehistoric (ca. AD 1300 to 1500) inhabitants of Glen Canyon is scanty, possibly reflecting the lack of diagnostic artifacts assigned to the period, and/or decreasing use of the area by native peoples (NPS 1987b). Scattered evidence of late prehistoric and protohistoric occupations are limited to lithic and ceramic scatters characterized by Ute and Paiute pottery and desert corner-notched points. Other types of resources include brush shelters and rock-art panels. Protohistoric and historic Native American archeological sites are affiliated with the Navajo and Southern Paiute Tribes (Smiley et al. 2010). The Numic-speaking Southern Paiute and Ute and Athapaskan-speaking Navajo occupied different ecozones on a seasonal basis in semipermanent base camps often located near springs. Tributary stream gravel beds provided sources of material for stone tools throughout the prehistoric and protohistoric periods.

Archeologists and anthropologists believe that the Southern Paiute and Ute Tribes spread across the Great Basin, southern Nevada, and Utah about 1,000 years ago during a period of population movement known as the Numic expansion (Grayson 2011). These Native American people were encountered by early Spanish and American explorers in the Glen Canyon portion of the Colorado River basin (Sucec 1996). Western scholars using linguistic analysis suggest that the Athapaskan Navajo may have entered the San Juan River basin including the Glen Canyon area sometime later perhaps only a few hundred years ago (Grayson 2011). The Navajo Nation, however, assert their ancestors had been in the region for a much longer time (Sucec pers. comm. 2013). By the time the Spanish arrived in the region, the Ancestral Puebloan peoples had moved south from the canyonlands and San Juan Basin to the mesas of Arizona (Sucec 1996). Contemporary Puebloan tribal leaders regard the Glen Canyon as containing physical and spiritual places important to their cultural heritage and way of life (Sucec 1996).

Both Paiute and Navajo archeological sites have been identified in Glen Canyon but remain to be systematically investigated (Smiley et al. 2010: 15). Obtaining base-line data on sites directly associated with these two Native American tribal groups is regarded as a high priority within the boundaries of the Glen Canyon National Recreation Area. Data gaps include site structure, artifact assemblage composition, and site location to name a few. Questions at the intra-site level of analysis involve co-occurrence of Paiute and Navajo sites with those of earlier inhabitants of the region and other aspects their settlement system and subsistence economy (Smiley et al. 2010).

Archeologists use the exploration of the Franciscan friars Domingues and Escalante in 1776 as a convenient event marking the end of the Protohistoric period and the beginning of the Historic period. Archeological, architectural, and archival research conducted during the Glen Canyon Dam Project resulted in the documentation of 270 historic sites in the flood pool and surrounding uplands (NPS 1987b; Jennings 1966). Archeological resources relating to Euroamerican pioneer, mining, and ranching activities have been identified within the boundaries of Glen Canyon. Prominent among these is the Lees Ferry and Lonely Dell Ranch National Historic District.

Archeological Site Location and Site Density

The ecological zonation of Glen Canyon has structured archeological enquiry since the 1950s (Geib 1996). Three ecozones have been significant in the Native American occupation of the region. Following Geib (1996), these ecozones are defined as follows:

1. **Lowlands**. This zone consists of the hot, arid canyons of the Colorado River and its tributaries below 4,500 feet. Water from the rivers, intermittent streams, seeps, and springs made this a focal point of settlement, particularly after the Late Archaic period when agriculture began to be practiced by Native Americans occupying the Glen Canyon region. Geib (1996) notes that alcoves and overhangs provided abundant shelter and nearby river gravel bars were a source of lithic raw material.
2. **Midlands**. This zone captures the arid benchlands and low plateaus situated between canyon rims from 4,500 to 5,500 feet above sea level. The midlands consist of slickrock barrens, dune fields, and scale-covered flats (Geib 1996). The grass-covered flatlands provided good antelope habitat. This zone would have provided numerous resources for Native American hunter-gatherers and was exploited during all phases of the Prehistoric period (Geib 1996; Jennings 1966).
3. **Highlands.** Located above 5,500 feet in elevation, the uplands of Glen Canyon are cool and covered with pinyon/juniper woodlands (Geib 1996). Interestingly, archeological survey evidence generated during the Glen Canyon Dam Project and subsequent archeological endeavors have documented numerous Ancestral Puebloan sites in the uplands (Jennings 1966; Smiley et al. 2010). How these ancient people were able to exploit the uplands for agriculture was a focal point of investigation during the 1950s and 1960s (Jennings 1966).

Geib's (1996) tripartite division of Glen Canyon into three ecozones reflects variation in terrain and lifezones critical to prehistoric Native American populations. The Glen Canyon grazing allotment study included parcels assigned to all three environmental divisions. Consequently, baseline information on the number of sites per ecozone in the grazing areas of Glen Canyon was summarized (table 16) (Vance 2010). These data indicate prehistoric use of all three ecological zones, with a marked preference for the better-watered lowland ecological settings, which feature arable terraces, diverse plant communities, and long growing seasons (Vance 2010).

Table 16: Previously Identified Grazing Land Sites by Ecozone

Ecozone	Acreage	Percentage of Total Acreage	Site Numbers	Percent of Total Sites
Lowlands	453,895.70	54.75	629	43.86
Midlands	256,734.15	30.97	411	28.66
Highlands	118,351.44	22.72	394	27.48
Total	828,981.29	NA	1,434	100.00

Source: Vance 2010.

NA = not applicable.

Probably the best data on site density for Glen Canyon was generated by surveys conducted by NAU between 1984 and 1989 (Smiley et al. 2010). This is because the survey methods used were intensive in nature and consistently applied by the consulting archeologists. Values range from one site per 2.8 acres at the Rainbow Bridge National Monument to one site per 127.7 acres in the Bullfrog/Henry Mountains region of Glen Canyon (Smiley et al. 2010). The NAU survey of 28,974 acres produced an average site density of one site per 37.4 acres; the range of variation in site density values generated by the NAU surveys is presented in table 17.

TABLE 17: NAU SITE INVENTORY 1984–1987 SITE DENSITY VALUES

Region	Number of Acres Surveyed	Number of Sites Documented	Site Density (sites/acre)
Lees Ferry	1,114	25	1/44.5
Lower Glen Canyon Benches	2570	58	1/44.3
Rainbow Bridge	70	25	1/2.8
Cow Canyon	1,080	45	1/24.0
25-mile Wash	990	47	1/21.0
Bowns Canyon	600	55	1/10.9
San Juan Arm	2,320	40	1/58.0
Bullfrog/Henry Mountains	3,450	27	1/127.7
Orange Cliffs	2,625	76	1/34.5
Clearwater Canyon	2,075	62	1/33.4
North Point	1,130	26	1/43.4
The Spur	950	20	1/47.5
Total*	18,974	506	1/37.4

Source: Smiley et al. 2010.

*Final column shows average.

Archeological Sites in the Study Area

The data presented in the sections below is drawn from a number of sources including published reports, personal communications, GIS analyses, and the Glen Canyon archeological site data base. Analysis of this data has revealed that 223 archeological sites are located within the study areas and surrounding buffers (table 18). A total of 70 of these sites have either been recommended eligible for the Nation Register by archeologists that meet the Secretary of the Interior's Standards and Guidelines or have received a consensus determination of eligibility finding based on Section 106 consultation between the NPS and the appropriate SHPO/Tribal Historic Preservation Offices (THPOs). The records indicate that an additional 82 sites have been evaluated as not eligible. While a further 70 sites are listed as having not been evaluated for inclusion in the National Register. Additional summary data for each ORV area is presented in subsequent sections.

TABLE 18: NATIONAL REGISTER STATUS OF ARCHEOLOGICAL SITES IN ORV AREAS

National Register Eligibility Status				
	Eligible	Not Eligible	Not Evaluated	Total
Lone Rock Beach and Play Area				
Lone Rock Beach Study Area	0	0	0	0
Lone Rock Beach Buffer	0	16	3	19
Lone Rock Beach Play Area Study Area	0	3	0	3
Lone Rock Beach Play Area Buffer	0	2	1	3
Subtotal Lone Rock Beach and Play Area	**0**	**21**	**4**	**25**

National Register Eligibility Status				
	Eligible	Not Eligible	Not Evaluated	Total
Accessible Shoreline Areas				
Stanton Creek Study Area	0	2	0	2
Stanton Creek Buffer	3	2	1	6
Farley Canyon Study Area	0	2	0	2
Farley Canyon Buffer	0	0	3	3
Dirty Devil Study Area	0	0	0	0
Dirty Devil Buffer	0	0	1	1
Bullfrog North and South Study Area	1	1	0	2
Bullfrog North and South Buffer	5	6	8	19
White Canyon Study Area	0	0	0	0
White Canyon Buffer	0	0	0	0
Blue Notch Study Area	2	0	0	2
Blue Notch Buffer	0	0	0	0
Crosby Canyon Study Area	0	0	0	0
Crosby Canyon Buffer	4	0	3	7
Paiute Canyon Study Area	0	0	0	0
Paiute Canyon Buffer	1	1	1	3
Neskahi Study Area	0	0	0	0
Neskahi Buffer	0	0	0	0
Nokai Study Area	3	0	1	4
Nokai Buffer	0	0	1	1
Copper Canyon Study Area	0	0	0	0
Copper Canyon Buffer	1	0	11	12
Paiute Farms Study Area	0	0	1	1
Paiute Farms Buffer	0	1	8	9
Red Canyon Study Area	0	0	0	0
Red Canyon Buffer	0	0	0	0
Warm Creek Study Area	0	0	2	2
Warm Creek Buffer	0	0	0	0
Hite Boat Ramp Study Area	0	0	0	0
Hite Boat Ramp Buffer	5	3	0	8
Subtotal Accessible Shoreline Study Area	**6**	**5**	**4**	**15**
Subtotal Accessible Shoreline Buffer	**19**	**13**	**37**	**69**
Unpaved GMP Roads Study Area	**35**	**35**	**23**	**93**
Paved GMP Roads Study Area	**4**	**6**	**0**	**10**
Ferry Swale ORV routes Study Area	**6**	**2**	**3**	**11**
Total	***70***	***82***	***70***	***223***

Lone Rock Beach: A total of three archeological surveys have been conducted within the 0.5-mile buffer that surrounds the Lone Rock Beach study area resulting in the identification of 19 archeological sites (Liestman 1986; Tipps 1987) (see table 18). All of these sites are located in the buffer area. None of these sites are eligible for the National Register.

Lone Rock Beach Play Area: In general, the three archeological surveys conducted in the Lone Rock Beach study area and buffer also captured the Lone Rock Beach Play Area. Consequently, there is some overlap in the archeological inventories especially with regard to the buffers. A total of three archeological sites are located within the study area of this ORV area (see table 18). None of these sites are eligible for the National Register. The 0.5-mile buffer surrounding the study area contains three archeological sites. None of these sites are eligible for the National Register.

Accessible Shoreline Areas

Glen Canyon has prepared a definition for the accessible shoreline study areas (Baker pers. comm. 2012b). The definition consists of two variables: (1) a 35° gradient is used as the restricting limit for off-road use below the 1988 maximum flood pool of 3,700 feet in designated ORV areas; and (2) a 0.5-mile buffer around each study area is proposed to address indirect impacts (Baker pers. comm. 2012a)

Acting on this information, NAU prepared archeological survey designs for the accessible shoreline areas (Bryce 2010; Caldwell 2011). The research designs include information on archeological sites inventoried in the vicinity of the shoreline study area. For the purposes of the research designs the buffer was expanded from 0.5 mile to 1.0 mile. Archeological survey teams from NAU have completed the accessible shoreline areas fieldwork. The results have been published in two letter reports (Vance and Downum 2012, 2013). The NAU findings were used for the analysis. Although the NAU used a 1.0-mile buffer in their study, Glen Canyon has indicated that a 0.5-mile buffer is adequate for estimating potential indirect impacts on archeological resources (Baker pers. comm. 2012a). This is consistent with the Accessible Shoreline Cultural Considerations draft document (Baker 2010).

The Glen Canyon archeological database indicates that a total of 83 sites are located within the accessible shoreline study area and surrounding buffers. The National Register status of these sites includes 25 determined to be eligible, 17 believed to be not eligible, and 41 that have not been evaluated. Summaries about the archeological sites found within the study area and buffer for each accessible shoreline area are presented below.

Stanton Creek: Archeological surveys conducted within the vicinity of Stanton Creek resulted in the identification of six archeological sites in the 0.5-mile buffer and two archeological sites in the study area (Caldwell 2011; Vance and Downum 2012; and Vance and Downum 2013) (see table 18). Sites GCNRA-014 and GCNRA-015 located in the study area are recommended not eligible for the National Register. However, there are three sites within the boundaries of the buffer that are either recommended eligible for the National Register or have been determined eligible for the National Register (Sites GCNRA-003, GCNRA-004, and GLCA01037/42KA03375) (see table 18). A total of two sites in the buffer are listed as not eligible for the National Register, while a third site is noted as unevaluated.

Farley Canyon: Archeological surveys conducted in the vicinity of the Farley Canyon have resulted in the identification of three archeological sites within the 0.5-mile buffer and two archeological sites in the study area (Caldwell 2011; Vance and Downum 2012; Vance and Downum 2013) (see table 18). Sites GCNRA-006 and GCNRA-007 located within the study area are recommended as not eligible for the National Register (Vance and Downum 2012). The three sites in the buffer area have not been evaluated.

Dirty Devil: One archeological survey has been conducted in the vicinity of the Dirty Devil study area (Vance and Downum 2012). No archeological sites were recorded or revisited during the NAU survey (Vance and Downum

2012). However, one previously identified site is located within the buffer surrounding the study area (Caldwell 2011). This site has not been evaluated for the National Register.

Bullfrog North and South: Archeological surveys conducted in the vicinity of Bullfrog North and South resulted in the identification of 19 archeological sites in the 0.5-mile buffer and 2 archeological sites in the study area (Caldwell 2011: 17; Vance and Downum 2012; Vance and Downum 2013) (see table 18). Site GCNRA-002 located within the study area is recommended eligible for the National Register (Vance and Downum 2013). A second site, GCNRA-020 is also located in the study area. This site has been recommended as not eligible for the National Register. In addition, five previously recorded National Register eligible sites are situated in the surrounding buffer. These remaining 14 sites situated in the buffer are either not eligible or have not been evaluated (see table 18).

White Canyon: An archeological survey conducted in the vicinity of White Canyon did not record any archeological sites (Vance and Downum 2013) (see table: 18). No previously identified sites have been recorded in the buffer or study area (Caldwell 2011).

Blue Notch: Archeological surveys conducted in the vicinity of Blue Notch identified a total of two archeological sites in the study area (Caldwell 2011, Vance and Downum 2012; Vance and Downum 2013) (see table 18). Sites GCNRA-005 and GCNRA-017 located in the study area are recommended eligible for the National Register.

Crosby Canyon: Archeological surveys conducted in the vicinity of Crosby Canyon identified a total of seven archeological sites in the 0.5-mile buffer (Caldwell 2011, Vance and Downum 2012; Vance and Downum 2013) (see table 18). Sites GCNRA-018, GCNRA-019, GLCA00983/42KA03219 and GLCA00987/42KA03223 located within the 0.5-mile buffer are either recommended eligible for the National Register or have been determined to be eligible for the National Register. A total of three unevaluated sites are also located within the buffer.

Paiute Canyon: Archeological surveys conducted in the vicinity of Paiute Canyon resulted in the identification of three archeological sites in the 0.5-mile buffer (Caldwell 2011; Vance and Downum 2013a: Table 3) (see Table 18). Site GLCA02040 is reported to be drowned by the flood pool of Lake Powell. This site has not been evaluated for the National Register. Site GCNRA-008 was identified during the NAU shoreline survey and has been evaluated as eligible for the National Register. A second archeological deposit, Site GCNRA-009 has been evaluated as not eligible for the National Register. No sites were identified within the study area of the Paiute Canyon accessible shoreline.

Neskahi: An archeological survey conducted in the vicinity of Neskahi did not record any archeological sites (Vance and Downum 2013: Table 3) (see table: 18). No previously identified sites have been recorded in the buffer or study area (Caldwell 2011).

Nokai Canyon: Archeological surveys conducted in the vicinity of Nokai Canyon resulted in the identification of one archeological site in the 0.5-mile buffer and four sites in the study area (Caldwell 2011, Vance and Downum 2012, 2013) (see table 18). Sites GCNRA010, GCNRA011, and GCNRA012 located in the study area are recommended eligible for the National Register. Site GLCA02014/42NA06810 also located in the study area has not been evaluated and is described as having been destroyed (Caldwell 2011). Finally, the buffer contains one site that has not been evaluated for the National Register.

Copper Canyon: Archeological surveys conducted in the vicinity of Copper Canyon resulted in the identification of 12 archeological site within the 0.5-mile buffer (Caldwell 2011, Vance and Downum 2012; Vance and Downum 2013) (see table 18). A total of 11 sites are listed as unevaluated for the National Register. Site 42SA20912 was re-located during the recent NAU Copper Canyon survey (Vance and Downum 2013: Table 3). This site has been recommended as eligible for the National Register.

Paiute Farms: Archeological surveys conducted in the vicinity of Paiute Farms resulted in the identification of nine sites in the 0.5-mile buffer and one site in the study area (Caldwell 2011; Vance and Downum 2012; Vance and Downum 2013) (see table 18). Site GLCA02009/NA06802 located in the study area is described as unevaluated for the National Register. NAU recorded Site GCNRA-013 is in the buffer (Vance and Downum 2013: Table 3). This site is recommended as not eligible for the National Register. The remaining eight sites situated in the buffer are described as unevaluated.

Red Canyon: No previous archeological surveys have been conducted in the vicinity of the Red Canyon study area (Bryce 2010). No previously identified sites have been recorded in the buffer or study area (see table 18). This accessible shoreline was not included in the recent archeological surveys conducted by NAU (Vance and Downum 2012; Vance and Downum 2013) as funding was not available for this survey.

Warm Creek: One previous archeological survey has been conducted in the Warm Creek study area (Bryce 2010; Caldwell 2011). This accessible shoreline was not included in the recent archeological surveys conducted by NAU (Vance and Downum 2012; Vance and Downum 2013). However, based on the available ASMIS data, it appears that two archeological sites are located in the Warm Creek study area (see table 18). These two sites, GLCA00635/42LA00251 and GLCA00636/42KA00252, have not been evaluated for the National Register.

Hite Boat Ramp: One previous archeological survey has been conducted in the Hite vicinity (Baker 2004). Data from this accessible shoreline was not included in the Caldwell (2011) design document. Based on examination of the data from the Baker (2004) report, it appears that eight archeological sites are located in the 0.5-mile buffer that surrounds the study area (Baker 2004) (see table 18). Sites 42SA3954, 42SA3955, and Sites 42SA24694-24697 have been determined eligible for listing in the National Register (Baker 2004). The remaining three sites have been determined not eligible for the National Register.

Unpaved GMP Roads

The unpaved GMP roads are described as consisting mainly of old jeep trails leading to scenic viewpoints and camping locations. Many of the roads are unimproved, cross natural soils and bare slickrock, are subject to washouts, and require high-clearance, 4-wheel-drive vehicles for safe passage. Speed of travel is limited by natural conditions at the time of the visit, and may be no more than 5 to 10 mph for extensive periods of travel time. The roads are often difficult to negotiate and can be even more difficult to follow as the movement of desert sands and rockslides obscure or even block routes.

Analysis of the archeological data pertaining to these roads revealed a total of 93 previously recorded archeological sites within the study area for each road (see table 18). To ensure that sites immediately adjacent to these tracks were included in the study, a 60-meter buffer measured from the centerline of the road for a total of 120-meters was included in the study area. A total of 35 sites determined to be eligible for the National Register are included in these linear corridors. An additional 58 sites are either not eligible or have not been evaluated.

Paved GMP Roads

Glen Canyon has approximately 72 miles of paved road to facilitate visitor access to the recreation areas main recreational and educational facilities. The study area of the paved roads is the same as for the unpaved roads described in the preceding section. A total of four previously identified archeological sites located within the study area have been determined eligible for the National Register (see table 18). Evaluation of an additional six sites found within the study area yielded findings of not eligible for the National Register.

Ferry Swale

This analysis was limited to the ORV routes that fall within the Ferry Swale portion of Glen Canyon. The study area for Ferry Swale is the same as that described above for the paved and unpaved GMP roads. It consists of a 60-meter buffer drawn from the center line of the road for a total width of 120 meters. A total of 11.9 miles of previously established ORV routes have been inventoried for archeological sites (Baker and Burrillo 2013). The survey and GIS analysis indicate that a total of 11 archeological sites are located in the study area (see table 18). Sites AZ C:02:067, AZ C:03:032, and GLCA02272/42NA25984 have been evaluated and determined eligible for the National Register. In addition, sites FS-1, FS-4, and FS-5 have been recommended eligible for the National Register. These latter three sites are identified by temporary site numbers reflecting the draft status of the Baker and Burrillo (2013) report. The National Register status of the remaining sites is listed as either not eligible or unevaluated.

Ethnographic Resources

NPS defines "ethnographic resources" as "objects and places, including sites, structures, landscapes, and natural resources, with traditional cultural meaning and value to associated peoples" (NPS 2006a). Research and consultation with associated people identifies and explains the places and things they find culturally meaningful. Associated peoples include those that are the contemporary neighbors to the Glen Canyon National Recreation Area and ethnic or occupational communities that have been associated with the area for two or more generations (40 years), and whose interests in the resources began before the area was established (NPS 2006a).

Ethnographic resources eligible for the National Register are called "traditional cultural properties" or TCPs. TCPs are defined by NPS as "a property associated with cultural practices, beliefs, the sense of purpose, or existence of a living community that is rooted in that community's history or is important in maintaining its cultural identity and development as an ethnically distinctive people" (NPS 2006a). This class of cultural resource was specifically addressed in the 1992 amendments to the NHPA. Contemporary communities are often, but not necessarily Native American groups.

Ethnographic resources eligible for the National Register are called "traditional cultural properties."

There are seven tribes associated with Glen Canyon / Rainbow Bridge: Hopi Tribe; Kaibab Paiute Tribe; Navajo Nation (inclusive of the Coppermine Chapter; Gap/Bodaway Chapter; Ts'ah Biikin Chapter; Kaibeto Chapter; LeChee Chapter; Oljato Chapter; and Shonto Chapter); Paiute Indian Tribe of Utah (inclusive of the Kanosh Band; Koosharem Band; and Shivwits Band); Pueblo of Zuni; San Juan Southern Paiute; and Ute Mountain Ute (inclusive of the White Mesa Ute). In addition, Glen Canyon consults with members of The Church of Jesus Christ of Latter-day Saints on matters involving cultural resources that are associated with the settlement history of the Latter-day Saints Church in Glen Canyon National Recreation Area.

Archeological sites made by indigenous peoples are regarded as ethnographic resources. American Indian archeological sites known and likely to occur within the study area include Paleoindian, Archaic, Ancestral Puebloan, Paiute and Ute sites, as well as Navajo sites. The Pueblo of Zuni and the Hopi Tribe both passed resolutions declaring their relationships with the people who lived during the Paleoindian and Archaic periods. Paleoindian and Archaic period sites, therefore, become ethnographic resources. The Hopi Tribe also claims association with any Ancestral Puebloan and Fremont sites. The Pueblo of Zuni claims association with Fremont period sites. Therefore, the sites are ethnographic resources because of the significance of those sites within the cultural traditions and histories of the Hopi Tribe and Pueblo of Zuni. Any archeological sites associated with Navajo inhabitance of the area are also ethnographic resources. Any Numic or Paiute or Ute sites would similarly be regarded as ethnographic resources by contemporary Paiute and Ute tribes and bands.

Ethnographic resources that are archeological sites have been documented in association with the accessible lakeshores and within the play area of Lone Rock Beach. Ethnographic resources that are archeological resources

have not been documented for the areas proposed for ORV routes and for Ferry Swale. Consultation with tribes and SHPO are ongoing over these resources.

Ethnographic Resources that are or have the Potential to be Traditional Cultural Properties: Four historic properties potentially eligible to the National Register as TCPs lie adjacent to, but are not within, the study area. They include (1) Rainbow Bridge within Rainbow Bridge National Monument; (2) the Colorado River inclusive of what is now Lake Powell; (3) an archeological site associated within the Wahweap governmental housing complex near the Lakeshore Drive Access Road; and (4) a location in association with the Halls Crossing Access Road. Rainbow Bridge is considered significant to the histories and on-going traditions of five tribes associated with Glen Canyon/ Rainbow Bridge. These tribes include the Kaibab Paiute Tribe, San Juan Southern Paiute Tribe, Navajo Nation, Hopi Tribe, and Ute Mountain Ute that includes the White Mesa Ute Band. The Colorado River within the jurisdiction of Glen Canyon, and adjacent to various accessible lakeshores, is regarded as a TCP by the Kaibab Paiute Tribe, the Navajo Nation, the Hopi Tribe, and the Pueblo of Zuni. The Colorado River has been and remains a significant place within the histories traditions and cultures of these tribes. The archeological site that is a potential TCP to the Navajo Nation lies within the government housing complex, but outside of the study area. The location in association with Halls Crossing Access Road is a potential TCP to the Navajo Nation Hopi Tribe, the San Juan Southern Paiute, and the White Mesa Ute of the Ute Mountain Ute Tribe but is outside the study area.

One potential TCP is located within the study area. The Hole-in-the-Rock Road/Trail corridor is significant to members of The Church of Jesus Christ of Latter-day Saints as a location associated with their pioneer history, and it continues to be important in the development as an ethnically distinctive group maintenance of their on-going communal identity and in their development as an ethnically distinctive group. The significance of the corridor is documented in the 2011 Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road (NPS 2011c).

The Hole-in-the-Rock Road traverses portions of Garfield and Kane counties and is approximately 61 miles long (USDOI-BLM 2011). This historic trail falls within Glen Canyon and the Grand Staircase-Escalante National Monument. This cultural resource is managed by Glen Canyon as part of its unpaved GMP road system. Sites located along the trail are recognized as significant by members of The Church of Jesus Christ of Latter-day Saints for its association with the 1879–1880 San Juan Mission expedition. It was during this period that Latter-day Saints pioneers mounted a series of expeditions for the purpose of colonizing areas south and east of the Colorado River.

The site of the engineered wagon passage is known as the Hole-in-the-Rock. Over the decades, members of The Church of Jesus Christ of Latter-day Saints have conducted re-enactments of the events leading to the crossing of the Colorado River by passing through the Hole-in-the-Rock. These reenactments include camping along the historic trail in Glen Canyon and the Grand Staircase-Escalante National Monument. An EA was conducted by the BLM which manages the Grand Staircase-Escalante National Monument to address the issuance of permits for group activities along the Hole-in-the-Rock corridor (USDOI-BLM 2011). The EA resulted in a Finding of No Significant Impact (FONSI) for issuance of organized group permits for day time use of the Hole-in-the-Rock and nearby Dance Hall Rock sites, as well as overnight camping in the Grand Staircase-Escalante National Monument and Glen Canyon (DOI-BLM-UT-0300-2010-0008-EA).

SOCIOECONOMICS

This section describes current social and economic conditions that could potentially be affected by the proposed alternatives. The social and economic conditions of a region are characterized by its demographic composition, the structure and size of its economy, and the types and levels of services and social qualities and factors available to its citizens. Glen Canyon provides recreational opportunities, quality of life, and other amenities to both visitors and residents in the region.

Glen Canyon provides recreational opportunities, quality of life, and other amenities to both visitors and residents in the region.

SOCIOECONOMIC AREA OF CONSIDERATION

Glen Canyon lies in five counties: Coconino County, Arizona, and Garfield, Kane, San Juan, and Wayne counties, Utah. A labor analysis conducted through the U.S. Census Bureau's "LED on the Map" tool revealed that the labor market for this region should include additional counties where residents live and commute to jobs in the counties that encompass the Glen Canyon National Recreation Area. Each county was assessed through the "LED on the Map" tool (U.S. Census 2008).

Counties that account for at least 60% of the workforce in the counties encompassing Glen Canyon were included: Coconino County, Arizona, and Kane, San Juan, and Wayne counties in Utah. However, in Garfield County, Utah, only 30.3% of the jobs were held by Garfield County residents. Some members of the Garfield County workforce also reside in Washington County (11.3%), Iron County (11.3%), and Sevier County, Utah (11.0%). When combined with Garfield County, these three counties accounted for approximately 63.9% of the labor force in Garfield County. Therefore, Sevier, Washington, and Iron counties are also included in this socioeconomic study area because these counties could be affected by socioeconomic events in the counties encompassing Glen Canyon.

The communities adjacent to Glen Canyon are primarily rural. Although formerly dependent on natural resource and extractive industries, the communities adjacent to Glen Canyon have long since diversified their economies. Tourism, service, and trade sectors have grown in the economy, supporting job creation, the local tax base, and overall economic growth in the region.

The towns through which most tourists travel on the way to Glen Canyon include the following:

- Page, Arizona, on Highway 98
- Kanab and Big Water, Utah, on Highway 89
- Escalante and Boulder, Utah, on Highway 12
- Hanksville, Utah, on Highway 276
- Bluff and Blanding, Utah, on Highway 191
- Mexican Hat, Utah, on Highway 163

These are gateway communities into Glen Canyon, and will be further described in the sections below.

Demographics

Glen Canyon lies in a sparsely populated region predominantly encompassing the southeastern region of Utah and a small portion of far north-central Arizona. The closest large cities are Flagstaff, Arizona (in Coconino County), with a population of 60,222 in 2008 (U.S. Census 2010a), approximately 135 miles south of Glen Canyon; and St. George, Utah (in Washington County), with a population of 72,718 in 2008 (U.S. Census 2010a), approximately 110 miles east of Glen Canyon.

The nearest major population centers are Phoenix, Mesa, and Scottsdale, Arizona, with a combined population of more than 4 million (U.S. Census 2008), approximately 225 miles south of Glen Canyon; and Salt Lake City–Ogden–Clearfield, Utah, with a population of over 1.6 million (U.S. Census 2008), approximately 185 miles northwest of Glen Canyon.

Demographic information in the study area states and counties are summarized in table 19 and are described in more detail in the sections that follow. Additionally, as described in chapter 1, the proposed action would not have disproportionate health or environmental impacts on minority or low-income populations or communities as defined in the Environmental Protection Agency's Environmental Justice Guidance (EPA 1998). Therefore, environmental justice was dismissed as an impact topic and is not being carried forward in this analysis.

Arizona

The Arizona portion of Glen Canyon is in Coconino County, Arizona. Coconino County encompasses 18,617 square miles and, by land area, is the largest county in Arizona. Flagstaff, about 135 miles south of Glen Canyon Dam and Lake Powell, is the county seat and the largest city in Coconino County.

In 2000, the population of Coconino County was 116,320 people, and in 2008 it grew to 128,558, reflecting a 10.5% increase. Over the same period, the population of Arizona expanded by 25.8%. As of 2008, only 2.0% of Arizona's total population of 6,500,180 people resided in Coconino County (U.S. Census 2010c). Coconino County is quite rural in nature, with 6.9 people per square mile. By contrast, the population density in Arizona overall was 57 people per square mile. In 2010, 63.4% of Coconino County's population was identified as white. American Indians and Alaskan Natives constituted 28.2% of the population. The remaining 8.4% of the population identified other ethnic backgrounds (U.S. Census 2010d).

In Coconino County, per capita personal income was $31,855 (2007$). This figure is about 2% below Arizona's 2007 per capita personal income of $32,833 (BEA 2010a).

Trends: Arizona was the second-fastest-growing state in the United States from 2000 to 2008, with a population growth of 26% during this period (U.S. Census 2010e). For the period 2006 to 2008, the state population grew by 3.7%, giving Arizona the third-largest percent growth of any state for that period (U.S. Census 2010e). Coconino County had the ninth-fastest-growing population of any of Arizona's 15 counties for the period 2000 to 2008, growing 10.5% (U.S. Census 2010c). For the period 2006 to 2008, the Coconino County population grew 2.1%, giving it the tenth-largest percent growth of any Arizona county for that period (U.S. Census 2010c).

TABLE 19: DEMOGRAPHIC CHARACTERISTICS FOR THE STUDY AREA

Demographic Characteristics	Utah	Garfield County	Iron County	Kane County	San Juan County	Sevier County	Washington County	Wayne County	Arizona	Coconino County
Population est. in 2008[a]	2,727,343	4,658	44,540	6,577	15,055	20,014	137,589	2,589	6,499,377	128,558
Percent of State 2008 Population	-	0.2%	1.6%	0.2%	0.6%	0.7%	5.0%	0.1%	-	2.0%
Population in 2000[a]	2,244,314	4,748	33,992	6,079	14,373	18,868	91,254	2,529	5,166,697	
Percent Change 2000 to 2008[a]	21.5%	–1.9%	31.0%	8.2%	4.8%	6.1%	50.8%	2.4%	25.8%	10.5%
Race / Ethnicity Composition 2000[b]										
White	89.2%	96.2%	93.1%	96.8%	40.6%	95.9%	93.7%	97.8%	75.5%	63.4%
American Indian or Alaskan Native	1.3%	1.3%	1.9%	0.9%	56.6%	1.7%	1.0%	0.7%	4.9%	28.2%
Other Backgrounds	9.5%	2.5%	5.0%	2.3%	2.8%	2.4%	5.4%	1.5%	19.6%	8.4%
Hispanic or Latino	9.0%	1.9%	4.0%	3.0%	3.1%	2.5%	5.0%	1.5%	25.3%	10.9%
Per Capita Personal Income in 2007[c, d]	$29,831	$24,167	$21,103	$29,663	$17,170	$23,081	$24,014	$23,610	$32,833	$31,855
Land Area (square miles)[e]	82,168.1	5,174.5	8,543.1	3,992.2	7,820.7	4,947.9	6,286.4	2,460.5	113,642.2	18,619.1
Persons per Square Mile in 2008	33	1	5	2	2	4	22	1	57	7

[a] U.S. Census 2010c.

[b] U.S. Census 2010d.

[c] BEA 2010a, 2010b.

[d] Personal income figures are reported in 2007 dollars, adjusted with the GDP deflators (OMB 2010).

[e] U.S. Census 2000.

Arizona Gateway Communities: The gateway community to Glen Canyon in the state of Arizona is the City of Page. This city was established in 1957 to provide housing for workers during the construction of Glen Canyon Dam and has evolved into a gateway community for Glen Canyon. The 2008 U.S. Census population estimate for Page was 6,928, whereas the 2000 population estimate was 6,819, reflecting population growth of only 1.5% during this time period (U.S. Census 2010a).

The per capita income in Page was $22,703 (2009$) for the period 2005 to 2009, below the Arizona average of $25,203 (U.S. Census 2010g). Tourism and power generation are the largest sources of revenue in Page. The largest employers are Lake Powell Resorts and Marinas, the Navajo Generating Station, and the Page Unified School District (Cobb pers. comm. 2011).

The City of Page is adjacent to the Navajo Indian Reservation, the largest American Indian reservation by land area in the United States. The Navajo people represent the largest segment of the population in the Glen Canyon area. Their reservation adjacent to Page contains more than 16 million acres (25,000 square miles) and extends into both Utah and New Mexico. The Navajo Indian Reservation and its off-reservation trust land were home to 181,269 people in 2000 (U.S. Census 2010f).

Utah

The Utah portion of the study area includes seven counties: Garfield, Iron, Kane, San Juan, Sevier, Wayne, and Washington. These areas are sparsely populated, all having population densities of five or fewer people per square mile. Washington County, which includes the city of St. George, is the only exception, at 22 people per square mile in 2008 (U.S. Census 2000, 2010c). These counties are surrounded by federal lands, including several popular national park system units, as well as lands administered by the BLM and the U.S. Forest Service.

The seven-county Utah region had a 2008 population of 231,022. Iron, Kane, San Juan, Sevier, Wayne, and Washington counties recorded population growth between 2000 and 2008, whereas Garfield recorded a decline. Iron and Washington counties had a higher population growth rate than any of the other counties, with Washington County growing by over 50% from 2000 to 2008 (U.S. Census 2010c).

In San Juan County, which includes part of the Navajo Indian Reservation, nearly 56.6% of the population is American Indian or Alaskan Native, and 40.6% is reported to be white. The other six counties were predominantly white, reporting at least 93% of all residents as white (U.S. Census 2010d).

The highest per capita income in the Utah region was Kane County, at $29,663. The lowest was San Juan County, at $17,170. The Utah state average per capita income in 2007 was $29,831 (BEA 2010b). All per capita income figures are reported in 2007 dollars.

The largest population center located in the Utah portion of the study area is St. George, Utah, in Washington County, with a population of 72,718 in 2008. The next-largest population center is Cedar City, Utah, in Iron County, with a population of 28,667 in 2008 (U.S. Census 2010b). Communities that are close to the Utah portion of Glen Canyon include Big Water, Blanding, Boulder, Escalante, Hanksville, Kanab, Mexican Hat, and Monticello, many of which are considered gateway communities.

Trends: Utah was the third-fastest-growing state in the United States from 2000 to 2008, with a population increase of 21.5% (U.S. Census 2010e). Washington County was the fastest-growing of all counties in the study area for the period 2000 to 2008, with a percent population change of more than 50% (U.S. Census 2010c).

Utah projects continued population growth through 2060, up to 6.8 million citizens, more than double the current population. Population growth is projected to slow down, with the annual projected growth rate decreasing from 2.7% in 2010 to 1.3% by 2060 (Utah Governor's Office of Planning and Budget 2008). Population growth across the state has been slowing as a result of the economic downturn. As such, it is possible that the population projection figures overestimate the future population growth in Utah.

Utah Gateway Communities: The town of Hanksville (Wayne County), the city of Blanding and towns of Bluff and Mexican Hat (San Juan County), the towns of Escalante and Boulder (Garfield County), and the towns of Big Water and Kanab (Kane County are Utah gateway communities to Glen Canyon. Hanksville, Blanding, Bluff and Mexican Hat are gateways to uplake destinations, including Glen Canyon's Bullfrog, Halls Crossing, and Hite developed areas. Escalante, Boulder, Kanab, and Big Water serve as gateways to the Escalante region and southwestern sections of Glen Canyon. For the location of these areas, see the vicinity map (figure 1 in chapter 1). Some of these gateway communities are described in this section.

The economy of Hanksville has depended and still depends on mining and ranching. Visitation to Lake Powell and other federal lands is important to the small town of Hanksville (Wine pers. comm. 2011). The town, with an estimated population of 204 in 2008 (U.S. Census 2010b), has some lodging, restaurants, and a small store. Hanksville is 45 road miles north of Hite, 68 miles north of Bullfrog, and 70 miles north of Halls Crossing.

Blanding, with a population of 3,290 in 2008 (U.S. Census 2010b), depends economically on tourism and government institutions, including the state-operated Utah State University Eastern. Additionally, a uranium manufacturing plant and a gallium manufacturing plant are major employers in the area, along with the Four Corners Regional Health Care Center, which is the healthcare provider for southeastern Utah (Webb pers. comm. 2011). Because Blanding is located near Lake Powell and many other natural attractions (for example, Natural Bridges and Hovenweep National Monuments, Goosenecks and Edge of the Cedars State Parks, and Monument Valley Navajo Tribal Park), it has a range of lodging, restaurants, and other visitor-oriented business establishments. At least two ATV tour companies operate in Blanding. Blanding, along with Monticello, is host to the annual San Juan ATV Safari, a three-day ATV trail ride that is a popular event. Blanding is also host to the Arch Canyon Jeep Jamboree, an event sponsored by Jeep-Chrysler. Bluff, located 26 miles south of Blanding, had a population of 320 in 2000. Mexican Hat, population of 88, is located southwest of Bluff.

The population of Escalante in 2008 was 763 (U.S. Census 2010b). Escalante provides visitor services to tourists and recreationists seeking access to the BLM-administered Grand Staircase–Escalante National Monument and the Escalante region of Glen Canyon. Escalante provides access to the Hole-in-the-Rock Road, a significant cultural and recreational resource in Grand Staircase–Escalante and Glen Canyon. Escalante also serves as an access point to a number of backcountry roads that cross Grand Staircase–Escalante into Glen Canyon. Escalante is home to an outdoor sporting goods store, several backcountry recreation outfitters, a number of small inns and lodges, two hotels, and other services. An ATV rental business operates out of Escalante. Boulder, Utah is located 29 miles northeast of Escalante, with a population of 180.

Big Water, Utah, is a small community whose population was 406 in 2008 (U.S. Census 2010b). It is located approximately 18 miles north of Page, Arizona. Originally called Glen Canyon City, the town housed workers who constructed Glen Canyon Dam. Big Water is home to several boat storage businesses that serve Lake Powell visitors. Big Water provides access to a network of backcountry roads that transect Grand Staircase–Escalante and Glen Canyon and connect with the town of Escalante to the north. Kanab, located approximately 57 miles west of Big Water, is home to 3,564 residents in 2000.

Employment

Government is a major employer in the study area, accounting for at least 15% of employment in all counties except Washington County. Government employment in Washington County accounted for 11% of the total. It is notable that Washington County is the farthest county from Glen Canyon and is also the most urban in nature. Of all the counties in the study area, San Juan County had the highest proportion of government employment, at 27%. Most of the government employment in the study area is associated with state and local governments, generally with the proportion of employment by local governments higher than that of state governments. With the exception of Washington County, for which retail trade is the largest category of employment, all the counties in the study area have a higher proportion of government employment than their respective states; in 2009, government employment in Utah was 14.3%, and in Arizona it was 14.1%.

Industries related to tourism include accommodation and food services; retail trade; and arts, entertainment, and recreation. These industries were very important in Garfield County (36.4% of total employment) and in Wayne County (24.5% of total employment). Notably, four of the gateway communities are found in these counties, which suggest that visitor spending associated with Glen Canyon is important to the counties' economies. Accommodation and food services accounted for at least 7% of total employment in all study area counties. Employment in arts, entertainment, and recreation in the Utah counties, with the exception of San Juan and Sevier Counties, was comparable with the Utah state total of 2%. Employment in this industry in San Juan and Sevier Counties was approximately 1% of total employment. However, Coconino County in Arizona had a slightly higher proportion of its employment in arts, entertainment, and recreation than did the state: 3.8% in the county compared to 2% in the state. Retail trade was an important source of employment throughout the study area, with at least 8% of employment in retail sectors in all counties. Of all the study area counties, Sevier County had the highest proportion of retail trade (15.0%).

Healthcare employment data was not available for all counties; however, healthcare is also an important employing industry, generally accounting for 8% to 12% of all employment for counties that report these data.

The size of other industries varied across the study area. Farm employment accounted for approximately 9% of total employment in Garfield County, 12.9% in Wayne County, and 11.2% in San Juan County, but was not otherwise an important employer in other counties in the study area. Mining was an important industry in San Juan and Sevier Counties, both accounting for approximately 6% and 5% of total employment, respectively. Most other industries represented less than 5% of the counties' respective total employment.

Employment by industry in the study area for the year 2009 is summarized in table 20. Note that the percentages in a column may not add up to 100% due to missing data for some industry.

TABLE 20: EMPLOYMENT BY INDUSTRY IN THE STUDY AREA (2009)

Industry	Utah	Garfield County	Iron County	Kane County	San Juan County	Sevier County	Washington County	Wayne County	Arizona	Coconino County
Total Employment	1,622,518	3,394	23,087	4,395	6,376	11,191	68,930	1,672	3,217,666	82,367
Accommodation and Food Services	6.16%	25.87%	7.23%	20.59%	10.76%	8.40%	9.04%	13.64%	7.43%	13.84%
Administrative and Waste Services	5.22%	ND	4.92%	1.96%	2.71%	2.19%	4.52%	ND	7.74%	3.04%
Arts, Entertainment, and Recreation	2.13%	2.36%	2.46%	1.82%	1.13%	0.72%	2.33%	2.51%	2.13%	3.77%
Construction	6.15%	3.42%	7.28%	5.16%	4.81%	5.17%	8.88%	8.07%	5.63%	4.61%
Educational Services	2.83%	ND	1.26%	ND	ND	ND	1.19%	ND	1.90%	1.25%
Farm Employment	1.16%	8.78%	2.84%	3.07%	11.17%	6.09%	0.79%	12.86%	0.84%	1.99%
Finance and Insurance	6.88%	ND	5.83%	3.53%	2.62%	3.03%	6.30%	ND	6.00%	2.61%
Forestry, Fishing, and Related Activities	0.20%	ND	ND	ND	ND	ND	ND	ND	0.47%	0.31%
Healthcare and Social Assistance	8.31%	ND	8.26%	ND	ND	ND	12.11%	ND	10.23%	10.80%
Information	2.16%	ND	0.87%	0.57%	0.19%	0.87%	ND	ND	1.52%	0.92%
Management of Companies and Enterprises	1.31%	0.00%	0.39%	0.00%	ND	0.26%	0.49%	0.00%	0.92%	0.15%
Manufacturing	7.36%	2.06%	6.80%	3.44%	3.20%	3.48%	3.62%	1.32%	5.06%	5.13%
Mining	0.92%	ND	ND	ND	5.93%	5.43%	0.59%	ND	0.60%	0.42%
Other Services, Except Public Administration	5.12%	3.42%	5.52%	14.72%	4.75%	5.42%	5.53%	4.13%	5.05%	4.86%
Professional, Scientific, and Technical Services	6.59%	2.03%	4.47%	2.50%	ND	3.65%	5.23%	ND	6.44%	4.67%
Real Estate and Rental and Leasing	5.66%	ND	6.25%	5.03%	2.35%	3.48%	6.88%	1.91%	5.98%	5.80%

Industry	Utah	Garfield County	Iron County	Kane County	San Juan County	Sevier County	Washington County	Wayne County	Arizona	Coconino County
Retail Trade	10.89%	8.13%	11.62%	10.81%	7.59%	14.97%	12.85%	8.37%	11.24%	10.99%
Transportation and Warehousing	3.22%	ND	2.07%	ND	1.73%	9.36%	4.77%	ND	2.79%	2.60%
Utilities	0.28%	ND	0.42%	ND	ND	ND	0.19%	ND	0.40%	0.14%
Wholesale Trade	3.18%	1.41%	1.56%	1.02%	ND	ND	2.09%	1.73%	3.52%	1.43%
Government and Government Enterprises	14.29%	17.91%	18.84%	17.04%	26.76%	15.48%	11.00%	17.58%	14.10%	20.67%
Federal, Civilian	2.24%	5.22%	1.51%	2.34%	2.60%	1.84%	0.80%	6.04%	1.77%	3.70%
Military	1.05%	0.59%	0.87%	0.66%	1.04%	0.79%	0.88%	0.66%	1.07%	0.35%
State Government	4.07%	2.15%	7.77%	1.46%	6.09%	2.92%	1.79%	1.32%	2.67%	7.06%
Local Government	6.93%	9.96%	8.69%	12.58%	17.03%	9.93%	7.53%	9.57%	8.59%	9.56%

Source: BEA 2011.

ND = No data available.

Unemployment

Table 21 summarizes unemployment rates in the study area, Utah, Arizona, and the United States, for the years 2000, 2008, and 2010. Arizona's unemployment rate rose by 6.0% from 2000 to 2010, whereas Utah's unemployment rate rose 4.3% over the same period of time. In 2008, unemployment rates in Garfield, San Juan, and Sevier Counties were lower than their respective 2000 rates, but unemployment rates increased for all counties in the study area over the 10-year period from 2008 to 2010.

Table 21: Unemployment Rates (Percent of Labor Force)

Area	2000	2008	2010
Arizona	4.0%	5.5%	10.0%
Coconino County	4.5%	5.1%	8.9%
Utah	3.4%	3.4%	7.7%
Garfield County	6.8%	5.9%	10.3%
Kane County	3.8%	4.0%	8.2%
Iron County	3.3%	4.2%	9.6%
San Juan County	8.0%	6.0%	13.3%
Sevier County	3.9%	3.8%	8.3%
Washington County	3.5%	4.6%	10.1%
Wayne County	4.6%	5.3%	9.3%
United States	4.0%	5.8%	9.6%

Source: BLS 2010a, 2010b, 2010c.

The rise in the unemployment rate in the study area follows the same general trend as that of the nation between the years 2000 and 2010.

Economic Contributions to Local Economies

Visitors to Glen Canyon and the surrounding public lands contribute to local economies by spending money at local and regional businesses on lodging, gasoline, food, permits and fees, and souvenirs. These expenditures create jobs and income that, in turn, create secondary economic impacts. This section analyzes general tourism and travel spending in the study area, visitor spending and NPS payroll associated with Glen Canyon, and the economic contribution of ORV/ATV activities.

Economic Contributions of Travel and Tourism Activities

Travel and tourism visitor spending in the eight-county region is provided in table 22. Coconino County accounts for nearly half of all travel- and tourism-related visitor spending in the study area. Washington County accounts for almost 27% of visitor spending on the region, followed by Garfield and Iron counties, with 7.8% and 7.5% respectively.

TABLE 22: 2006 DIRECT TRAVEL AND TOURISM IMPACTS—VISITOR SPENDING IN THE STUDY AREA

County	Direct Visitor Spending	Percentage of Total Study Area Visitor Spending
Arizona		
Coconino	$870,000,000	44.8%
Utah		
Garfield	$151,544,908	7.8%
Iron	$146,191,632	7.5%
Kane	$99,127,314	5.1%
San Juan	$71,242,554	3.7%
Sevier	$60,070,251	3.1%
Washington	$513,894,657	26.5%
Wayne	$28,866,267	1.5%
Total	$1,940,937,583	100%

Sources: Dean Runyan Associates 2009; Utah Office of Tourism 2006.

Note: All monetary values in this table are in 2008 U.S. dollars.

ECONOMIC CONTRIBUTIONS OF GLEN CANYON NATIONAL RECREATION AREA

Glen Canyon contributes to local economies in several ways. First, it provides jobs to Glen Canyon employees, including seasonal, term, and permanent full-time or part-time positions. Glen Canyon employees spend their income and wages in the local economies, which support jobs, income, and gross regional product in the area. In 2010, Glen Canyon employed 182 employees, who supported an additional 27 jobs in the local economy, for a total of 209 jobs.[9] This payroll spending contributes to the value added,[10] or the region's gross regional product, by an estimated $12.5 million (Stynes 2011). These payroll benefits are summarized in table 23. Glen Canyon may also support the local economy if local vendors are used, through contracted construction services or purchases of supplies and materials, for example, although these figures are not assessed in this "Socioeconomics" section.

[9] The local economy or local regions are defined as a 50-mile radius around the recreation area, which is the primary impact region around most parks. Economic multipliers are based on regions or areas defined as groupings of counties to approximate a 50-mile radius of the recreation area (Stynes 2011).

[10] Value added, also known as gross regional product, is defined as gross output (sales or receipts and other operating income, plus inventory change) minus intermediate inputs (consumption of goods and services purchased from other industries or imported). Value added consists of compensation of employees, taxes on production and imports less subsidies (formerly indirect business taxes and nontax payments), and gross operating surplus.

TABLE 23: 2010 GLEN CANYON NATIONAL RECREATION AREA PAYROLL SPENDING IMPACTS

NPS Payroll and Impacts	NPS	Total (NPS and Supporting Jobs and Income)
Jobs	182	209
Labor Income (Payroll and Benefits)	$10,721,000	$11,615,000
Total Value Added (Gross Regional Product)	NA	$12,528,000

Source: Stynes 2011.
Note: All monetary values in this table are in 2010 U.S. dollars.
NA = not applicable.

Second, Glen Canyon attracts a large number of visitors, many from outside the region. These visitors consume from local businesses, such as restaurants, hotels, and retail outlets, during their visits in communities surrounding Glen Canyon, contributing to local economies. The economic contribution of the visitor spending is a function of how many visitors arrive and how much money they spend while visiting. Visitor spending benefits for Glen Canyon have been estimated by Stynes (2011) and Cui, Mahoney, and Herbowicz (2013) and are summarized in table 24.

TABLE 24: TOTAL VISITOR SPENDING AND IMPACTS

Impact	Total Amount (2009)	Total Amount (2011)
Spending by All Visitors	$181,609,000	$233,895,000
Labor Income Generated	$68,395,000	$88,152,000
Gross Regional Product	$100,298,000	$138,044,000
Jobs Supported in Local Economy	2,278	2,755

Source: Stynes 2011; Cui, Mahoney, and Herbowicz 2013.
Note: Monetary values in this table are in 2009 U.S. dollars and 2011 U.S. dollars.

Glen Canyon had a total of 2,124,467 recreational visits in 2010, and in 2009, visitation was slightly less, at 1,960,345 (NPS Public Use Statistics Office 2010; Stynes 2011). Recreation visits for 2011 are 2,270,817, approximately 150,000 more than in 2010 (Cui, Mahoney, and Herbowicz 2013). Overnight stays in 2009 were 1,580,992, or approximately 80% of recreational visits. Total spending associated with Glen Canyon visitation in 2011 was estimated to be $233,895,000, all of which was spent by nonlocal visitors. The total labor income generated by this spending was over $88,152,000, and the gross regional product was $138,044,000. This economic activity supported 2,755 jobs in the local economy (Cui, Mahoney, and Herbowicz 2013).

In 2006, total visitor spending in the eight counties was estimated to be $1.9 billion. Visitor spending for Glen Canyon was estimated to be $152,205,000 in 2009 (Stynes 2011), which represents approximately 7.3% of total visitor spending in the study area in 2009 dollars.[11]

Total employment in the seven-county study area (see "Employment") in 2009 was 201,412, while employment in the five-county regions in which Glen Canyon lies was 98,204. Employment associated with Glen Canyon in 2010 was estimated to be 209 for employment and 2,278 for visitor spending, for a total of 2,487 jobs. This employment

[11] $1.9 billion is in 2006 dollars. This amount, when converted to 2009 dollars, is $2.1 billion. This allows for the comparison of 2009 visitor spending, which is in 2009 dollars, with the total visitor spending of all eight counties, which is in 2006 dollars.

from 2010 represents approximately 1.2% and 2.5% of the 2009 employment that existed in the seven-county and five-county areas, respectively.

Economic Contributions of Off-road Vehicle Recreation

A number of economic surveys have documented the investments that ORV/ATV owners make to purchase vehicles and related equipment, and to maintain and operate them (Otto 2008; Stynes 2000; Reed and Haas 1989; the Louis Berger Group 2009; Keith et al. 2008). Additional expenditures occur when ORV owners take trips away from home. Communities bordering public ORV areas benefit economically from these trip-related expenditures.

Stynes (2000) has estimated the spending and economic impacts that occur from ORV/ATV trips on Michigan's public trail system. He reported that in 1998/1999, ORV/ATV users spent $264 per party per trip en route and at their destination. Spending on lodging, restaurants, and food accounted for the three largest expenditures at the destination. A similar study in Minnesota reported that direct residential ATV-related expenditures totaled approximately $642 million in 2005. This includes money spent on ATV trips, with groceries constituting the largest share of the cost per trip, and does not include the price of vehicle purchase. Approximately 41% of this total ($260.3 million) was spent at the destination area in the state, and 48.6% ($311.8 million) was spent at home and en route to the destination (Schneider and Schoenecker 2006).

A study documenting the economic contribution of ORV/ATV recreation in the state of Colorado found that, statewide, ORV/ATV users spent approximately $541 million on trip expenditures (spending between $120 and $620 per trip), and $241 million on vehicle-related expenditures such as vehicle purchases, maintenance, and equipment, in the 2007/2008 season (figures are in 2007 dollars; The Louis Berger Group, Inc., 2009). This generated over 10,000 jobs, and $294 million in labor income, for the state of Colorado during that period of time.

An internal U.S. Forest Service memorandum highlighted how developing ATV recreation opportunities can affect adjacent communities (Reid 2004). The Paiute ATV Trail is a 275-mile loop trail located in south-central Utah. Established in 1990, it has grown into a popular destination for ATV riders, and in 2004 attracted over 72,000 users. According to the memorandum, in 2003 the trail brought in over $7 million in revenues to local economies. Five new ATV rental and outfitter businesses have been established and numerous side businesses, including an 80-unit campground that caters to users of the Paiute Trail, have been opened since the inception of the Paiute ATV Trail.

Arizona has documented the economic importance of ORV recreation to state and local economies. Arizona State Parks reported that ORV/ATV use contributed in excess of $4 billion in annual economic activity through direct expenditures for vehicles, equipment, and other costs related to ORV/ATV trips (Arizona 2003). All the figures from Arizona (2003) are expressed here in inflation-adjusted 2007 dollars (OMB 2010). According to the study, which only included expenditures made by Arizona residents, total ORV/ATV expenditures in Coconino County included $122.3 million for vehicles and equipment, and $119.5 million in trip-related expenditures. Of the $119.5 million in trip-related expenditures, $86 million (72%) came from other Arizona residents traveling to Coconino County. ORV/ATV recreation expenditures in the county, including trip-related, vehicle, and equipment expenditures, supported 2,580 jobs and $58 million in income for county residents, and contributed $11.8 million in state tax revenues. Using an economic multiplier, the study concluded that ORV/ATV recreation in Coconino County resulted in a total economic impact (i.e., total sales or revenues) of $289.8 million.

Arizona has documented the economic importance of ORV recreation to state and local economies. Arizona State Parks reported that ORV/ATV use contributed in excess of $4 billion in annual economic activity through direct expenditures for vehicles, equipment, and other costs related to ORV/ATV trips (Arizona 2003). All the figures from Arizona (2003) are expressed here in inflation-adjusted 2007 dollars (OMB 2010). According to the study, which only included expenditures made by Arizona residents, total ORV/ATV expenditures in Coconino County included $122.3 million for vehicles and equipment, and $119.5 million in trip-related expenditures. Of the $119.5 million in

trip-related expenditures, $86 million (72%) came from other Arizona residents traveling to Coconino County. ORV/ATV recreation expenditures in Coconino County, including trip-related, vehicle, and equipment expenditures, supported 2,580 jobs and $58 million in income for county residents, and contributed $11.8 million in state tax revenues. Using an economic multiplier, the study concluded that ORV/ATV recreation in Coconino County resulted in a total economic impact (i.e., total sales or revenues) of $289.8 million.

A Utah study for the Governor's Public Lands Policy Coordination Office indicates that the number of registered ORV/ATV owners in Utah has risen 233% over the past decade to more than 170,000 in 2006 (Keith et al. 2008). ORV/ATV visitation in the four Utah counties in which Glen Canyon is located accounted for a total of 111,500 trips during a 12-month period in 2006 and 2007. Kane County had the largest number: over 49,000 trips. Trip expenditures were used to estimate the economic impacts on local economies. The authors indicate that ORV/ATV expenditures are a very small part of the regional economies, never exceeding more than 1.5% of total employment, income, value added, or economic output (sales). As part of the study, the authors projected the change in ORV/ATV trips by county associated with proposed changes in BLM policies. The results generally indicate that there would be decreases in ORV/ATV trips in eastern and southeastern Utah and increases in trips in northern and western Utah. The estimated decrease in trips for the four Utah counties range from 2.7% in Kane County to a 17.0% decrease in trips to Wayne County. The change in trips does not exceed 0.1% for any economic measure within any of these counties (Keith et al. 2008).

HEALTH AND SAFETY

The protection and safety of human life takes precedence over all other management actions in NPS.

The protection and safety of human life takes precedence over all other management actions in the Park Service. Under Section 8.2.5 of NPS *Management Policies 2006* (NPS 2006a), the Park Service recognizes that both recreational activities and Glen Canyon resources that attract visitors can pose a significant risk to visitors. Visitors assume the risk and responsibility for their own safety when visiting areas that are managed and maintained as natural, cultural, or recreational environments. According to a Utah State University study, the vast majority of ORV trips involve ATVs. Off-highway motorcycles are a distant second, and other 4-wheel-drive vehicles that are not street-legal, dune buggies, and sand rails represent an even smaller percent of Utah's off-road use (Burr et al. 2008).

Public health and safety facilities in the area are located at Bullfrog, Halls Crossing, and Hite. The uplake district ranger's office at Bullfrog coordinates law enforcement and emergency response, fire protection, and visitor information for all three developed areas. Rangers are assigned to Bullfrog, Halls Crossing, and Hite subdistricts. Jurisdiction for handling public safety issues (i.e., law enforcement) is managed by NPS rangers, although other law enforcement entities may also respond. The Bullfrog medical clinic provides emergency care through a staff of physician's assistants and ranger staff. The skill level of clinic staff varies from first responders to emergency medical technicians and paramedics (NPS 2006b). A permanent helipad is located at Bullfrog for emergency events (NPS 2009c).

ALL-TERRAIN VEHICLE–RELATED INJURIES AND FATALITIES

NPS is concerned with safety issues connected with on- and off-road motor vehicle use. ATVs have been the subject of inquiries and actions by the Consumer Product Safety Commission due to their injury and accident record. The Consumer Product Safety Commission reports that the number of deaths and injuries associated with ATV use has increased since 1982. Nationwide, a total of 11,688 ATV-related deaths occurred between 1982 and 2011 (CPSC 2013). From 1982 to 2011, in the state of Arizona 252 deaths occurred resulting from an ATV-related injury, and 207 deaths occurred in Utah. California is ranked as the state with the highest amount of fatalities, with 628 ATV-related deaths reported between 1982 and 2011. Arizona is ranked as the 19th state in reported ATV-

related fatalities, and Utah is ranked 24th (CPSC 2013). Table 25 shows ATV-related fatality numbers for Arizona and Utah.

TABLE 25: REPORTED ALL-TERRAIN VEHICLE–RELATED FATALITIES IN ARIZONA AND UTAH (JANUARY 1, 1982–DECEMBER 31, 2011)

	Reported Deaths 1982–2007	Reported Deaths 2008–2011	Total Reported Deaths 1982–2011
Arizona	210	42	252
Utah	159	48	207
Total	369	90	459

Source: CPSC 2013.

Note: Includes ATVs with three, four, or an unknown number of wheels.

According to the report, an estimated 25% of the reported fatalities during the same period were people under the age of 16 years, and 10% were under 12 years of age (CPSC 2013).

Table 26 shows estimates of ATV-related injuries treated in hospital emergency departments between 2000 and 2011. Since 2008, there has been a decrease in emergency-treated injuries of all ages. However, data showed that there was a significant increase in ATV-related injuries from 2000 to 2007.

TABLE 26: ANNUAL ESTIMATES OF ALL-TERRAIN VEHICLE–RELATED EMERGENCY DEPARTMENT–TREATED INJURIES (JANUARY 1, 2001–DECEMBER 31, 2011)

Year	Estimated Number of Injuries: All Ages	Estimated Number of Injuries: Younger than 16 years	Percentage of Total: Ages Younger than 16 years
2011	107,500	29,000	27
2010	115,000	28,300	25
2009	131,900	32,400	25
2008	135,100	37,700	28
2007	150,900	40,000	27
2006	146,600	39,300	27
2005	136,700	40,400	30
2004	136,100	44,700	33
2003	125,500	38,600	31
2002	113,900	37,100	33
2001	110,100	34,300	31
2000	92,200	32,000	35

Source: CPSC 2013.

Note: Includes ATVs with three, four, or an unknown number of wheels.

According to a news release from Utah State Parks, an average of 12 people die every year and 4,000 more are treated in emergency rooms for injuries suffered in ATV accidents. In 2002, the release noted, nearly 1,600 children were among those injured in accidents (Utah State Parks 2004). The release noted that many accidents were due to user failure to follow manufacturer instructions regarding the safe use of their vehicles.

Off-road Vehicle–related Accidents and Injuries at Glen Canyon

A review of incident reports from Glen Canyon reveals a low accident / personal injury rate related to ORV operation. Since 2000, 17 incident reports involving personal injury have been filed at Glen Canyon. Three of these incidents involved Glen Canyon staff; two incidents involved property damage to NPS vehicles and two incidents involved damage to personal property after an argument and an attempt to tow another vehicle from the sand; the remainder involved ATV accidents by recreationists at Lone Rock Beach, Lone Rock Beach Play Area, and in the Halls Crossing area (Sweatland pers. comm. 2010b; Carey pers. comm. 2013).

Compliance with Glen Canyon Recreation Area Rules and Regulations

Compliance with Glen Canyon use rules and regulations is an important consideration for Glen Canyon management. These rules exist to protect resources and visitors alike from the harm that can be caused by inappropriate user behavior.

A review of available social research reveals that noncompliance is a finding common to many ORV user surveys. For example, in a 2006 survey of Montana ORV owners, Montana Fish, Wildlife, and Parks reported that 58% of survey respondents stated that they did not follow ORV user guidelines and traveled off established routes to retrieve game (Lewis and Paige 2006). In a study to test the effectiveness of a voluntary ORV compliance and education program in Colorado, two-thirds of adult ORV riders were found to occasionally ride off trail, even when they knew that this behavior was not “correct.” An estimated 15% to 20% of ORV users “frequently” break the rules and often go off trail (Frueh and Monoghan and Associates 2001).

On-the-ground observations of ORV operators in other areas have noted compliance problems. Resource managers at California’s Red Rock Canyon State Park found that illegal off-trail riding is a regularly occurring problem impacting routinely monitored archeological sites. They reported that ORV tracks in a riparian zone signposted as closed by the Glen Canyon were observed on every single visit by Glen Canyon staff (Sampson 2007).

In a study to develop an ORV monitoring program on the Dixie National Forest in Utah, researchers described as a “surprising finding” the number of occurrences of ORV encroachment and impacts on signposted hiking/bicycling/horse trails where off-road use clearly was prohibited. They further described “evidence that ORV users had taken extensive measures to access nonmotorized trails,” including moving boulders, chainsawing trees, and otherwise purposely creating new trails around ORV traffic barriers (Divine and Foti 2004).

Similar ORV-user compliance problems were noted in a USFWS 2007 Federal Register notice on a proposed threatened and endangered species petition (72 FR 24260–24261). The USFWS cited a study by the BLM that had identified high levels of noncompliance with a voluntary route closure system. The USFWS stated that the BLM reported that 50% of noncompliance ORV intrusion points occurred at or near red Carsonite posts designed to discourage travel beyond the posts.

In Glen Canyon, ATV users have been observed riding around "Road Closed" and "No ORV" signs. The presence of illegal off-road tracks, by both ATV and conventional 4-wheel-drive vehicles, are routinely observed during ranger patrols. A search of incident reports maintained by Glen Canyon reveals that from 2003 through October 2008, there were 224 off-road incidents reported by law enforcement staff. Not all incidents lead to citations, or even contact with the responsible individual(s). Incidents range from observations of off-road damage to a previously undisturbed area, to issuing citations for illegal off-road use, to incidents that lead to the impoundment of the offender's vehicle. Of the 224 cases, 75 resulted in NPS law enforcement personnel issuing at least one citation. A similar file search yielded a total of nine personal injury incidents (unspecified) in which there was an injury to an individual during the same period.

Tire Tracks Near "No Motor Vehicles"

PALEONTOLOGICAL RESOURCES

Glen Canyon has a nearly complete record of Mesozoic rocks, with many geologic formations containing abundant and significant fossils. Paleontological resources at Glen Canyon are known from the Honaker Trail Formation (marine invertebrates), Halgaito Formation (bones), Cedar Mesa Sandstone (tetrapod tracks), Moenkopi Formation (tetrapod tracks), Chinle Formation (petrified wood, plant debris, bones, and dinosaur tracks), Wingate Sandstone (tracks), Kayenta Formation (tracks), Navajo Sandstone (trace fossils, bones, and wood), Page Sandstone (wood), Entrada Sandstone (tracks), Morrison Formation (a dinosaur track, bone fragments, and termite nests), Dakota Formation (coal and bivalves), Tropic Shale (marine invertebrates, fish, turtles, and marine reptiles), Straight Cliffs Formation (coal), and Quaternary deposits (plant matter, pollen, spores, bones, hair, dung, packrat middens, and tracks in alcoves) (Santucci et al. 2009).

Glen Canyon has a nearly complete record of Mesozoic rocks, with many geologic formations containing abundant and significant fossils.

Fossils have not yet been documented from the following rock units in Glen Canyon: Paradox Formation, Organ Rock Formation, De Chelly Sandstone, White Rim Sandstone, Carmel Formation, and Summerville Formation / Romana Sandstone. However, these formations are known to preserve fossils elsewhere, and future field investigations in Glen Canyon may recover fossils from one or more of them (Santucci et al. 2009).

PROTECTION OF FOSSIL RESOURCES

Intentional theft and vandalism through unauthorized collecting of fossils has been reported at Glen Canyon. The majority of these impacts have occurred with the collection of vertebrate tracks from the Orange Cliffs area and the collection of petrified wood from the Chinle Formation throughout the Glen Canyon National Recreation Area, especially along the shores of Lake Powell. Motorized vehicle access facilitates such unauthorized collection in more remote areas of Glen Canyon.

Protection of fossil resources involves active enforcement of laws and regulations, including the Paleontological Resources Protection Act of 2009 (PL 111-011) and periodic monitoring of known resources for assessment of existing and potential impact from erosion and other natural causes such as inundation by Lake Powell. The following recommendations, adopted with modifications from Santucci (1998), establish the basis for fossil protection in Glen Canyon National Recreation Area.

- Review Glen Canyon National Recreation Area records over the past decade related to paleontological theft or vandalism.
- Provide paleontological resource protection training for staff working in Glen Canyon National Recreation Area with fossiliferous exposures.
- Establish interagency cooperative efforts to protect fossils on public lands in the immediate area (e.g., other NPS parks, BLM, U.S. Army Corps of Engineers, Utah State and Institutional Trust Lands Administration).
- Offer public education for local and regional audiences on the importance of fossils on public lands and the need to manage these resources responsibly.
- Engage paleontologists and other field-oriented scientists (e.g., archeologists, geologists, biologists) in recognition and observation of fossils.
- Establish reciprocal training for field-based scientific activity that can benefit all disciplines. For example, training paleontologists to recognize rare and endangered species of immediate concern to the Glen Canyon National Recreation Area will help in conservation of those species and plotting their occurrence. Likewise, training field biologists to look for fossils or to locate fossils known or expected in their field areas will facilitate discovery and enhance management initiatives.
- Establish protocols and strategies for the proper permitting of paleontological research, including required mitigation needs, planning such as National Environmental Policy Act (NEPA) requirements, and appropriate curation procedures.

Paleontological Resources at Off-road Vehicle–accessible Shorelines

A paleontological resources assessment was conducted by Clites (2011) that describes the sensitivity of several accessible shoreline areas in Glen Canyon. The resources assessment found that Lone Rock Beach and Lone Rock Beach Play Area contains no known paleontological sites. Fossils of plant material, mammal bones, and animal dung of many different types (including mammoth, shrub ox, mountain lion, and bison) may be present. No significant Pleistocene-age fossils are known to exist there. By contrast, abundant and widespread significant fossils are present in the Neskahi and Paiute Canyon area, such as petrified logs in the Neskahi Wash. Copper Canyon and Nokai Canyon cut through the Monitor Butte and Shinarump Conglomerate Members of the Chinle Formation, which contain extensive fossiliferous lacustrine deposits, abundant petrified logs, and a variety of invertebrate, leaf, and trace fossils. The primitive campground at Stanton Creek is set in the Carmel Formation. The campground road traverses aeolian and alluvial deposits with some significant but sporadic sites. The Farley Canyon campground is located on alluvial deposits, whereas the access road to this site is located on a bench formed by the Organ Rock Formation, occasionally passing through Quaternary deposits. The Organ Rock formation represents terrestrial conditions where Permian reptiles dominated the landscape and may contain reptile or reptile-related fossils. It is known to contain plant fossils and vertebrates. These include root casts in petrified soil horizons, ferns, and pteriodosperms, and conifer, fish, amphibian and reptile fossils. Common fossils may be abundant in the Quaternary deposits, but significant fossils are rare. Hite Boat Ramp and Dirty Devil campground are located amid

the Organ Rock Formation, which has yet to produce fossils within Glen Canyon boundaries. Paiute Farms is located in the Moenkopi Formation, which contains locally common tracks and traces.

The following sections have been condensed from the Glen Canyon National Recreation Area Paleontology Inventory Report (Santucci et al. 2009).

Hermosa Group: Honaker Trail Formation (Middle-Late Pennsylvanian)

The Honaker Trail Formation is composed of sandstone, limestone, and shale. At Glen Canyon, it is 100 to 1,300 feet (30 to 400 meters) thick, 550 feet (170 meters) on average, and is composed of gray to tan limestone with minor sandstone. Only the upper part of the formation is exposed, and only in northern Glen Canyon and the San Juan Arm. Honaker Trail Formation fossils include plants, algae, fusulinid foraminifera, other foraminifera, bryozoans, gastropods, crinoids, conodonts, and pellets. Fossils of the upper Honaker Trail Formation include algae, sponges, corals, bryozoans, brachiopods, bivalves, cephalopods, gastropods, trilobites and other arthropods, crinoids, and trace fossils (Santucci et al. 2009).

Cutler Group: Halgaito Formation / Rico Formation / Elephant Canyon Formation (Late Pennsylvanian–Early Permian)

The Halgaito / Rico / Elephant Canyon interval was deposited during the Late Pennsylvanian and Early Permian, sometime between 305 and 280 million years ago (Ma). Rocks include a mix of continental to nearshore sandstone, siltstone and conglomerate, and marine limestone. At Glen Canyon, this interval is 0 to 500 feet (0 to 150 meters) thick, 250 feet (75 meters) on average, and is composed of yellowish-tan to brown limestone and silty sandstone. Like the Honaker Trail Formation, it is only present in northern Glen Canyon and on the San Juan Arm (Santucci et al. 2009).

A vertebral "sail back" from the unusual temnospondyl amphibian *Platyhystrix* (an extinct early amphibian) was collected from the Halgaito Formation at the extreme eastern end of the San Juan Arm. Isolated bones and fragments are reported from aeolian sandstones, channel limestones, and conglomerates of the Halgaito Formation elsewhere in Glen Canyon. Fossils from sharks, crossopterygian fish (lobe-fins), early ray-finned fish, amphibians, early tetrapods, early diapsid reptiles (the group including lizards, snakes, and crocodilians), and pelycosaur synapsids (mammal-like reptiles) have also been collected from this unit. Fossils reported from the Halgaito Formation in general include seed ferns, lycopods, the tree-like horsetail *Calamites*, foraminifera, bivalves, gastropods, crinoids, echinoids, sharks, palaeoniscid and phyllodont fish, lungfish, crossopterygians, temnospondyl and aistopod (limbless) amphibians, anthracosaurs (reptile-like tetrapods), early diapsid reptiles, and several types of pelycosaurs, such as *Edaphosaurus*. Bones are largely limited to stream channels. Fossils reported from the Rico Formation include foraminifera, brachiopods, bivalves, gastropods, and crinoids. Fossils reported from the Elephant Canyon Formation include wood fragments, algal mats, foraminifera, corals, bryozoans, brachiopods, bivalves, gastropods, cephalopods, trilobites, echinoderms, invertebrate burrows, and palaeoniscid fish (Santucci et al. 2009).

Cutler Group: Cedar Mesa Sandstone (Early Permian)

The Cedar Mesa Sandstone is a marginal marine aeolian unit. At Glen Canyon, it is 700 to 1,400 feet (210 to 425 meters) thick, 1,100 feet (335 meters) on average, and is composed of yellowish-tan, brown, and red sandstone with minor siltstone and limestone. The Cedar Mesa Sandstone was deposited during the Early Permian, sometime between 299 and 280 Ma. It forms slickrock in northern Glen Canyon and on the San Juan Arm. Fossils are not common in the Cedar Mesa formation, but this formation has yielded critically important plant fossils that provide details of terrestrial plant species that existed here prior to the catastrophic extinction event at the end of the Permian period.

Three published track sites have been found in the Cedar Mesa Sandstone at Glen Canyon, with two more sites just outside its boundaries. The Dirty Devil site, now submerged, appears to preserve a predation event, with a larger animal catching a smaller animal. The other track sites are not as potentially dramatic. Synapsids (the group including pelycosaurs, other mammal relatives, and true mammals) were the primary track makers, leaving tracks similar to *Anomalopus* and *Chelichnus* (Santucci et al. 2009). This formation is exposed in the area of the Hite Boat Ramp.

Moenkopi Formation (Early-Middle Triassic)

The Moenkopi formation contains the earliest record of Triassic flora and fauna of the southern Colorado Plateau. The fossil record represents the recovery stage following the catastrophic end-Permian extinction event that nearly extinguished all life on earth. Reptilian ancestors to dinosaurs and all other reptiles are contained in the Moenkopi formation. There is some evidence that the oldest dinosaurs in the world occur in this formation. The Moenkopi Formation is a heterogeneous unit present in several western states. In central and southeastern Utah, it was deposited on a coastal plain affected by two major marine transgressions and other smaller changes in sea level. At the northeast end of Glen Canyon, the Moenkopi Formation represents a fairly stable shelf. At Glen Canyon, it is 270 to 500 feet (80 to 150 meters) thick, 390 feet (120 meters) on average, and is composed of reddish-brown, yellow-gray, pale-green, and white beds of siltstone, sandstone, claystone, limestone, and conglomerate. This formation is exposed around the Hite Boat Ramp, on the eastern shores of Lake Powell in the San Juan Arm, and in the Escalante canyons of the northwestern part of Glen Canyon. The Moenkopi Formation dates to the Early and early-Middle Triassic, between approximately 250 and 240 Ma. It has been divided into several members, depending on location. In southeastern Utah, it was only divided relatively recently, aside from the Sinbad Limestone. At Glen Canyon the members that may be used are, from oldest to youngest, the Hoskinnini and rough equivalent Black Dragon, Sinbad Limestone, Torrey, and Moody Canyon Members (Santucci et al. 2009).

Fossils are not currently well known in the Black Dragon Member, but trace fossils are known. Fossil organisms of the Sinbad Limestone include stromatolites, algae, sponges, bivalves, gastropods, scaphopods, ammonites, ostracodes, crinoids, echinoids, conodonts, and trace fossils. The dominant fossils are microgastropods, which may have been opportunist species spreading after the Permian–Triassic extinction event.

Until recently, fossils from the Torrey Member have been uncommon, with only rushes, bivalves, ostracodes, fish scales, a labyrinthodont amphibian skull, and amphibian tracks reported. However, more extensive finds, particularly tracks and traces from invertebrates and vertebrates, have now been reported from the Torrey Member and equivalents at Glen Canyon. The depositional setting of these areas is interpreted as a broad flat coastal delta plain influenced by both tidal and fluvial processes. Tracks have been found as sandstone casts in mudstone. To date, reptile tracks are dominant, with horsetail molds, invertebrate trace fossils (such as those of millipedes and horseshoe crabs), fish fin marks, and fish bones also found. The Moody Canyon Member is similar to the Torrey Member, and has a similar trace fossil assemblage, at least in central and northern Utah (Santucci et al. 2009).

At least five track sites have been found in Moenkopi Formation rocks at Glen Canyon (Gillette and Newcomb 2009), at least some from the Torrey Member. Two have been published and include horseshoe crab tracks, swim traces, and lizard-like tracks; the horseshoe crab tracks are most abundant.

Chinle Formation (Late Triassic)

The Late Triassic-age Chinle Formation (or Group) is an important fossiliferous unit of the southern Colorado Plateau. It is a heterogeneous terrestrial unit largely deposited in various fluvial and lacustrine settings, and is divisible into several members depending on location. In the Glen Canyon, these include from oldest to youngest the Shinarump, Monitor Butte, Moss Back, Petrified Forest, Owl Rock, and Church Rock Members, but these are often lumped together. At Glen Canyon, the Chinle Formation is 480 to 1,195 feet (145 to 365 meters) thick, 750 feet (230 meters) on average, and is composed of red, orange, purple, green, and dark-brown beds of sandstone,

mudstone, siltstone, claystone, limestone, and conglomerate. Its colorful, slope-forming beds are best exposed along Lake Powell. The Chinle Formation is particularly known for petrified wood and other plant fossils, and such fossils have been reported from Glen Canyon. Its exact age is uncertain, but its base predates 219 Ma, and its top predates the Triassic/Jurassic boundary (201.6 Ma) because this division is known to be in the overlying Wingate Sandstone (Santucci et al. 2009).

The most common fossils of the Shinarump Member are plants. Fossils from the Chinle Formation at Glen Canyon include petrified wood and carbonaceous debris, gastropods, crayfish burrows, bones, coprolites, and dinosaur tracks. At least three track sites have been found in Chinle Formation rocks at Glen Canyon (Gillette and Newcomb 2009). Two sites have been described from Four Mile Canyon and Mike's Mesa. The Four Mile Canyon site has prints of dinosaur-like *Atreipus*, and lizard-like *Rhynchosauroides* tracks. The tracks were removed in 1992 and are in NPS collections. The Mike's Mesa site has tridactyl (three-toed) tracks. Isolated reports of bones have come from several locations and stratigraphic levels, including the Lees Ferry area; the Rincon area; and bones, including those of fish, from the Church Rock / Rock Point Member at an unspecified location. Petrified wood has been reported from many localities. Dubiel reported conchostracans while working in and near Glen Canyon on lower Chinle Formation rocks of the White Canyon / Red Canyon area (Santucci et al. 2009).

Glen Canyon Group: Wingate Sandstone (Late Triassic–Early Jurassic)

The Wingate Sandstone is an aeolian sandstone unit that spans the Triassic/Jurassic boundary. Limestone lenses are also present. At Glen Canyon, it is 100 to 400 feet (30 to 120 meters) thick, 250 feet (75 meters) on average, and is composed of cliff-forming brown sandstone. The best exposures are in the northern part of Glen Canyon. Trace fossils have been collected from the Wingate Sandstone at Glen Canyon. At least five track sites have been found (Gillette and Newcomb 2009). Three sites have been described from Glen Canyon and the immediate vicinity, from Lees Ferry, the Rincon, and North Wash (outside Glen Canyon).

In general, fossils are uncommon in the Wingate Sandstone, although tracks are known from multiple levels in Utah, Arizona, and Colorado. Track makers include invertebrates, mammal-like animals, nondinosaurian reptiles, and theropod, prosauropod, and possible sauropod ("brontosaur") dinosaurs. Mammal-like tracks are often found nearly alone and are confined to dunes. There appear to be distinct Late Triassic and Early Jurassic assemblages, with mammal-like tracks limited to the Late Triassic and prosauropod tracks appearing in the Early Jurassic. Aside from these trace fossils, petrified wood and a phytosaur skull are also known (Santucci et al. 2009).

Glen Canyon Group: Kayenta Formation (Early Jurassic)

The Kayenta Formation is mostly made up of fine to coarse sandstone with some small amounts of interbedded shale and siltstone, and rare limestone and conglomerate. At Glen Canyon, it is 250 to 330 feet (75 to 100 meters) thick, 310 feet (95 meters) on average, and is composed of pale-red to dark-orange sandstone with minor siltstone and shale. It is exposed in the Good Hope Bay area, between the Rincon and a few miles south of the Escalante / Colorado River junction, and in the western San Juan Arm. The age of the Kayenta Formation is now thought to be early- to middle-Early Jurassic, between approximately 197 and 190 Ma. The Kayenta Formation was formed by shifting, freshwater, braided and meandering streams; floodplain deposits are also known.

At Glen Canyon, dinosaur tracks have been found at multiple sites in the Kayenta Formation. Six sites have been described from Glen Canyon and its immediate vicinity, from Explorer's Canyon, Long Canyon, Mike's Mesa, Slick Rock Canyon (two sites), and at neighboring Rainbow Bridge National Monument. At least 29 track sites were found in the Kayenta-Navajo transition (Gillette and Newcomb 2009). These sites were later determined to be located within carbonate beds within the Navajo Formation.

Kayenta Formation vertebrate trace fossils include coprolites and tracks of small (*Grallator*) and large (*Eubrontes*) theropods. Lesser-known theropod track taxa include *Hopiichnus* and *Kayentopus*. Kayenta Formation fossils that

are not vertebrates or vertebrate traces include algal limestone, petrified wood (which is locally abundant in the silty facies), invertebrate trails and burrows, unionid bivalves, freshwater gastropods, and ostracodes (Santucci et al. 2009).

Glen Canyon Group: Navajo Sandstone (Early-Middle Jurassic)

The Navajo Sandstone Formation is the uppermost part of the Glen Canyon Group. Although the dating of Glen Canyon Group units has proven difficult to establish, the bulk of the Navajo Sandstone probably dates to the middle and late Early Jurassic, between approximately 190 and 175 Ma.

Several reports of fossils in the Navajo Sandstone have been made from Glen Canyon or its immediate vicinity. Ten track sites ranging from single track site to multiple track ways have been reported. *Eubrontes* prosauropods (*Otozoum*), small theropods (*Grallator* or *Grallator*-like), large biped (*Eubrontes*-like), both small and large tridactyl tracks, ornithopod tracks similar to *Anomoepus*, and mammal-like reptile tracks (*Brasilichnium*). As with the Kayenta Formation, additional track sites have been exposed by the recent water level drop of Lake Powell, and at least 39 track sites are known in all (Gillette and Newcomb 2009). An undescribed reptile skeleton was found in a lacustrine limestone bed in the Navajo Nation section of Glen Canyon. Traces of termite mounds were reported, and wood has also been reported (NPS 1999a). Two crocodylomorph skeletal specimens have been collected from north-central Arizona near the Utah border at West Canyon, which runs into and is partially in Glen Canyon. These specimens largely consist of scutes and feet. Finally, tree fossils are known from a possible oasis near Page, Arizona, at the southern tip of Glen Canyon (Santucci et al. 2009). At least two vertebrate tracksites, including one with multiple trackways, are now known from the Page Sandstone within Glen Canyon.

San Rafael Group: Page Sandstone (Middle Jurassic)

The Page Sandstone is another aeolian sandstone, very similar to the Navajo Sandstone. It is sometimes considered to be the uppermost part of the Navajo Sandstone, as the Page Member. At Glen Canyon, it is mapped with the Navajo Sandstone, because the two are difficult to distinguish. At Glen Canyon, Page Sandstone is 0 to 300 feet (0 to 90 meters) thick, 40 feet (12 meters) on average, and is composed of tan to reddish-brown sandstone. It dates to the Middle Jurassic, with internal ash units of 167.7 ± 0.5 Ma to 166.3 ± 0.4 Ma. The Carmel–Page sequence includes two transgressive/regressive cycles. The various tongues of the Page Sandstone represent aeolian and beach sand and sandy, muddy, or limy marginal marine locations, deposited against the Carmel–Twin Creek Seaway represented by the Carmel Formation. This seaway ran through Glen Canyon during the Middle Jurassic. The lower Carmel Formation is more prominent to the west, and the Page is more prominent to the east.

Fossils are extremely rare in the Page Sandstone; however, wood is reported from the Page Sandstone at Glen Canyon (NPS 1999a). Otherwise, to date there have been reports only of echinoderm fragments and a single possible theropod footprint from Grand Staircase–Escalante (Santucci et al. 2009). At least two vertebrate track sites, including one with multiple track ways, are now known from the Page Sandstone in Glen Canyon.

San Rafael Group: Entrada Sandstone (Middle Jurassic)

The Entrada Sandstone is dominated by red sandstone, with some silt. It is divided into multiple members depending on location. It lacks age-diagnostic fossils and is regarded as late Middle Jurassic in age, approximately 165 Ma. The Entrada Sandstone represents a semiarid to arid dune field that was hot and sparsely vegetated. It is 120 to 850 feet (35 to 260 meters) thick at Glen Canyon, 350 feet (105 meters) on average, and is composed of reddish-orange to white sandstone with minor siltstone and shale. It is particularly prominent in the Bullfrog area, and to the south along the western shore of Lake Powell.

At Glen Canyon, some theropod tracks from Lake Powell have been reassigned to the Entrada Sandstone from the Navajo Sandstone. Trace fossils are the best-known fossils from the Entrada Sandstone in general. Types of trace fossils include rare root traces, insect burrows, vertebrate burrows, traces of sand-swimming vertebrates, and theropod and sauropod dinosaur tracks. Tracks are common in some areas, and megatrack sites with large theropod tracks are known from upper beds that grade into the overlying Summerville Formation. This level may not be present at Glen Canyon because the Entrada Sandstone and Summerville Formation are separated by an unconformity (Santucci et al. 2009).

Morrison Formation (Late Jurassic)

The Morrison Formation is a heterogeneous unit dated to the middle Late Jurassic, 155 to 148 Ma. Several members have been named; at Glen Canyon, the Tidwell and overlying Salt Wash Members are present, and the overlying Brushy Basin Member may be present in the vicinity. At Glen Canyon, Morrison Formation rocks are 0 to 710 feet (0 to 215 meters) thick, 350 feet (105 meters) thick on average, and include tan sandstone and maroon to gray-green shale. It is present in the Lake Powell area, particularly along the western shoreline.

The Morrison Formation is famous for its fossils, particularly its large dinosaurs. Such familiar genera as *Allosaurus*, *Apatosaurus* ("*Brontosaurus*"), *Brachiosaurus*, *Diplodocus*, and *Stegosaurus* are best known from skeletons found in Morrison Formation rocks. To date, only a few Morrison Formation fossils have been reported from Glen Canyon. The most notable is a handprint of a small sauropod dinosaur found near Bullfrog, the first sauropod track with skin impressions. This specimen was found in the Tidwell Member, so could also be referred to the Summerville Formation. Dinosaur bone fragments are also known. Termite nests preserved as cylindrical concretions 8 inches (20 centimeters) across and 12 to 16 inches (30 to 40 centimeters) tall are known from an unspecified location in Glen Canyon.

The potential for diverse fossils exists, because the Morrison Formation has one of the best terrestrial fossil records of the Mesozoic. Fungal or photosynthetic organisms and traces represented in the Morrison Formation include fungi (both body and traces), algae (including stromatolite structures), charophyte algae, bryophytes, horsetails, ferns, pteridosperms, cycads, bennettitales, ginkgoes, czekanowskiales, and conifers, along with spores and pollen of the following: rhodophytes, bryophytes, lycopsids, ferns, cycads, bennettitales, conifers, gnetales, and unknown plants. Also found were a variety of plant debris, root casts, wood, and seeds. Invertebrates represented by body fossils include sponges, gastropods, unionid bivalves, conchostracans, ostracodes, and crayfish. Many other invertebrates are known from traces, including numerous insect groups not yet known from body fossils. Invertebrate trace fossils have been assigned to anthozoans (corals and anemones), brachiopods, gastropods, bivalves, nematodes, annelids, horseshoe crabs, mayflies, orthopterans (grasshoppers, crickets, and locusts), caddisflies, hemipterans (aphids, cicadas, and allies), flies, beetles, hymenopterans (ants, bees, and wasps), termites, decapods, and echinoderms.

Vertebrates known from body fossils in the Morrison Formation include several varieties of early ray-finned fish like bowfins, lungfish, frogs, salamanders, turtles, sphenodonts, lizards, possible snakes, the lizard-like aquatic reptile *Cteniogenys*, terrestrial crocodylomorphs, *Goniopholis* (closely related to the ancestry of modern crocodilians) and other extinct crocodylomorphs, long-tailed and short-tailed pterosaurs, multiple large (such as *Allosaurus*, *Ceratosaurus*, and *Torvosaurus*) and small (such as *Ornitholestes*) theropods, diverse sauropods (generalized, stocky like *Camarasaurus*, elongate like *Diplodocus*, or long-limbed and long-necked like *Brachiosaurus*), plated dinosaurs like *Stegosaurus*, armored dinosaurs, bipedal herbivorous dinosaurs (such as *Camptosaurus* and *Dryosaurus*), and triconodont, docodont, multituberculate, and symmetrodont mammals. Tracks are known from most of these groups as well, as well as coprolites of herbivorous dinosaurs and mammal burrows. Finally, eggshells from the Morrison Formation have been assigned to turtles, crocodile relatives, and dinosaurs (Santucci et al. 2009).

Dakota Formation (Late Cretaceous)

The Dakota Formation (also Sandstone or Group) is a heterogeneous rock unit with outcrops as far from Utah as Minnesota. The Dakota Formation present at Glen Canyon is 20 to 170 feet (5 to 50 meters) thick, 75 feet (20 meters) on average, and is found between Wahweap and Fiftymile Mountain. It is divided into three informal units. At the base, there is a conglomeratic unit. This is overlain by a heterogeneous middle unit of sandstone, mudstone, claystone, and coal, which is capped by an upper sandstone unit. In the Glen Canyon, the deposition of the Dakota Formation took place during the early Late Cretaceous, around 94.7 Ma, although it is known to be older elsewhere. The Dakota Formation leads into the overlying Tropic Shale without a break in deposition at Glen Canyon.

The fossils of the Dakota Formation are diverse, befitting a formation including rocks from a variety of depositional settings present over a wide geographic range. At Glen Canyon, there are coal beds in the middle unit and bivalves in the upper sandstone, which was deposited under brackish to marine conditions. The best-known terrestrial fossils from the Dakota Formation are plant fossils (particularly angiosperm leaves) and vertebrate tracks.

Dakota Formation outcrops of the neighboring Kaiparowits Plateau and the rest of Grand Staircase–Escalante have yielded diverse fossils, and provide a model for what might be found at Glen Canyon. These include palynomorphs, petrified wood, coal, algae, foraminifera, gastropods, bivalves, ostracodes, ammonites, invertebrate traces, sharks, rays, ray-finned fish, lungfish, amphibians, turtles, lizards, several types of crocodilians and crocodile relatives, small theropods such as dromaeosaurids and troodontids, tyrannosaurids, armored dinosaurs, hypsilophodonts (small bipedal herbivorous dinosaurs), hadrosaurids (duckbills), mammals, and footprint sites. The mammal fossils are significant, and include multituberculates, marsupials, and a nonmarsupial therian. Most fossils there were found in floodplain settings of the middle unit, with some from lacustrine rocks, and algae, foraminifera, gastropods, bivalves, ostracodes, and burrows from the upper part (Santucci et al. 2009).

Tropic Shale (Late Cretaceous)

The Tropic Shale crops out at the southeastern end of Fiftymile Mountain in Glen Canyon. It is 500 feet (150 meters) thick on average in Glen Canyon, and is composed of dark, slope-forming marine shale. It may grade into sandier beds near its upper boundary in southern Utah, and there is no depositional gap between it and the overlying Straight Cliffs Formation. It represents a transgression and regression over a broad coastal plain. Because the marine transgression reached different areas at different times (e.g., the Western Interior Seaway), deposition occurred over a range of time during the early Late Cretaceous, between approximately 94 and 90.5 Ma.

Most fossils in the Tropic Shale are marine specimens. Several fossiliferous localities at Glen Canyon have been described in publications. All sites are from the extreme southwest of Glen Canyon near Big Water and include plesiosaur *Trinacromerum bentonianum,* turtles (both *Desmatochelys* and *Naomichelys*), ammonites, bivalves, fish, *Brachauchenius lucasi*, *Eopolycotylus rankini*, and polycotylid plesiosaur (Santucci et al. 2009).

Straight Cliffs Formation (Late Cretaceous)

The Straight Cliffs Formation is a heterogeneous unit deposited in multiple settings. At Glen Canyon, the Straight Cliffs Formation averages 1,500 feet (455 meters) thick and is composed of sandstone, siltstone, shale, and coal, found stratigraphically above the Tropic Shale. Beach and coastal plain sandstones intertongue with marine shales. Like the Tropic Shale, it crops out near Fiftymile Mountain. The Straight Cliffs Formation of south-central Utah is divisible into four members. From oldest to youngest, these are the Tibbet Canyon Member, the Smoky Hollow Member, the John Henry Member, and the Drip Tank Member. Straight Cliffs Formation rocks are known for their mammal fossils (Gillette and Newcomb 2009).

So far, only coal is known from the Straight Cliffs Formation at Glen Canyon, but fossils are well known from the various members at Grand Staircase–Escalante, and provide a guide for what might be present at Glen Canyon. Fossils from the Tibbet Canyon Member include marine invertebrates, sharks, rays, gars, crocodilians, and marsupials. Fossils from the Smoky Hollow Member include dicotyledonous leaf compressions (possibly in this unit) at Alvey Wash; sharks, rays, and ray-finned fish such as bowfins and gars; the unusual amphibian *Albanerpeton*, frogs, turtles, lizards, and several types of crocodilians and crocodile relatives; small theropods (such as dromaeosaurids and troodontids), tyrannosaurids, armored dinosaurs, hypsilophodonts, and hadrosaurids; and symmetrodont, marsupial, and possible eutherian mammals. Fossils in the John Henry Member include coal; palynomorphs; bivalves and ammonites; footprints; sharks, rays, and ray-finned fish like bowfin and gars; *Albanerpeton*, frogs, turtles, lizards, and several types of crocodilians and crocodile relatives; dromaeosaurids, armored dinosaurs, and hadrosaurids; and multituberculate, symmetrodont, and marsupial mammals. Finally, fossils in the Drip Tank Member include turtle and crocodilian fragments (Santucci et al. 2009).

Quaternary Rocks and Sediments (Pleistocene-Holocene)

Quaternary sedimentary rocks and deposits at Glen Canyon include fragments of igneous rocks, metamorphic rocks, sandstone, limestone, dolomite, quartzite, siltstone, and shale, and are 0 to more than 200 feet (0 to more than 60 meters) thick. They include alluvial deposits left by rivers, aeolian deposits, mass-wasting deposits (like landslides and talus), colluvium on moderate slopes, and residuum from weathered, in-place bedrock. Typical Quaternary fossils include isolated bones of large mammals (such as sloths, proboscideans, equids, bison, and camelids) and fossil material useful for paleoecological and paleoclimatological studies (such as pollen and packrat middens). Both types are common at or within approximately 60 miles (approximately 100 kilometers) of Glen Canyon.

Alcove sites are of great importance at Glen Canyon. These sites are commonly found at the boundary of the Kayenta Formation and Navajo Sandstone. The best-known Quaternary site from Glen Canyon is a large cave that contained 10,600 cubic feet (300 cubic meters) of fossil dung (Santucci et al. 2009). The cave contains diverse fossil resources, including fungal spores in droppings; pollen, charcoal, wood, seeds and plant fragments, and insects; dung assigned to packrats (*Neotoma*), cottontail rabbits (*Sylvilagus*), Shasta ground sloths (*Nothrotheriops shastensis*), mammoths (*Mammuthus*), horses (*Equus*), shrub oxen (*Euceratherium collinum*), bighorn sheep (*Ovis canadensis*), and mountain goats (*Oreamnos harringtoni*); hair from shrews, packrats (*Neotoma*), deer mice (*Peromyscus*), olive-backed mice (*Perognathus*), Abert's squirrel (*Sciurus aberti*), small-footed bats (*Myotis*), coyotes (*Canis latrans*), bear (*Ursus*), ground and mylodont sloths (*Glossotherium* and *Nothrotheriops*), mammoths, horses, bison (*Bison*), bighorn sheep, and deer (*Odocoileus*); bones from toads (*Scaphiopus*), snakes (*Crotalus* and *Pituophis*), grouse-sized birds, marmots (*Marmota*), ground squirrels (*Spermophilus*), pocket gophers (*Thomomys*), voles (*Microtus*), packrats, rabbits (*Brachylagus*), and the extinct shrub ox *Euceratherium* (a tooth); and packrat middens covering the last 12,000 years (Santucci et al. 2009).

Nine other alcove sites have been described from Glen Canyon. Fossil materials range from oak twigs to mammoth bones and dung. Mammoth bones are also known from other locations in Glen Canyon at the southern end and the northeastern tip (Santucci et al. 2009).

Although less spectacular than the cave fossils, microfossils, plant matter, and freshwater invertebrates, such as Pleistocene bivalves and Holocene plant debris, can be found in Quaternary fluvial sediments (Santucci et al. 2009).

WILDERNESS

NPS manages significant Glen Canyon acreages for wildness characteristics.

NPS manages significant Glen Canyon acreages for wildness characteristics. PL 92-593, which established Glen Canyon National Recreation Area, required a wilderness review in accordance with subsections 3(c) and 3(d) of the 1964 Wilderness Act (Section 9, PL 92-593). NPS completed this study and in 1980 submitted to the Secretary of the Interior a proposed wilderness recommendation that identified 588,855 acres as suitable for addition to the National Wilderness Preservation System. An additional 48,955 acres (4% of the total Glen Canyon acreage) that contained federal oil and gas leases were proposed as potential wilderness additions (NPS 1980).

The proposed wilderness areas are largely congruent with the Natural Zone, as shown previously in this chapter in "Figure 11: Management Zones." However, because the proposed wilderness excluded (1) suitable state lands and state mineral rights, (2) federal oil/gas leases (zoned as potential wilderness additions), and (3) boundary additions, it makes up only 588,855 acres, or 47% of Glen Canyon, compared to 681,918 acres of the Natural Zone. Potential wilderness additions totaling 48,955 acres are to become wilderness once the nonconforming conditions or uses are terminated. Like the Natural Zone, the lakeside boundary of the proposed wilderness is coincident with the fluctuating surface of Lake Powell (except at Antelope Island). In the Glen Canyon GMP (NPS 1979), the 3,700 foot contour was identified as the lakeside boundary of the proposed wilderness. However, as the water surface fluctuates when it is lower than this contour, there would be more proposed wilderness acreage with a corresponding decrease in non-wilderness acreage. Conversely, the opposite would occur when the fluctuating water surface is higher than this contour (NPS 1979).

The proposed wilderness identified nine roadless areas exceeding the Wilderness Act minimum requirement of 5,000 acres. These roadless areas range in size from 6,900 acres to 906,920 acres. The largest area includes the vast portion of Glen Canyon that encompasses the lands of the Escalante Region across to Wilson Mesa and along the San Juan Arm to Mexican Hat. The proposed wilderness noted that the "largest and most scenically outstanding" of the roadless areas is located in the Orange Cliffs, and includes "such beautiful canyons between the cliffs and the Green River as Millard, Horsethief, Deadhorse, and Horse" (NPS 1980).

The preservation of wilderness character in proposed wilderness areas traversed by roads is a management challenge. In proposed wilderness areas, the public use of motor vehicles is prohibited (NPS 2006a, Section 6.4.3.3). However, roads open to conventional motor vehicles exist where Hole-in-the-Rock Road crosses the Escalante Region; where Hole-in-the-Rock Road crosses Wilson Mesa; and in the Orange Cliffs Special Management Unit, where a network of unpaved GMP roads cross through proposed wilderness areas (see "Figure 11: Management Zones").

The Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan (NPS 1995) describes backcountry management objectives specifically for the Orange Cliffs unit. This backcountry plan only briefly addresses proposed wilderness in Orange Cliffs, but states that Glen Canyon lands zoned as "natural" will continue to be managed as wilderness until Congress acts on the proposed wilderness areas (NPS 1995). Lands zoned as "natural," which are managed as wilderness, are depicted in "Figure 11: Management Zones."

Chapter 4 Environmental Consequences

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This "Environmental Consequences" chapter analyzes both beneficial and adverse impacts that could result from implementing any of the alternatives related to off-road vehicle (ORV) management at Glen Canyon National Recreation Area (Glen Canyon). This section includes a summary of laws and policies relevant to each impact topic, methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. As required by the Council on Environmental Quality's (CEQ) regulations implementing the National Environmental Policy Act of 1969 (NEPA), a summary of the environmental consequences for each alternative is provided in table 5 (in chapter 2). The resource topics presented in this section, and the organization of the topics, correspond to the impact topics identified in the "Purpose of and Need for Action" chapter, and the resource discussions contained in the "Affected Environment" chapter.

IMPACT ASSESSMENT METHODOLOGY AND ASSUMPTIONS

The general approach for measuring the effects of the alternatives on each impact topic includes the following elements:

- General analysis methods as described in guiding regulations
- Basic assumptions used in this analysis
- Define the level of impact resulting from each alternative
- Methods used to evaluate the cumulative impacts of each alternative in combination with unrelated factors or actions affecting Glen Canyon resources.

These elements are described in the following sections.

General Analysis Method

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures (NPS 2011a).

A substantial body of scientific literature has described the effects of motor vehicle recreation on the environment. The Park Service interdisciplinary planning team reviewed literature and studies applicable to the region and setting and the resources being evaluated. This information was used to augment the on-site observations and documentation gathered by National Park Service (NPS) personnel at Glen Canyon and the advice of internal and external resource management experts to support the qualitative and quantitative statements presented in this impact analysis section. When resource-specific data, observations, studies, or other evidence is available these resources are noted in the methodology section for each impact topic. Geographic information system (GIS) analysis contributed significantly to the assessment of impacts for several topics.

Assumptions

Several guiding assumptions, as defined below, were made to provide context for this analysis.

Analysis Period: This plan/DEIS establishes goals, objectives, and specific implementation actions needed to manage motor vehicle recreation for the next 10 to 15 years.

Analysis Area: The geographic study area for this plan/DEIS is Glen Canyon National Recreation Area and the surrounding planning landscape. Specifically, this includes all ORV areas in Glen Canyon, including Lone Rock Beach and Lone Rock Beach Play Area, the 13 accessible shoreline areas, and Paiute Farms and Nokai Canyon. The analysis also incorporates paved and unpaved General Management Plan (GMP) roads and designated ORV routes in Ferry Swale and adjacent areas. The analysis area may be adjusted to reflect each impact topic as deemed necessary. These adjustments are explained in the "Context" section associated with each impact topic.

Duration and Type of Impacts. For the purpose of the analysis provided in this plan/DEIS, the following assumptions are used for all impact topics:

- ***Duration*** describes the length of time an effect will occur, either short term or long term:
  - *Short-term* impacts are those that occur in the immediate future.
  - *Long-term* impacts are those occurring from motor vehicle management actions over several seasons through the next 10 to 15 years and beyond.
- ***Type*** describes the classification of the impact as beneficial or adverse, direct or indirect:
  - *Beneficial*: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
  - *Adverse*: A change that moves the resource away from a desired condition or detracts from its appearance or condition.
  - *Direct*: An effect that is caused by an action and occurs in the same time and place.
  - *Indirect*: An effect that is caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable.
- ***Context*** describes the area or location in which the impact will occur. The effects may be site-specific, local, regional, or even broader in scale. Director's Order 12 directs that impacts should be analyzed in several contexts when the impact varies geographically, over time, or in some other way (NPS 2011a, Section 4.5).

Other assumptions for impacts analysis of GMP roads and designated ORV routes included direct impacts within 33 feet (10 meters) from centerline (a 66-foot corridor) and indirect impacts for 33 feet (10 meters) up to approximately 200 feet (60 meters) for GMP roads. A smaller corridor was assumed for designated ORV routes, with possible direct impacts within 12 feet from centerline of the route and indirect impacts from 13 feet up to 200 feet meters (60 meters).

Significance of the Impacts

According to the NEPA Regulations adopted by the President's CEQ (40 CFR 1500-1508), the term significantly is based on the twin criteria of context and intensity (40 CFR 1508.27).

> ***Context***: This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

Intensity: This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

1. Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect will be beneficial.

2. The degree to which the proposed action affects public health or safety.

3. Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

4. The degree to which the effects on the quality of the human environment are likely to be highly controversial.

5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

6. The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

8. The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places (National Register) or may cause loss or destruction of significant scientific, cultural, or historical resources.

9. The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

10. Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

Cumulative Impacts Analysis Method

The CEQ regulations, which implement NEPA (42 USC 4321 et seq.), require the assessment of cumulative impacts in the decision-making process for federal projects. A cumulative impact is 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 nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including the no-action alternative.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans at Glen Canyon and, if applicable, the surrounding region. Table 27 summarizes the actions that could affect the various resources at Glen Canyon. These actions are described in more detail in the "Related Laws, Policies, Regulations, and Plans" section of this document (see "Chapter 1: Purpose of and Need for Action").

TABLE 27: ACTIONS THAT CONTRIBUTE TO CUMULATIVE IMPACTS

The study area for all impact topics in this table is the Glen Canyon National Recreation Area Boundary, plus adjacent land.

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
Geology and Soils	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP **Lone Rock Beach** Development of 1981 Lone Rock Beach Environmental Assessment / Development Concept Plan (EA/DCP) **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina Development Concept Plan / Environmental Assessment (DCP/EA) Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 Record of Decision (ROD) Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc.	**Glen Canyon-wide** Illegal off-road use Implementation of 1979 Glen Canyon GMP **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP Off-road use at Lone Rock Beach **Play Area** Implementation Interim Management Plan for Lone Rock Beach ORV Area (Play Area) Off-road use at Lone Rock Beach **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of environmental assessment (EA) for group use permits on Hole-in-the-Rock Road Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP Operations of Amangiri Resort	**Glen Canyon-wide** Planning for a new GMP **Lone Rock Beach** Fee Station improvements Installation of portable decontamination facility for zebra mussels **Accessible Shorelines** Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road Implementation of Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office BLM Programmatic EIS for Oil Sands and Tar Sands in Utah Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Lake Powel Pipeline project Continued operation of the Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Ferry Swale Road and ORV routes improvements for utility access by the Coconino County, Arizona Department of Transportation (DOT) Development of Bureau of Land Management (BLM) Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Adjacent Lands** Unauthorized off-road uses on adjacent lands	
Vegetation	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP Release of Tamarisk Beetles to control the tamarisk **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Illegal off-road use Implementation of 1979 Glen Canyon GMP Current effects of Tamarisk Beetles to control the tamarisk Escalante Watershed Partnership, invasive species removal (Russian olive) **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP **Play Area** Implementation of Interim Management Plan for Lone Rock Beach ORV Area(Play Area) **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Planning for new GMP **Lone Rock Beach** Fee Station improvements Installation of portable decontamination facility for zebra mussels **Accessible Shorelines** Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road Implementation of Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office BLM Programmatic EIS for Oil Shale and Tar Sands Development in Utah Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Unpaved GMP Roads Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc. **Ferry Swale** Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Unpaved GMP Roads** Development of Programmatic EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP Operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Ferry Swale** Lake Powel Pipeline project Continued operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Wildlife and Wildlife Habitat	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP Recreational hunting as allowed by the Glen Canyon enabling legislation Military overflights **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area)	**Glen Canyon-wide** Illegal off-road use Implementation of 1979 Glen Canyon GMP Implementation of recreational hunting as allowed by the Glen Canyon enabling legislation Military overflights **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP	**Glen Canyon-wide** Planning for new GMP Continued implementation of recreational hunting as allowed by the Glen Canyon enabling legislation Military overflights **Lone Rock Beach** Fee Station improvements Installation of portable decontamination facility for zebra mussels

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Accessible Shorelines Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc. **Ferry Swale** Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Play Area** Implementation of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP Operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Accessible Shorelines** Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road Implementation of Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office BLM Programmatic EIS for Oil Shales and Tar Sands Development in Utah Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Lake Powel Pipeline project Continued operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
Special-status Species	**Glen Canyon-wide** Illegal off-road use Special-status species inventories for bald eagles, Christmas bird counts; Brady's pincushion Utah Pronghorn Statewide Management Plan affecting Lone Rock Beach, Ferry Swale, and unpaved GMP roads **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Glen Canyon-wide** Illegal off-road use Special-status species inventory for Desert Bighorn Sheep Reintroduction of the California condor to the Colorado Plateau Designated Critical Habitat for the Mexican spotted owl critical habitat at Orange Cliffs Unit Reintroduction/release of Desert Bighorn Sheep **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Ferry Swale** Closure or seasonal closure for lambing areas for Desert Bighorn Sheep Reintroduction/release of Desert Bighorn Sheep **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Soundscapes	**Glen Canyon-wide** Illegal off-road use Initial grant for air tours as covered in the Interim Operating authority Federal Register notice by FAA in 2005); the initial grant has now been reduced Military overflights from nearby bases **Lone Rock Beach** Noise from ORV and boat use Personal Watercraft EIS **Accessible Shorelines** Personal Watercraft EIS Development of 2008 Uplake DCP/EA Antelope Point DCP Lees Ferry DCP Warm Creek DCP **Unpaved GMP Roads** Use of motor vehicles on roads	**Glen Canyon-wide** Illegal off-road use Reduced air tours Military Overflights from nearby bases **Lone Rock Beach** Noise from ORV and boat use Personal Watercraft EIS **Accessible Shorelines** Personal Watercraft EIS Implementation of 2008 Uplake DCP/EA Antelope Point DCP Lees Ferry DCP Warm Creek DCP **Unpaved GMP Roads** Use of motor vehicles on roads **Ferry Swale** Operation of Amangiri Resort and its associated air tours	**Glen Canyon-wide** Continue air tours operations Continued military overflights from nearby bases **Lone Rock Beach** Noise from ORV and boat use Personal Watercraft EIS to include 10-year phase out of 2-stroke engines; newer 4-stroke engines are quieter **Accessible Shorelines** Personal Watercraft EIS Continued implementation of 2008 Uplake DCP/EA Antelope Point DCP Lees Ferry DCP Warm Creek DCP **Unpaved GMP Roads** Continued use of motor vehicles on roads **Ferry Swale** Continued operation of Amangiri Resort and its associated air tours

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Ferry Swale Development of Amangiri Resort and its associated air tours **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Adjacent Lands** Unauthorized off-road uses on adjacent lands
Visitor Use and Experience	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan	**Glen Canyon-wide** Illegal off-road use Upgrading exhibits in the Carl Hayden Visitor Center Upgrading Defiance House in Bullfrog area Implementation of 1979 Glen Canyon National Recreation Area GMP **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP Off-road use at Lone Rock Beach **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) Off-road use at Lone Rock Beach **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office	**Glen Canyon-wide** Planning for new GMP Upgrading interpretation on the Glen Canyon reach of the Colorado River **Lone Rock Beach** Fee Station improvements **Accessible Shorelines** Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road Implementation of Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office **Ferry Swale** Continued operation of the Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Ferry Swale Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Ferry Swale** Operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands	
Archeological Resources	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Lone Rock Beach Play Area** Development of Play Area EA **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Illegal off-road use Implementation of 1979 Glen Canyon GMP **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP Off-road use at Lone Rock Beach **Lone Rock Beach Play Area** Implementation of interim ORV plan Off-road use at Lone Rock Beach **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Planning for new GMP **Lone Rock Beach** Continued implementation of 1981 Lone Rock Beach EA/DCP Fee Station improvements Installation of portable decontamination facility for zebra mussels **Accessible Shorelines** Continued implementation of 1988 Accessible Shorelines EA/DCP Continued implementation of 1986 Paiute Farms/San Juan Marina DCP/EA Continued implementation t of 2008 Uplake DCP/EA Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road BLM PEIS for Oil Shale and Tar Sands Development in Utah Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Unpaved GMP Roads Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc. **Ferry Swale** Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Ferry Swale** Lake Powel Pipeline project **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Ethnographic Resources	**Glen Canyon-wide** Illegal off-road use **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Illegal off-road use **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Accessible Shorelines** Continued implementation of 1988 Accessible Shorelines EA/DCP Continued implementation t of 1986 Paiute Farms/San Juan Marina DCP/EA Continued implementation t of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Unpaved GMP Roads Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc. No ethnographic resources in Ferry Swale, Lone Rock Beach and Lone Rock Beach Play Area **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office American Indian archeological sites that are ethnographic resources in Ferry Swale, accessible shorelines, Lone Rock Beach and Lone Rock Beach Play Area Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Unpaved GMP Roads** Development of 1979 Glen Canyon National Recreation Area GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses Special use permits for filming, photography, etc. No ethnographic resources in Ferry Swale, Lone Rock Beach and Lone Rock Beach Play Area **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Socioeconomics	Buildout of Antelope Point Marina Phase I Construction of Town of Escalante Hole-in-the-Rock Cultural Facility **Ferry Swale** Development of Amangiri Resort adjacent to Ferry Swale	Construction of Town of Escalante Hole-in-the-Rock Cultural Facility	Future phases of build out of Antelope Point Marina Operations of Escalante heritage Center Lake Powell Pipeline
Health and Safety	Illegal off-road use Ferry Swale area annexed by the City of Page; now providing emergency response to the area Vehicle acquisitions to better respond to incidents to remote an rugged areas Increase in Air Ambulance service for back country rescues Acquisition of a fire boat for responses at accessible shorelines **Adjacent Lands** Unauthorized off-road uses on adjacent lands	Illegal off-road use Memorandums of Agreement with emergency service providers through Glen Canyon, BLM, mutual aid agreements Continued air ambulance service for back country rescues **Adjacent Lands** Unauthorized off-road uses on adjacent lands	Repeater Tower Improvements at Navajo Mountain - impact radio communication capabilities **Adjacent Lands** Unauthorized off-road uses on adjacent lands

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
Paleontological Resources	**Glen Canyon-wide** Development of 1979 Glen Canyon GMP Illegal off-road use **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Play Area EA **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc.	**Glen Canyon-wide** Implementation of 1979 Glen Canyon GMP Illegal off-road use **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP Off-road use at Lone Rock Beach **Play Area** Implementation of interim ORV plan Off-road use at Lone Rock Beach **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Glen Canyon-wide** Development of 1979 Glen Canyon GMP **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Play Area EA **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses Special use permits for filming, photography, etc.

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Ferry Swale Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands		**Ferry Swale** Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Wilderness	**Glen Canyon-wide** Initial grant for air tours as covered in the Interim Operating authority (FR notice by FAA in 2005); the initial grant has now been reduced Military overflights from nearby bases Illegal off-road use **Accessible Shorelines** Personal Watercraft EIS Development of 2008 Uplake DCP/EA Antelope Point DCP Warm Creek DCP Lees Ferry DCP **Unpaved GMP Roads** Use of motor vehicles on roads cherry-stemmed though areas managed as wilderness **Ferry Swale** Development of Amangiri Resort and its associated air tours **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Glen Canyon-wide** Reduced air tours Military Overflights from nearby bases Illegal off-road use **Accessible Shorelines** Personal Watercraft EIS Development of 2008 Uplake DCP/EA Antelope Point DCP Warm Creek DCP Lees Ferry DCP **Ferry Swale** Operation of Amangiri Resort and its associated air tours **Unpaved GMP Roads** Use of motor vehicles on roads cherry-stemmed though areas managed as wilderness **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Glen Canyon-wide** Continue air tours operations Continued military overflights from nearby bases **Accessible Shorelines** Personal Watercraft EIS Continued implementation of 2008 Uplake DCP/EA Antelope Point DCP Warm Creek DCP Lees Ferry DCP **Unpaved GMP Roads** Continued use of motor vehicles on roads cherry-stemmed though areas managed as wilderness **Adjacent Lands** Unauthorized off-road uses on adjacent lands

The geographic scope for this analysis includes elements mostly within the boundaries of Glen Canyon, whereas the temporal scope includes projects within a range of approximately 15 to 20 years. The following points attempt to clarify potential cumulative impact issues in the vicinity of Glen Canyon:

- No projects are proposed or in planning stages that would change road access to any area in Glen Canyon.
- No new visitor use or developed areas are being considered in Glen Canyon.
- No new resorts or major upgrades of existing facilities are being planned.
- General visitation is expected to follow trends similar to those that have been experienced for the past several years.
- NPS is evaluating the need for a new GMP for Glen Canyon.

The analysis of cumulative impacts was accomplished using four steps:

- *Step 1*—Identify resources affected.

  Fully identify resources affected by any of the alternatives.
- *Step 2*—Set boundaries.

  Identify an appropriate spatial and temporal boundary for each resource.
- *Step 3*—Identify cumulative action scenario.

  Determine which actions to include with each resource.
- *Step 4*—Cumulative impact analysis.

  Summarize the impacts of these other actions (x) plus impacts of the proposed action (y), to arrive at the total cumulative impact (z). This analysis is included for each impact topic in this chapter. The following past, present, and foreseeable future actions at Glen Canyon or in the surrounding area have been identified as having the potential to impact the resources evaluated in this plan/DEIS.

Glen Canyon Plans, Policies, and Actions

Glen Canyon National Recreation Area General Management Plan (NPS 1979), Superintendent's Compendium (NPS 2010), EA/DCP for Lake Powell's Accessible Shorelines (NPS 1998), Uplake DCP/EA (NPS 2006b), EA/DCP for Lone Rock Beach (NPS 1981), DCP/EA for Paiute Farms/San Juan Marina, Uplake DCP/EA (NPS 2008e), Antelope Point Marina and Resort DCP/EA (NPS and Navajo Nation 2002), Lees Ferry Area Improvements Final EA (NPS 2006d), OHV Interim Management Plans at Lone Rock Beach and Accessible Shorelines (NPS 2007h), the Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan (NPS 1995), various cultural resources management plans (CRMPs), the grazing component of the GMP (NPS 1999a), Programmatic EA for Special Recreation Permits for Organized Use along Hole-in-the-Rock Road (NPS 2011c), and the personal watercraft EIS are all park planning documents that include policies, goals, or desired conditions, that, when implemented, could contribute to the cumulative effects on the resources addressed by this plan/DEIS. These plans are described in the chapter 1 under "Related Plans and Policies for Glen Canyon National Recreation Area."

Projects throughout Glen Canyon

Numerous past, ongoing, and planned projects are occurring throughout Glen Canyon. These projects have added to or changed the infrastructure operating in Glen Canyon during the winter season, impacting how Glen Canyon operates and how the visitor experiences Glen Canyon during this time. Projects have included the following:

- Release of Tamarisk Beetles to control the tamarisk (*Tamarix* spp.)
- Upgrading exhibits in the Carl Hayden Visitor Center
- Upgrading Defiance House in Bullfrog area
- Upgrading interpretation on the Glen Canyon reach of the Colorado River
- Build out of Antelope Point Marina Phase I
- Vehicle acquisitions to better respond to incidents to remote an rugged areas
- Continued and increased air ambulance service for back country rescues
- Acquisition of a fire boat for responses at accessible shorelines
- Repeater tower improvements at Navajo Mountain to upgrade radio communication capabilities
- Memorandums of agreement with emergency service providers through Glen Canyon, to include the BLM
- Special-status species inventories for bald eagles, Brady's pincushion, and the desert bighorn sheep
- Christmas bird counts
- Implementation of several memorandums of agreement with other agencies or park units to manage pieces of Glen Canyon to include Canyonlands National Park for Orange Cliffs Special Management Unit (Orange Cliffs Unit); Grand Canyon National Park for Lees Ferry; and the BLM for the San Juan River and Escalante
- Planned fee station improvements at Lone Rock Beach
- Planned installation of portable decontamination facility for zebra mussels
- Implementation of the 1999 Grazing Management Plan (for grazing and associated vehicle uses).

Other Activities within Glen Canyon

A wide range of activities exist in Glen Canyon that includes the following:

- Off-road use at Lone Rock Beach and Lone Rock Beach Play Area and at accessible shorelines (legal and illegal)
- Recreational hunting and livestock grazing as allowed by the Glen Canyon's enabling legislation
- Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (Bureau of Reclamation 1996; Bureau of Reclamation 2007)
- Special use permits for filming, photography
- Air tours as covered under the Notice of Interim Operating Authority Granted to Commercial Air Tour Operators Over National Parks and Tribal Lands Within or Abutting National Parks (Federal Register Volume 70, Number 120, Thursday, June 23, 2005)

- Recreational motorized and non-motorized boating on Lake Powell, the Escalante River, and the Colorado River
- Day and overnight hiking and backpacking at multiple locations throughout Glen Canyon, including the Escalante River canyons
- A wide variety of special events
- Interpretive programs and activities
- Unauthorized off-road uses on adjacent lands.

Other Federal Agency Plans, Policies, and Actions

In addition to the laws and policies above, other federal planning documents exist that directly or indirectly relate to off-road use at Glen Canyon, were taken into consideration during the development of this plan/DEIS.

Record of Decision for Operation of Glen Canyon Dam Final Environmental Impact Statement (1996)

This ROD of the Department of the Interior, Bureau of Reclamation, documented the selection of operating criteria for Glen Canyon Dam, as analyzed in the final EIS, dated March 21, 1995 (Bureau of Reclamation 1996). The EIS on the operation of Glen Canyon Dam was prepared with an unprecedented amount of scientific research, public involvement, and stakeholder cooperation.

The Secretary of the Interior's decision is to implement the Modified Low Fluctuating Flow Alternative (the preferred alternative) as described in the final EIS on the operation of Glen Canyon Dam with a minor change in the timing of beach/habitat building flows. This alternative was selected because it will reduce daily flow fluctuations well below the no-action alternative levels (historic pattern of releases) and will provide high steady releases of short duration which will protect or enhance downstream resources while allowing limited flexibility for power operations.

Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead Final Environmental Impact Statement/Record of Decision (2007)

Reservoir elevations have declined over the past decade (1997–2007) and the duration of this ongoing, historic drought is unknown. This is the first long-term drought in the modern history of the Colorado River, although climate experts and scientists suggest droughts of this severity have occurred in the past and are likely to occur in the future. The Colorado River provides water to two nations and to users within seven western states.

Declining reservoir levels in the basin led to interstate and interbasin tensions. As the agency charged with management of the Colorado River, the Department of the Interior had not yet developed rules for the full range of operations at Lake Powell and Lake Mead because these types of low-reservoir conditions had not yet occurred. At the direction of the Secretary of the Interior, the Department of the Interior initiated a public process in May 2005 to develop additional operational guidelines and tools to meet the challenges of the drought in the basin. While water storage in the massive reservoirs afforded great protection against the drought, the Department of the Interior set a goal to have detailed, objective operational tools in place by the end of 2007 in order to be ready to make informed operational decisions if the reservoirs continued to decline.

In 2007, the ROD constituted the Department of the Interior's final decision after facilitating, analyzing, and considering public input received over two and one-half years, during which the ongoing drought continued to focus nationwide attention on the basin. A broad range of alternatives were analyzed, involving water supply, environmental protection, hydropower production, and recreation.

Update to 1996 Long-term Experimental and Management Plan for Glen Canyon Dam, Bureau of Reclamation

The Bureau of Reclamation proposed to develop and adopt a long-term experimental plan that will implement a structured, long-term program of experimentation (including dam operations, modifications to Glen Canyon Dam intake structures, and other non-flow management actions, such as removal of nonnative fish species) in the Colorado River below Glen Canyon Dam (Bureau of Reclamation 2008).

Development or Update of Travel Management Plan, Bureau of Land Management

The Arizona Strip Field Office, Monticello Field Office, and Richfield Field Office are in the process of developing or updating their travel management plans. These comprehensive travel management plans will address all resource use aspects, including recreational, traditional, casual, agricultural, commercial, and educational uses; and the accompanying modes and conditions of travel on public lands that abut Glen Canyon.

Updated Resources Management Plans, Bureau of Land Management

The Monticello Field Office and Richfield Field Office are in the process of updating their resources management plan. The resources management plan for the Monticello Field Office will provide direction for future management of public lands administered by the BLM Monticello Field Office in San Juan and Grand Counties. The resources management plan for Richfield Field Office will provide for future management for Sanpete, Sevier, Paiute, Wayne, and Garfield Counties in central Utah.

Draft Programmatic EIS and Possible Land Use Amendments for Allocation of Oil Shale and Tar Sands Resources, Bureau of Land Management

The BLM recently published the Notice of Availability of the Draft Programmatic Environmental Impact Statement and Possible Land Use Amendments for Allocation of Oil Shale and Tar Sands Resources on Lands Administered by the BLM in Colorado, Utah, and Wyoming. The draft programmatic EIS analyzes several alternatives for land allocation and resource management. Under the BLM's preferred alternative identified in the draft programmatic EIS, the BLM would continue to support the research and development of hydrocarbon deposits in an environmentally responsible way that protects scarce water supplies in the arid West. If the BLM decides to adopt the preferred alternative, 461,965 acres would be available for research and development of oil shale, a kerogen-rich rock (35,308 acres in Colorado; 252,181 acres in Utah; and 174,476 acres in Wyoming). In addition, 91,045 acres in eastern Utah would be available for activities related to tar sands, a type of hydrocarbon-wet sedimentary deposit.

Memorandum of Understanding between Bureau of Land Management and National Park Service (1984) and Interagency Agreement between Bureau of Land Management and National Park Service for Grazing Management on Glen Canyon National Recreation Area (1993)

These agreements prescribe the manner in which the BLM administers grazing permits within Glen Canyon and the values and purposes determination[12] requirement for the Superintendent of Glen Canyon. The determination requirement is to ensure that grazing activities do not conflict with the protection of resources as called for in the 1916 NPS Organic Act of the Glen Canyon Grazing Management Plan (NPS 1999a).

Military Overflights from Nearby Bases

Military bases in the vicinity of Glen Canyon include Hill Air Force Base, Nellis Air Force Base, and Creech Air Force Base. Aircraft from these military installations, as well as others in the vicinity, contribute to the ambient noise level at Glen Canyon from overflights.

Reintroduction of the California Condor to the Colorado Plateau, U.S. Fish and Wildlife Service

California condors (*Gymnogyps californianus*) are the largest flying land bird in North America. Condors are opportunistic scavengers that feed primarily on large dead mammals such as deer, elk, bighorn sheep, range cattle, and horses.

As Euro-Americans began to extensively settle the West they often shot, poisoned, captured, and disturbed the native condors. Settlers also intensively hunted antelope, elk, and other large wild animals, significantly reducing the bird's food supply. Eventually condors could no longer survive in much of their former range, and by the 1970s just a few remaining wild individuals were left, confined to the mountainous areas of southern California.

The California condor has been protected as an endangered species by federal law since 1967. Captive-bred condors were first released to the wild in southern California in 1992, and since that time reintroduction efforts have been expanded. On the Colorado Plateau, condors are currently being reintroduced just north of the Grand Canyon in the Vermilion Cliffs region of southern Utah and northern Arizona (CP-LUHNA n.d.).

Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Mexican Spotted Owl; Final Rule, U.S. Fish and Wildlife Service (50 CFR Part 17)

In 2004, the U.S. Fish and Wildlife Service (USFWS) designated critical habitat under the Endangered Species Act of 1973, as amended, for the Mexican spotted owl (*Strix occidentalis lucida*). The owl inhabits canyon and forest habitats across a range that extends from southern Utah and Colorado, through Arizona, New Mexico, and west Texas, to the mountains of central Mexico. the USFWS designated approximately 3.5 million hectares (8.6 million acres) of critical habitat in Arizona, Colorado, New Mexico, and Utah, on federal lands. Critical habitat for the Mexican spotted owl has been designated in areas of the Orange Cliffs Unit of Glen Canyon.

---

[12] Before authorizing an activity (such as grazing) it must be determined if recreation area values and purposes are affected. This decision process is called a "Values and Purposes Determination" (NPS 1999).

Utah Pronghorn Statewide Management Plan, Utah Department of Natural Resources (2009)

This management plan is the statewide management plan for pronghorn in Utah. The plan provides overall direction and guidance to Utah's pronghorn management activities. Included in the plan are an assessment of current life history and management information; identification of issues and concerns relating to pronghorn management in the state; and the establishment of goals, objectives; and strategies for future management programs. The statewide plan provides direction for establishment of individual pronghorn unit management plans throughout the state.

Other State and Local Planning Documents, Policies, Actions

Lake Powel Pipeline Project, Utah

The Utah State Board of Water Resources, Department of Natural Resources, is proposing to build 120 miles of 66-inch diameter pipeline from the Lake Powell Glen Canyon dam site in Arizona to Sand Hollow Reservoir near St. George, Utah, and 38 miles of 30-inch diameter pipeline from Sand Hollow to Cedar City. It is anticipated that much of the pipeline would be within the legislated utility corridor in Kane County that parallels highway US 89, and then would parallel Interstate-15 to Iron County. One alternative proposes that the pipeline would dip south back into Arizona and transverse the Kaibab Band of the Paiute Tribe Reservation, as well as sensitive BLM lands within the Arizona Strip Field Office.

Road and ORV Routes Improvements for Utility Access by the Coconino County, Arizona Department of Transportation

Improvements by the county include grading of access utility routes in Ferry Swale.

Development and Operation of the Amangiri Resort

The Amangiri Resort is located on 600 acres in Canyon Point, Utah, a 25-minute drive from the nearest town of Page, Arizona, and a 15-minute drive to the shores of Lake Powell. The resort offers a wide variety of activities, including hiking trails, boating trips, scenic flights, and spa treatments. In addition, the resort is located in proximity to Glen Canyon, and visitors to the resort can partake in all the opportunities Glen Canyon offers.

Operations of Escalante Heritage Center and Construction of Escalante/Hole-in-the-Rock Heritage Center, Town of Escalante, UT

The Escalante Heritage Center is dedicated to preserving the history and heritage of the Hole-in-the-Rock and San Juan pioneers who passed through the Escalante Valley in the winter of 1879 and 1880. The Escalante Heritage Center provides a special place to present and preserve the rich and amazing heritage and culture of the Escalante Valley.

Ferry Swale Area Annexed by the City of Page

The Ferry Swale area was annexed by the City of Page, Arizona, in 2010. The city now provides emergency response to the area.

Escalante Watershed Partnership, Invasive Species Removal of Russian Olive

Created in 2009, the Escalante River Watershed Partnership brings together a diverse group of private and federal agencies to achieve restoration goals for the Escalante River. The Escalante River Watershed Partnership now

includes federal and state agencies, local government representatives, nonprofit organizations, businesses, local landowners, and citizens. Since 2009, Glen Canyon has been teaming with the Escalante River Watershed Partnership to remove the Russian olive and restore the Escalante River watershed.

Release of Desert Bighorn Sheep at Last Chance Creek (Utah Division of Wildlife Resources)

The Utah Division of Wildlife Resources proposes to release 25 desert bighorn sheep from Nevada into Glen Canyon near the Last Chance Creek/Lake Powell confluence. Previous introductions by the state have occurred within Glen Canyon with NPS approval. Last Chance Creek is located in the northwest side of Glen Canyon. The UDWR Bighorn Sheep Statewide Management Plan (2008) identifies Last Chance Creek as a location where the state would like to augment existing populations to meet population management objectives.

Utah Division of Wildlife Resources is planning to capture 50 desert bighorn sheep in Nevada. Utah Division of Wildlife Resources would like to release 25 of the 50 sheep into Last Chance Creek. Utah Division of Wildlife Resources is interested in releasing the sheep near water, and is considering transporting the sheep to the release site by boat on Lake Powell. If this is not feasible, the sheep would be transported to a release site along County Road 230.

GEOLOGY AND SOILS

GUIDING REGULATIONS AND POLICIES

Soils and geologic features are fundamental natural resource components whose integrity is addressed in numerous laws and policies governing the management of national park system units. NPS *Management Policies 2006* (NPS 2006a) specifically directs that natural resources, including physical resources such as soils, be managed to preserve fundamental physical and biological processes. *Management Policies 2006* also states that "the Service will protect geologic features from unacceptable impacts of human activity while allowing natural processes to continue" (NPS 2006a, Section 4.8.2). Section 4.8.2.4 requires NPS to preserve soil resources and to prevent the unnatural erosion or removal of soils and to minimize adverse impacts on soil resources.

METHODOLOGY AND ASSUMPTIONS

The methodology for assessing impacts on geology and soils included a review of published literature, soils information from the Natural Resources Conservation Service, and the resource-specific knowledge of planning team members. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Context

The geographic study area for soils and geology is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

ALTERNATIVE A: NO ACTION

The impacts of off-road use have been thoroughly documented for areas with desert soils similar to Glen Canyon (Webb and Wilshire 1983). Major damage from off-road use to soils in arid areas includes destruction of soil stabilizers (Webb and Wilshire 1983), soil compaction and reduced rates of water infiltration (Webb 1982), accelerated rates of surface water runoff and erosion (Iverson 1980; Tuttle and Griggs 1987), accelerated rates of wind erosion (Gillette and Adams 1983), and declines in soil productivity (Adams et al. 1982; Tuttle and Griggs

1987; Belnap 2002). Damage to desert soils, like those found at Glen Canyon, can occur with a single pass of a vehicle (Webb and Wilshire 1983). The Colorado Plateau, which contains the greatest concentration of national parks in the United States (including Glen Canyon), is largely made up of deserts with scattered areas of forests. In the deserts of the Colorado Plateau, cyanobacterial soil crusts can account for 70% of the living soil cover (Belnap 1990). The function of these living soil crusts include stabilizing soils, improving soil structure to increase water infiltration, and concentrating essential nutrients for vascular plant growth (Belnap 2004). Cryptobiotic (or biological) crusts such as those found at Glen Canyon are particularly fragile, especially during the drier seasons. Small amounts of pressure will break through the crust and expose the loose sand or soil beneath to the forces of erosion. Such soils are very susceptible to damage by vehicles and may require 250 years or more for full recovery (Belnap 1993). Biological crusts are highly sensitive to disturbance. Tire treads can impact wide swathes of crusts, breaking down the delicate top layer through shearing and compaction and exposing the rocks and sand below to wind erosion (Belnap 1996). Crusts are most susceptible during the dry season, when footsteps or tire treads easily break through the brittle crust surface (Belnap and Lange 2001). Disturbance directly and indirectly affects many aspects of the structure and function of biological crust communities, including cover, species composition, and nitrogen fixation (Belnap 1993, 1996). Desert soils and associated biological crusts are slow to recover from disturbance due to lack of moisture, limited growth periods, and shallow, easily eroded soils. Crustal organisms are only active when wet; therefore, in desert ecosystems complete recovery may take centuries. Disturbance recovery rates for biological crusts in southern Utah are estimated at 45 years for lichen and 250 or more years for the entire crustal community (Belnap and Lange 2001). Impacts and associated recovery times increase with the number of passes, the total area of impact, and the timing and frequency of disturbance (Belnap and Lange 2001).

One important factor to consider in an analysis of soils is the extent to which already-denuded shorelines occur as a result of inundation as lake levels have fluctuated. Impacts on soils below the 3,700-foot elevation contour would occur on already-denuded areas that have been recolonized by native and exotic vegetation only over the last 10-12 years. There are unlikely to be any significant biological crusts occurring below this full pool elevation because there has not been sufficient time to allow for the redevelopment of these types of soils.

Glen Canyon contains very few areas of well-developed soils. Approximately one-third of the area is bare rock, another one-third is bare rock with pockets or thin cover (less than 20 inches) of windblown sand, and most of the remainder is unstable, wind- or water-deposited material subject to continual disturbance. Deeper, more mature soils do exist, however, in alluvial situations where active erosion is not now occurring (an estimated 1,850 acres). Except for these alluvial soils, all Glen Canyon soils are susceptible to erosion and are readily transported by wind and water. The only impediment to their movement is the sparse mantle of vegetation that helps bind the soil particles. Any disturbance of this vegetation cover by vehicles, trampling, or grazing can readily increase the volume of material transported.

Soil types can be described with regard to their susceptibility for erosion, which can be used to determine the degree of impact that would occur on specific soils given prolonged exposure to off-road use. Table 28 provides detail on the specific soil associations found at locations of interest for this analysis and their respective erodibility factor, or “K factor.” The K factor is a measure of the susceptibility of soil to erosion. Soils high in clay have low K values, from approximately 0.05 to 0.15, because they are resistant to detachment. Coarse-textured soils, such as sandy soils, have low K values, from approximately 0.05 to 0.2, because of low runoff even though these soils are easily detached. Medium-textured soils, such as the silt loam soils, have moderate K values, from approximately 0.25 to 0.4, because they are moderately susceptible to detachment and they produce moderate runoff. Soils having a high silt content are the most erodible of all soils. They are easily detached, and tend to crust and produce high rates of runoff. Values of K for these soils tend to be greater than 0.4 (IWR 2012). Soils in the study area are of low to moderate erodibility, as presented in table 28, with K factors ranging from 0.05 to 0.37.

TABLE 28: SOILS AT LOCATIONS OF INTEREST IN GLEN CANYON NATIONAL RECREATION AREA

Shoreline	Soil Series	K Factor
Crosby Canyon, Farley Canyon, Warm Creek	Rock outcrop–Torriorthents complex, 20% to 65% slopes, extremely bouldery	NR
Nokai Canyon	Rock outcrop–Moenkopi association, steep	NR
Bullfrog North, Bullfrog South, Lone Rock Beach, Lone Rock Beach Play Area, Ferry Swale, Warm Creek	Farb–Pagina–rock outcrop complex, 4% to 20% slopes, bouldery	0.37
Neskahi, Paiute Canyon, Paiute Farms	Lithic Torriorthents–Typictorriorthents–rock outcrop association, steep	0.24
Ferry Swale	Pagina–Denazar complex, 2% to 14% slopes	0.24
Copper Canyon	Hoskinnini–rock outcrop complex, 2% to 8% slopes	0.2
Blue Notch, Red Canyon, White Canyon	Somorent family–rock outcrop complex, 5% to 12% slopes	0.15
Dirty Devil	Tsaya–rock outcrop complex, 2% to 18% slopes	0.1
Stanton Creek	Myton very gravelly sandy loam, 5% to 18% slopes, very bouldery	0.05

Source: NRCS 2011.

NR = not rated.

The Farb–Pagina–rock outcrop complex (see figure 12) has the largest K factor (0.37), and is moderately likely to become eroded with continued off-road use. By contrast, Myton soils have a K factor of 0.05, representing a low susceptibility for erosion. It should be noted, however, that these K factors are intended as measurements of soils in their natural condition. They do not indicate how past management or misuse of a soil increases a soil's erodibility. In those areas where the subsoil is exposed, the organic matter has been depleted and/or the soil's structure destroyed, or soil compaction has reduced permeability, the K factor would be increased regardless of soil type (IWR 2012).

Lone Rock Beach

Lone Rock Beach and the neighboring play area are the only locations in Glen Canyon where all types of motor vehicle use (conventional and nonconventional) are currently allowed. Soils at Lone Rock Beach include those classified as Farb–Pagina–rock outcrop complex, with a soil K factor of 0.37, indicating a moderate susceptibility to erosion. Under the no-action alternative, direct impacts on soils and geology, including the erosion of these more sensitive soils, would continue to occur on approximately 250 acres with ongoing off-road use (by conventional motor vehicles, OHVs, and street-legal all-terrain vehicles (ATVs)) at Lone Rock Beach. Soils in these areas have historically been impacted through years of motor vehicle use, and damage to the soil substrate through shearing, compaction, and erosion resulting from motor vehicle use would continue and potentially increase in severity of impact under the no-action alternative.

Lone Rock Beach Play Area

The Lone Rock Beach Play Area at Lone Rock Beach is a fence-enclosed, 180-acre area that is open to high-intensity motor vehicle use. The play area is the only location in Glen Canyon where all types of ORVs (including conventional motor vehicles, OHVs, and street-legal ATVs) are allowed to be operated in an unrestricted manner.

Soils at Lone Rock Beach Play Area include those classified as Farb–Pagina–rock outcrop complex, with a soil K factor of 0.37, indicating a moderate susceptibility to erosion. Under the no-action alternative, impacts on soils and geology at the play area, including the erosion of these more sensitive soils, would continue to occur with ongoing unrestricted use. Soils in this area have historically been impacted through years of unrestricted motor-vehicle use, and damage to the soil substrate through shearing, compaction, and erosion resulting from motor vehicle use would continue and potentially increase in severity of impact under the no-action alternative.

Accessible Shorelines

Off-road use under alternative A would impact a relatively limited portion of the Lake Powell shoreline in comparison to the entire approximately 2,000 miles of shoreline available at Glen Canyon. The no-action alternative would result in adverse impacts on the soils and geology at accessible shoreline areas in Glen Canyon. Under alternative A, 13 accessible shorelines with ORV areas would remain open for use by conventional motor vehicles (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp) for a total of approximately 5,900 acres. These ORV areas are not intended as play areas (climbing hills in vehicles, driving at high speeds, and similar behavior is prohibited), and the operation of any OHVs or street-legal ATVs would not be allowed. Permitted off-road use in these areas would remain strictly to serve the purpose of providing immediate access to the shorelines. Because the no-action alternative would maintain current management practices related to these accessible shorelines, the control of off-road use by conventional motor vehicles at these shorelines would not be completely protective of Glen Canyon resources, including soil and geological features. As a result, these areas could continue to be vulnerable to off-road use in unauthorized areas or by unauthorized vehicles.

Under the no-action alternative, conventional motor vehicles would be permitted to depart roads and drive directly to the shoreline to park in designated areas, resulting in the continued disturbance of soils in this area. Approximately 258 acres of Farb-Pagina type soils would be directly disturbed at shoreline areas under this alternative (see table 29). Soil erodibility at accessible shorelines ranges from low to moderate, with soil K factors indicating a higher susceptibility to erosion at Warm Creek and Bullfrog North and South compared to the other accessible shorelines. Moderately erodible Farb-Pagina rock outcrop complex soils are present at the Warm Creek, Bullfrog North, and Bullfrog South shoreline areas. Soils at other shoreline areas are less susceptible to erosion and would incur less severe impacts from off-road use. These soils are described further in chapter 3 of this plan/DEIS, which describes in greater detail their presence at various shorelines.

Biological soil crusts occur in areas of Glen Canyon, which are free from historic or current non-natural disturbance, with shallow soil and limited water and wind erosion. As described in Belnap and Lange (2001), biological soil crust cover generally increases in areas with low vascular plant cover, at lower elevation, and with more loosely embedded rocks, shallower soils, and fine soil texture. These cryptobiotic crusts, which exist above the full pool 3,700-foot elevation in these areas, would be damaged by pressure from motor vehicles, which would expose the loose sand or soil beneath to the forces of erosion. Continued off-road use by conventional motor vehicles at the accessible shorelines would lead to changes in soil structure due to the crushing and shearing of the soil substrate, resulting in soil compaction and accelerated erosion. These direct impacts would continue to occur at and near the accessible shoreline sites. Continued soil erosion in these areas would result in a degraded surface, a diminished ability for vegetation to become established, and the eventual loss in the amount of shoreline suitable for recreational use. These direct impacts would be long term and localized, occurring at specific locations rather than being widespread over the entire Glen Canyon area.

The designated accessible shorelines were established at a time when Lake Powell was at or near full pool. When the water level of Lake Powell is at these higher elevations, each designated ORV area is bounded by natural topographical features, resulting in a confined space for off-road use. The Lake Powell water level has dropped in recent years, leading to more topography being exposed at these shoreline areas. In some instances the designated ORV area is no longer bounded by natural features, resulting in land beyond the designated ORV area being

available to off-road use as recreational visitors seek access to the lake. Sensitive paleontological resources occur in these and other areas of Glen Canyon (see the "Paleontological Resources" section later in this chapter). Under the no-action alternative, Glen Canyon would place controls on this activity, such as signage informing visitors that travel is restricted to authorized areas. Although this measure may be only marginally effective, such restrictions would potentially curtail impacts on additional acres resulting from occasional off-road driving in unauthorized areas.

In aerial views, motor vehicle use in non-authorized areas is evident throughout Glen Canyon, and may greatly impact any biological soil crusts (as discussed above), leading to increased erosion, increased formation of physical crusts, and reduced overall soil stabilization. Additionally, because of slow recovery times, tracks made by motor vehicles driving off-road on the soil may be evident for many years, particularly if they occur in areas of otherwise well-established biological crusts. These tracks from unauthorized off-road use may attract additional ORV traffic to an area and increase soil disturbance and subsequent erosion.

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively discontinue the off-road use of these shoreline areas. Currently Warm Creek, Crosby Canyon, and Bullfrog North and South are temporarily closed due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. The Paiute Farms and Nokai Canyon accessible shorelines (approximately 1,400 acres) are not officially authorized for off-road use, although they are currently being accessed. Under alternative A, off-road use at Paiute Farms and Nokai Canyon would be discontinued and management action taken to prevent access. Soils in these ORVs areas would benefit from the recovery time provided by the cessation of off-road use.

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on all GMP roads in Glen Canyon (there are approximately 315 miles of unpaved GMP roads, and approximately 75 miles of paved GMP roads at Glen Canyon), with the exception of the Orange Cliffs Unit where street-legal ATVs are prohibited. OHVs and ATVs that do not meet the street-legal requirements under Utah and Arizona code are prohibited from operating on any road in Glen Canyon. Under the no-action alternative, these current management practices would continue.

No impacts on soils would result from motor vehicle use on paved GMP roads because paved roads contain an asphalt top and no soils that would be disturbed, and it is assumed that vehicles would be travelling on the roadway, including paved shoulders, and not contributing to erosion at roadway edges. Soils along unpaved GMP roads, by contrast, may be subject to increased wind erosion and compaction due to vehicle pass-bys and shoulder pull-offs. However, the impact is expected to be low as long as these vehicles remain on the roadways. Direct impacts (those within 33 feet (10 meters) on either side of the road centerline) would occur on approximately 714 acres of the most commonly occurring soils at Glen Canyon, including approximately 240 acres of moderately-erodible soils of the Farb-Pagina soil complex. Indirect impacts (those between 33 feet (10 meters) and approximately 200 feet (60 meters) on either side of the road centerline) would occur on approximately 3,428 acres of the most common soils at Glen Canyon, including approximately 1,167 acres of moderately- erodible soils of the Farb-Pagina soil complex.

Because the majority of Glen Canyon's unpaved GMP roads have compacted dirt surfaces, impacts on soils on designated unpaved GMP roads would likely be contained to the edges of already disturbed areas. Soils along these roads are previously disturbed through blading, compaction, other earthmoving activities required for road construction and routine maintenance, and use. As a result, the continued use of conventional motor vehicles and street-legal ATVs would not result in notable harm to soils on these surfaces.

Ferry Swale

In Ferry Swale there are areas with unauthorized user-created routes over which ORVs travel before crossing onto federal lands administered by the BLM. The Vermilion Cliffs is an area of sensitive geologic formations administered by the BLM. The formation itself is composed of a 3,000-foot sandstone escarpment. These unauthorized user-created routes are currently being accessed. Under the no-action alternative, approximately 53 miles of unauthorized user-created routes would be authorized and designated for use by conventional motor vehicles, OHVs, and street-legal ATVs.

Under alternative A, soils in Ferry Swale would experience direct adverse impacts from continued rutting, erosion, and compaction along the approximately 53 miles of designated ORV routes. However, because the majority of these designated ORV routes have compacted dirt surfaces, impacts on soils would likely be contained to the edges of already disturbed areas. Soils along these ORV routes are previously disturbed. As a result, the continued use of conventional motor vehicles, OHVs, and street-legal ATVs along these routes would not result in notable harm to soils on these surfaces.

Soil K factors in the Ferry Swale area indicate a relatively low to moderate susceptibility to erosion. These soils include Farb-Pagina; Juanalo; Needle-Sheppard; and Pagina-Denazari. Under the no-action alternative, off-road use would be allowed only on designated ORV routes. Direct disturbances within 12 feet of either side of the centerline of the ORV routes in Ferry Swale would occur over approximately 40 acres of moderately erodible Farb-Pagina type soils, while indirect disturbances to these soils (i.e., disturbances over an area from 13 feet to approximately 200 feet (60 meters)) from the centerline of the designated ORV route would equate to approximately 527 acres under this alternative (see table 29).

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect soils and geology. These cumulatively considerable actions are presented on table 27 in this chapter and described in greater detail in chapter 1. Both adverse and beneficial impacts have occurred as a result of these cumulative actions. Adverse impacts have accrued to soils and geological resources from illegal off-road use within the recreation areas and on adjacent lands, reintroduction of desert bighorn sheep, grazing, and associated vehicle use, all of which have contributed to soil compaction and erosion. The formation of nonbiotic or physical soil crusts, in particular, which are formed in soils with low organic matter and low silt and clay content, is reduced by livestock grazing management, soil surface protection, and increased soil organic matter (Neff et al. 2005). Beneficial impacts on soils and geology have also occurred, and would continue to occur into the future from the implementation of the following plans or actions:

- 1979 Glen Canyon National Recreation Area General Management Plan, which considers soils and geology in managing Glen Canyon resources
- 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan which determines how the backcountry areas of Glen Canyon should be managed.
- Road and ORV route improvements at Ferry Swale

Additional actions include the development of BLM Arizona Strip Office Travel Management Plan, which also results in beneficial impacts on soils and geology. Beneficial cumulative impacts may also result from the above-mentioned management plans where restrictions to where ORVs can be operated are established. These actions contribute to cumulatively considerable long-term adverse and beneficial impacts on soils and geologic resources. The continuation of local and adverse impacts on soils and geological resources under alternative A, in

combination with the beneficial impacts from the other, primarily NPS-related actions, would result in a slight contribution of adverse impacts on overall long-term beneficial impacts.

Alternative B: No Off-road Use

Lone Rock Beach

Under alternative B, off-road use at Lone Rock Beach would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs, and the area restored to natural conditions. Soils at Lone Rock Beach, which include those classified as Farb-Pagina rock outcrop complex, with a soil K factor of 0.37 indicating a moderate susceptibility to erosion, would benefit from the recovery time provided by the cessation of off-road activity in Glen Canyon under alternative B. These benefits would extend to approximately 250 acres of soil at Lone Rock Beach. By prohibiting all off-road use in this area, alternative B would allow for soils in impacted areas of Lone Rock Beach to recover. As vegetation is allowed to reestablish in areas of former impact, soil erosion would diminish. Over the long term, these beneficial effects would become readily apparent in areas of previous disturbance.

Lone Rock Beach Play Area

Under alternative B, off-road use at the 180-acre Lone Rock Beach Play Area would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs, and the area restored to natural conditions. In the same way as described above for Lone Rock Beach, soils at Lone Rock Beach Play Area would benefit from the recovery time provided by the cessation of all off-road activities in Glen Canyon under alternative B. By prohibiting off-road use, alternative B would allow soils in impacted areas of Lone Rock Beach Play Area to recover. As vegetation is allowed to reestablish in areas of former impact, soil erosion would diminish. Over the long term, these beneficial effects would become readily apparent in areas of previous disturbance in the play area, where moderately erodible soils of the Farb–Pagina–rock outcrop complex have been impacted.

Accessible Shorelines

Under alternative B, off-road use at 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be discontinued permanently and restored to natural conditions. Farb-Pagina rock outcrop complex soils are present at the Warm Creek, Bullfrog North, and Bullfrog South shoreline areas. These soils are moderately susceptible to erosion. Soils at other shoreline areas are less susceptible to erosion and would incur less severe impacts from off-road use. By prohibiting off-road use at accessible shorelines areas, alternative B would remove the existing source of soil disturbance and allow soils in impacted areas of accessible shorelines (approximately 7,300 acres) to recover. In the same way as described above for Lone Rock Beach, soils at the accessible shoreline areas would benefit from the recovery time provided by the cessation of all off-road activities. As vegetation becomes reestablished in areas of former impact, soil erosion would be lessened. These beneficial effects would be more apparent in areas of previous disturbance and in areas of moderately erodible soils (based on K factors of 0.25 and above), such as the Bullfrog North and South shoreline area. These impacts would be long term and localized, occurring at specific locations rather than being widespread over the entire Glen Canyon area.

Travel on GMP Roads in Glen Canyon

Direct and indirect impacts on soils along paved and unpaved GMP roads under alternative B would be the same as those under alternative A. Conventional motor vehicles and street-legal ATVs would continue to operate on GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit where street-legal ATVs would not be authorized.

Ferry Swale

No off-road use would be allowed in Ferry Swale and existing user-created routes would be closed and the area restored to natural conditions. In the same way as described above for Lone Rock Beach, Lone Rock Beach Play Area, and the accessible shoreline areas, soils in Ferry Swale would benefit from the recovery time provided by the cessation of off-road activities in Glen Canyon under alternative B.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to affect soils and geology under the no-action alternative would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the beneficial impacts on soils and geology under alternative B, would result in long-term beneficial cumulative impacts on soils and geology.

Alternative C: Increased Motorized Access

Lone Rock Beach

Impacts on soils and geology at Lone Rock Beach under alternative C would be similar as impacts described for these areas under the no-action alternative. However, under this alternative, areas authorized for off-road use at Lone Rock Beach would be marked and defined with improved signage and/or barriers in a manner consistent with the control of off-road use for the protection of Glen Canyon resources, including soil and geological features. All ORV users would require a permit to operate at Lone Rock Beach and be permitted to drive off-road only from the end of the road directly to the shoreline areas; soils along this path between the roads and shorelines would continue to be impacted. Requiring all operators desiring to travel off-road to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations and resource protection which could result in better protection of the recreation area's resources.

Lone Rock Beach Play Area

Impacts on soils and geology at Lone Rock Beach Play Area under alternative C would be the same as impacts described for these areas under the no-action alternative. Similar to Lone Rock Beach, areas authorized for off-road use at the play area would be marked and defined with improved signage and/or barriers in a manner consistent with the control of off-road use for the protection of Glen Canyon resources. The addition of a permit system would be a means to better manage off-road use in the area and provide a means to monitor use as well as educate operators about rules and regulations and resource protection.

Accessible Shorelines

Under alternative C, a total of 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles, OHVs, and street-legal ATVs by permit, subject to water-level closures. This alternative would result in the increased potential for localized impacts on soils to approximately 7,300 acres of ORV areas that would be open to off-road use by conventional motor vehicles, OHVs, and street-legal ATVs at the accessible shorelines. The degree of impacts could be severe in specific areas with soil K factors indicating a higher susceptibility to erosion, such as at Bullfrog North and South.

Continued off-road use by conventional motor vehicles combined with the additional off-road use by OHVs and street-legal ATVs would lead to changes in soil structure due to the crushing and shearing of the soil substrate, resulting in soil compaction and accelerated erosion. These impacts would occur at and near the accessible shoreline areas. Approximately 258 acres of Farb-Pagina type soils would be directly disturbed at shoreline areas

under this alternative (see table 29). With increased off-road use, soils in already disturbed areas would be prevented from recovering through the reestablishment of erosion-mitigating vegetation.

Under this alternative, areas authorized for use at the shorelines would be marked and defined in a manner and defined with improved signage consistent with the control of off-road use for the protection of Glen Canyon resources, including soil and geological features. All ORV users would require a permit to operate at accessible shorelines and would be permitted to drive off-road only from the end of the road directly to the shoreline areas; soils along this path between the roads and shorelines would continue to be impacted. Requiring all operators desiring to travel off-road to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations and resource protection which could result in better protection of the recreation area's resources. Although increased motor vehicle use at accessible shorelines would result in the potential for more widespread and higher-intensity adverse impacts on soils and geology.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on all GMP roads in Glen Canyon, including roads within the Orange Cliffs Unit. Impacts on soils and geology from increased use on unpaved GMP roads under alternative C would be similar to the impacts described for the no-action alternative. Direct impacts would occur up to 33 feet (10 meters) from the road centerline. As under the no–action alternative, approximately 714 acres of the most common soils at Glen Canyon, including approximately 240 acres of moderately-erodible soils of the Farb-Pagina soil complex, would be directly impacted on GMP roads under alternative C. Indirect impacts (those from 33 feet (10 meters) to approximately 200 feet (60 meters)) would take place on approximately 3,428 acres of the most common soils at Glen Canyon, including approximately 1,167 acres of moderately-erodible soils of the Farb-Pagina soil complex. Although the geographic extent of impacts would be identical, assuming an accompanying increase in motor vehicles operating on GMP roads, impacts under alternative C would be potentially greater than the no-action alternative because of the addition of OHVs on unpaved GMP roads as well as OHVs and street-legal ATVs on unpaved GMP roads in the Orange Cliffs Unit. No impacts on soils would result from vehicle use on paved GMP roads because these roads have an asphalt top and no soils that would be disturbed, and it is assumed that vehicles will travel on the roadways and not contribute to erosion at roadway edges.

Ferry Swale

The designation of ORV routes (approximately 15 miles) in Ferry Swale could increase damage to soils and geologic resources along those routes because motor vehicle use would be concentrated to the 15 miles, but would be beneficial to segments of unauthorized user-created routes where its use would cease. Where unauthorized user-created routes become designated ORV routes, soils would be even more susceptible to damage from compaction, resulting in accelerated runoff potential that would lead to higher rates of erosion. Direct disturbances within 12 feet of either side of the route centerline in Ferry Swale would occur over approximately 0.2 acres of moderately erodible Farb-Pagina type soils, while indirect disturbances to these soils (i.e., those disturbances occurring over an area from 12 feet to approximately 200 feet [60 meters] of the route centerline) would equate to approximately 5 acres under this alternative (see table 29). Whereas previously, unauthorized off-road use would create dispersed, short-term effects on soils, alternative C would concentrate off-road impacts in specific areas along designated routes. Over the long- term, this would cause continued damage that could constitute a substantial level of impact on soils in the area due to their relative susceptibility to erosion.

Mitigation measures under this alternative would be similar to those in other ORV areas such as Lone Rock Beach, Lone Rock Beach Play Area, and accessible shorelines, and would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on soils and geology to some degree by limiting driving outside of designated ORV routes s, thereby limiting erosion and compaction outside of authorized areas.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect soils and geology under the no-action alternative would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the adverse impacts on soils and geology under alternative C, would result in long-term adverse cumulative impacts on soils and geology. However, the beneficial impacts on soils and geology accruing from greater protection of these resources provided under alternative C would provide long-term beneficial cumulative impacts.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Under alternative D, Lone Rock Beach would remain open to conventional motor vehicles, however, OHVs or street-legal ATVs would not be allowed. In areas of the beach where access with conventional motor vehicles is allowed, soils on approximately 250 acres would continue to experience impacts from shearing and compaction, leading to a greater potential for erosion. Soils at Lone Rock Beach include those classified as Farb-Pagina rock outcrop complex, with a soil K factor of 0.37, indicating a moderate susceptibility to erosion. Impacts in these areas would be adverse and considerable. Soils at Lone Rock Beach could benefit some from the recovery time provided by the reduction of activity because of no OHVs or street-legal ATVs would be allowed on the beach under alternative D. Soils in impacted areas of Lone Rock Beach would not have a greater chance of full recovery because vegetation in areas would continue to be impacted by conventional motor vehicle use. The potential for further soil erosion could be diminished. Over the long term, these beneficial effects could become readily apparent in areas of previous disturbance.

Lone Rock Beach Play Area

Under alternative D, off-road use at Lone Rock Beach Play Area would be discontinued and the area restored to natural conditions. Impacts on soils and geology at Lone Rock Beach Play Area under alternative D would be the same as impacts described for these areas under alternative B.

Accessible Shorelines

Under alternative D, off-road use at a total of 11 accessible shoreline areas would be discontinued permanently, whereas four (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp, approximately 1,100 acres) would be open only to conventional motor vehicles by permit, subject to water-level closures. No acres of Farb-Pagina type soils would be directly disturbed at the shoreline areas authorized for use under this alternative (see table 29).The cessation of off-road use in these 11 areas would allow soils in impacted areas to recover through a reprieve from routine compaction and by the reestablishment of erosion-mitigating native vegetation. Improvements to soils would be most notable in areas of currently heavy off-road use. It can be anticipated, however, that the loss of 11 accessible shoreline areas could result in those visitors relocating to other shoreline areas where off-road use is permitted; therefore, impacts on resources could increase at the four open accessible shorelines as demand for access and visitation to those sites increase. As a consequence, damage to soils and geologic features at Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp could be intensified beyond current levels. In these areas, soils would be damaged by compaction, resulting in accelerated runoff potential that would lead to higher rates of erosion, resulting in substantial to severe levels, but contained within the accessible shoreline area, of impacts because of the increased intensity of use in these areas. These impacts would be adverse, both short and long term and localized, occurring at the four specific accessible shoreline locations rather than being more widespread over the entire Glen Canyon area. Mitigation measures under this alternative would be the same as under alternative C, and would include improved signs and communication/education with partners and

users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on soils and geology to some degree by limiting driving outside of designated ORV areas, thereby limiting erosion and compaction outside of authorized areas.

Travel on GMP Roads in Glen Canyon

Under alternative D, there would be no direct impacts on soils on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on soils from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

Under alternative D, no ORV routes would be designated. Direct and indirect impacts on soils and geology in Ferry Swale would be similar to alternative B. Soils in Ferry Swale would benefit from the recovery time provided by the cessation of off-road activities. Mitigation measures would result in closure and barricading of unauthorized routes. As a result, levels of erosion and soil compaction would be reduced and eventual restoration would occur in areas of prior disturbance, resulting in beneficial impacts on soils at the recreation area.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to affect soils and geology under the no-action alternative would occur. As a result of discontinuation and non-designation of ORV routes, however, adverse impacts on soils and geology under alternative D would be greatly reduced compared to those described for alternative A. The impacts of cumulative actions, in combination with the beneficial impacts on soils and geology accruing from greater protection of these resources provided under alternative D, would result in long-term beneficial cumulative impacts.

Alternative E: Mixed Use

Lone Rock Beach

Impacts on soils and geology at Lone Rock Beach under alternative E would be similar to the impacts described for this area under alternative C. Under this alternative, impacts on soils and geology through shearing, compaction and erosion resulting from vehicle use would continue to occur with ongoing off-road use by conventional motor vehicles, OHVs, and street-legal ATVs. The prohibition of motor vehicles on a portion of the beach (approximately 20-acre vehicle-free zone) could slightly lessen impacts on soils. Although no substantial beneficial effects would accrue over time from this restriction, the cessation of motor vehicle use within the designated 20 acre vehicle-free area would produce benefits from decreased potential for soil shearing, compaction, and erosion.

Lone Rock Beach Play Area

Impacts on soils and geology at Lone Rock Beach Play Area under alternative E would be similar to the impacts described for this area under alternative C.

Accessible Shorelines

Under alternative E, off-road use at one accessible shoreline area would be discontinued permanently (Warm Creek). Fourteen areas (12 existing areas plus Paiute Farms and Nokai Canyon) would remain open to conventional motor vehicles and street-legal ATVs (approximately 6,000 acres), only by permit, subject to water-level closures. Under this alternative, the cessation of off-road use at Warm Creek would allow the soils in impacted areas to

recover through a reprieve from routine compaction and by the reestablishment of erosion-mitigating vegetation. Improvements to soils would be most notable in areas of currently heavy off-road use.

The loss of one shoreline access area is not anticipated to result in substantial impacts on resources at the other 14 accessible shorelines as a result of increased demand for access and visitation to those sites because the remaining areas could absorb the increased demand without additional disturbance of resources. Moreover, damage to soils and geologic features at 12 of the authorized accessible areas and Paiute Farms and Nokai Canyon is not likely to intensify to severe levels because only street-legal ATVs would be introduced. However, with the continued use of shoreline access sites, soils would remain impacted and damaged through compaction, and the resulting accelerated runoff potential would continue to occur, leading to higher rates of erosion and resulting in substantial levels of impacts. Approximately 270 acres of Farb-Pagina type soils would be directly disturbed at shoreline areas under this alternative (see table 29). These impacts would be adverse, both short and long term and localized, occurring at the authorized accessible shorelines rather than being widespread over the entire Glen Canyon area. Mitigation measures under this alternative would be the same as under alternatives C and D, and would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on soils and geology to some degree by limiting driving outside of designated ORV areas, thereby limiting erosion and compaction outside of authorized areas.

Travel on GMP Roads in Glen Canyon

Under alternative E conventional motor vehicles and street-legal ATVs, would be authorized to operate on paved GMP roads in Glen Canyon. OHVs and street-legal ATVs would also be authorized on unpaved GMP roads. No OHVs or street-legal ATVs would be allowed on any road segments of the Orange Cliffs Unit. Direct and indirect impacts on soils would be similar to alternative C. Soils near unpaved GMP roads in these areas would remain compacted from ongoing use, with a higher proportion of impacts directly within 12 feet of the road centerlines. The effects of erosion as a result of runoff from compacted areas, as discussed for other alternatives, would continue to impact areas immediately adjacent to roads, particularly near culverts and in areas of steeper terrain. No direct impacts on soils would result from vehicle use occurring on paved GMP roads because these roads contain no soils that would be disturbed and it is assumed that vehicles will travel on the roadways and not contribute to erosion at roadway edges.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 12 miles of designated ORV routes in the Ferry Swale area. Impacts on soils in this area would be the same as to those expected under alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to affect soils and geology under the no-action alternative would occur, and cumulatively considerable actions under alternative E would be the same as those described for alternative A. The impacts of these actions, in combination with the adverse impacts on soils and geology under alternative E, would result in long-term adverse cumulative impacts on soils and geology. However, the beneficial impacts on soils and geology accruing from greater protection of these resources provided under alternative E would provide long-term beneficial cumulative impacts. As a result, overall there would be negligible cumulative effects regardless of whether they are adverse or beneficial in character.

CONCLUSION

Table 29 below provides additional detail regarding the amounts of disturbance to various soils types under each alternative.

TABLE 29: COMPARISON OF IMPACTS ON SOILS ACROSS ALTERNATIVES*

Select Soil Types	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Accessible Shorelines (acres impacted)					
Farb-Pagina-Rock outcrop complex	258.3	0	Same as alternative A	0	270.2
Moenkopie-Rock outcrop complex	26.0		Same as alternative A	6.8	Same as alternative A
Myton very gravelly sandy loam	120.4		Same as alternative A	8.8	Same as alternative A
Pagina-Denazar complex	49.5		Same as alternative A	0	75.2
Rock outcrop-Needle complex	31.7		40.7	Same as alternative C.	Same as alternative C
Rock outcrop-Torriorthents complex	151.0		Same as alternative A	42.8	134.1
Sheppard sand	42.1		Same as alternative A	0	Same as alternative A
Somorent family-Rock outcrop complex	84.4		Same as alternative A	38.0	84.8
Torriorthents-Rock outcrop-Badland complex	59.6		Same as alternative A	0	Same as alternative A
Tsaya-Rock outcrop complex	35.0		Same as alternative A	1.0	Same as alternative A
TOTAL	858	0	867	138	888
Ferry Swale (acres impacted)					
Farb-Pagina-Rock outcrop complex	Direct: 40.6 Indirect: 527.0	Direct: 0 Indirect: 0	Direct: 0.2 Indirect: 4.6	Direct: 0 Indirect: 0	Same as alternative C
Juanalo family-Rock outcrop complex	Direct: 0 Indirect: 4.0		Direct: 0.2 Indirect: 4.0		Same as alternative A
Needle-Sheppard complex	Direct: 4.7 Indirect: 71.7		Direct: 12.6 Indirect: 174.9		Same as alternative C
Pagina-Denazar complex	Direct: 131.8 Indirect: 1,445.6		Direct: 4.8 Indirect: 80.3		Same as alternative C
Rock outcrop-Needle complex	Direct: 7.5 Indirect: 89.0		Direct: 12.8 Indirect: 184.0		Same as alternative C
Rock outcrop-Torriorthents complex	Direct acres impacted: 0.1 Indirect acres impacted: 2.9		Direct: 0.4 Indirect: 9.1		Same as alternative C

Select Soil Types	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Sheppard sand	Direct: 15.5 Indirect 205.9		Direct: 3.2 Indirect: 48.4		Same as alternative C
TOTAL (direct)	200	0	34	0	34
TOTAL (indirect)	2,346	0	505	0	505
Unpaved GMP Roads (acres impacted)					
Farb-Pagina-Rock outcrop complex	Direct: 239.9 Indirect: 1,167.2	Same as alternative A	Same as alternative A	0	Same as alternative A
Moenkopie-Rock outcrop complex	Direct: 32.4 Indirect: 151.7	Same as alternative A	Direct: 57.4 Indirect: 176.7	0	Same as alternative A
Myton very gravelly sandy loam	Direct: 45.7 Indirect: 213.2	Same as alternative A	Direct: 70.7 Indirect: 238.2	0	Same as alternative A
Juanalo family-Rock outcrop complex	Direct: 101.5 Indirect: 489.2	Same as alternative A	Same as alternative A	0	Same as alternative A
Needle-Sheppard complex	Direct: 24.9 Indirect: 123.7	Same as alternative A	Same as alternative A	0	Same as alternative A
Pagina-Denazar complex	Direct: 261.4 Indirect: 1,241.6	Same as alternative A	Same as alternative A	0	Same as alternative A
Sheppard sand	Direct: 7.7 Indirect: 41.8	Same as alternative A	Same as alternative A	0	Same as alternative A
TOTAL (DIR)	713.5	713.5	763.5	0	713.5
TOTAL (IND)	3,428.4	3,428.4	3,478.4	0	3,428.4

*Note: For the purpose of supporting the narrative discussion, only pertinent soil types are provided in the table. These are the most common and highly representative of soils generally found within the park unit. Direct impacts apply to soils contained within 12 feet (3.6576 meters) on either side of designated ORV route centerlines at Ferry Swale and within 33 feet (10.0584 meters) on either side of road centerlines on paved and unpaved GMP roads. Indirect impacts apply to soils contained within an area between 12 feet (3.6576 meters) and 196.85 feet (60 meters) on either side of route centerlines at Ferry Swale and between 33 feet (10.0584 meters) and 196.85 feet (60 meters) on either side of road centerlines on GMP roads.

As described above, impacts to soils from off-road use and on-road OHV use may include erosion, compaction, and sedimentation. The severity of impacts to soils varies by type of use and location. Understanding the significance of these impacts requires a closer look at the context in which these impacts occur.

Impacts to soils from on-road OHV use are not expected to be severe or significant, because roadways have been designed and engineered to be driven upon, and soils existing along these routes have been disturbed previously through blading, compaction, and other earthmoving activities required for road construction and routine maintenance. The most severe impacts to soils from on-road OHV use are likely to occur where moderately erodible Farb-Pagina soils exist. Unpaved GMP roads roughly occur on approximately 240 acres of that soil type.

Off road use at accessible shorelines would also cause erosion, rutting, sedimentation and other adverse impacts to soils. These impacts would be highly noticeable, apparent, and severe at the higher use accessible shorelines, such as Bullfrog North and South and Stanton Creek. Moderately erodible Farb-Pagina type soils at Bullfrog North and South would experience repeated use and may not readily recover from ongoing impacts. Past off-road use at these areas contribute to degraded soils, also make impacts at these locations more severe. However, these impacts are concentrated to certain portions within authorized accessible shorelines and generally do not extend beyond authorized areas.

Impacts to soils at Lone Rock Beach and Play area are extremely severe. Farb–Pagina type soils found in these areas do not readily recover from repeated disturbance and the soil structure has been significantly altered. For this reason, Glen Canyon has intentionally confined off-road use of this type to the play area in order to ensure that this level of impact does not occur in any other location in Glen Canyon. Off-road use at the play area severely impacts roughly 120 acres of the moderately erodible soils type at the play area.

Impacts on soils in Ferry Swale under alternative A, under which the most miles of ORV routes would be designated (approximately 53 miles, approximately 1 acre), are not likely to be severe because, although the direct effects of off-road use would continue, use would be confined to these existing routes. Soils outside of these routes would not be impacted. Additionally, under the action alternatives, Glen Canyon would mitigate impacts to soils by using signage, additional enforcement, and closures to ensure additional erosion does not occur outside designated routes.

In conclusion, in some areas, like the Ferry Swale area, soils are likely significantly degraded from past and present uses such as grazing and illegal off-road use. Future uses in this area, such as the Lake Powell Pipeline construction and ongoing maintenance of existing utilities have created and would likely continue to create severely degraded soils. Significant adverse impacts on soils are likely already occurring regardless of whether any off-road use is authorized. Alternatives A, C, D and E, which would authorize off-road use, would contribute to those significant impacts on soils. However, the authorization of off-road use and on-road OHV use within Glen Canyon by itself is not significant, because adverse impacts to soils from these uses would contribute only a small fraction of the overall adverse soil impacts. The total footprint of impacts on soils from off-road use estimated under alternative C, the alternative authorizing the most use, (from direct and indirect impacts along unpaved GMP and ORV routes in Ferry Swale and at accessible shorelines) is 19,970 acres. This represents less than 2% of the total 1,249,934 acres of soils within the park unit. Impacts to soils along accessible shorelines make up a tiny part of the 2,000 mile shoreline of Lake Powell. And finally, narrowing the context to soil type, the soil type most impacted by off-road use and on-road OHV use under any alternative is the moderately erodible Farb-Pagina. Even under the alternative authorizing the most use, less than 1% of the 66,766 acres of this soil type are impacted by use that would be authorized under this plan.

VEGETATION

GUIDING REGULATIONS AND POLICIES

The Park Service seeks to maintain all native plant populations in parks as part of the natural ecosystem, including the natural abundance, diversity, dynamics, distribution, and habitats of native plants (NPS 2006a). The Park Service is directed to minimize human impacts on native plants, populations, communities, and ecosystems, as well as the processes that sustain them (NPS 2006a, Section 4.4.1). This protection against impacts extends to individual plants as genetic parts of larger species communities and populations (NPS 2006a, Section 4.4.1.1).

Executive Order 13112, “Invasive Species,” directs federal agencies to prevent the introduction of invasive species and not to take actions that the agency believes are likely to cause or promote the introduction or spread of invasive species. NPS *Management Policies 2006* states that exotic (nonnative) species will not be allowed to displace native species if possible (NPS 2006a). The Park Service works to prevent the introduction of nonnative species (NPS 2006a, Section 4.4.1.1) and to restore natural systems, specifically including the removal of nonnative species and the restoration of native plants (NPS 2006a, Section 4.1.5).

The Strategic Plan for Glen Canyon NRA and Rainbow Bridge NM FY2008 – FY2012 (NPS 2007e) identifies restoring lands to natural conditions and controlling lands infested with nonnative, invasive species as management goals for Glen Canyon.

Methodology and Assumptions

The primary sources of information for assessing impacts on vegetation included information from Glen Canyon's botanist, site visits, and material from published literature for similar environments, and information from scientists with the Park Service to determine the likely effects on species present in Glen Canyon. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Context

The geographic study area for vegetation is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

Alternative A: No Action

Off-road use affects desert vegetation in two ways: first, of the five primary resources required to support terrestrial vegetation, three—water, mineral nutrients, and a porous medium for physical support—are derived directly from the soil. As soils are damaged, they lose the ability to support desert vegetation. Second, off-road use causes direct damage that includes the crushing of foliage, root systems, and seedlings; the uprooting of small plants; and the disruption of large plant root systems by shearing and compaction of desert soils (Luckenbach and Bury 1983). The extent of these existing conditions at Glen Canyon is discussed in detail in chapter 3.

Deserts and arid regions generally are considered areas of low productivity. Vegetation is slow growing and sparse, a reflection of the environmental stresses present in arid and semiarid environments. Damage to desert vegetation can be immediate and long lasting.

Scientific studies have reported a highly negative response by perennial desert vegetation to most types and intensities of off-road use. Smaller plants can be destroyed at very low levels of off-road use and larger, more resilient plants will succumb to damage following repeated impacts. In arid climates, areas that sustain heavy off-road use have been observed to have little to no vegetation, suggesting that the severity of damage to vegetation is directly correlated with the intensity of off-road use (Bury 1980; Luckenbach and Bury 1983).

Direct damage also clearly affects vegetation species, primarily blackbrush. Most species are capable of recovering from direct contact with ORVs; however, blackbrush does not reestablish after the elimination of the species. Due to the loose sandy soils of these areas, ORV tracks tend to fade away within a few years, allowing soil nutrients and vegetation species the opportunity to recover or return (Spence n.d.).

The introduction and spread of nonnative, invasive species by ORVs is also a concern. Invasive species are a significant threat, displacing native plant species and threatening the biodiversity and overall productivity of the desert environment. Off-road use and vehicle use in general have been shown to contribute to the introduction and establishment of invasive and nonnative species in three ways: expansion or creation of routes and trails, disturbance to previously undisturbed soils, and direct transportation of seeds into new areas (Switalski and Jones 2008).

Although off-road use may not account for ecologically significant nonnative seed dispersal, off-road use has been shown to transport seeds (Rooney 2005). A study by Lacey et al. (1997) demonstrated that a single vehicle engaging in off-road use is capable of distributing 2,000 knapweed seeds in one 10-mile trip. In another study, the number of seeds collected from a single vehicle during four sampling times over one year ranged from 513 to 1,330 (Schmidt 1989).

Although Glen Canyon possesses a significant variety of vegetation, vegetation species that are of particular concern are those located below 5,000 feet above sea level, in the area of off-road use. Vegetation in these areas is dominated by blackbrush and shadscale, with smaller populations of sand sage and Cutler-Mormon-tea and grasslands. To assess the potential effects of off-road use on desert vegetation, the planning team developed a GIS map using vegetation community layers to show which vegetation communities exist in ORV routes and areas and have the most potential to be affected (see chapter 3, figure 11, "Vegetation of Glen Canyon National Recreation Area").

Lone Rock Beach

Adverse impacts on vegetation at Lone Rock Beach would continue based on continued off-road use by conventional motor vehicles, OHVs, and street-legal ATVs at the beach. Vegetation communities consisting primarily of grasses, weeds and bushes at the beach were previously covered when the lake was inundated, killing all native plants. When the lake water receded a new colonization of vegetation communities began, much by exotic species. These communities have historically been physically impacted through vegetation crushing, as well as being impacted from the loss of the ability of soils to provide habitat for remaining vegetation species as a result of off-road use. Due to these impacts, minimal vegetation communities remain and are primarily exotic. However, for those native communities that do exist, damage from off-road use would continue and dependent on the magnitude of continued use could potentially increase, resulting in the destruction of native vegetation at the beach, which could be a severe adverse impact. In addition to vegetation destruction through crushing, continued impacts on soils would remove the ability of soils to provide suitable conditions for vegetation communities (Switalski and Jones 2008), further restricting the ability of vegetation to exist in the area. Continued off-road use would also increase the likelihood for the spread of nonnative, invasive species.

Lone Rock Beach Play Area

At the Lone Rock Beach Play Area there is unrestricted use by all types of motor vehicles - conventional motor vehicles, OHVs, and street-legal ATVs. Under alternative A, impacts on vegetation would continue to occur with ongoing unrestricted motor vehicle use. Vegetation communities in the play area have historically been physically impacted by unrestricted off-road use through crushing, as well as being impacted by the loss of the ability of soils to provide habitat for remaining vegetation species. Due to these impacts, minimal vegetation communities remain. However, for those that do exist, damage would continue and potentially increase, resulting in the destruction of all vegetation in the area, which would be a severe adverse impact. In addition to vegetation destruction through crushing, continued impacts on soils would remove the ability of soils to provide habitat for vegetation communities, further restricting the ability of vegetation to exist in the area. Continued off-road use would also increase the likelihood for the spread of nonnative, invasive species.

Accessible Shorelines

The no-action alternative would result in continued impacts on vegetation at approximately 5,900 acres of open accessible shorelines; however, this is a relatively small area in comparison to the entire approximately 2,000 miles of shoreline in Glen Canyon. Impacts would be primarily to blackbrush (416 acres), sand sagebrush (933 acres) and shadscale (612 acres), however similarly to above this is a relatively small portion of the overall amounts of these vegetation types in comparison to the approximately 291,180 acres, 101,440 acres, and 203,730 acres respectively for each vegetation type. Under alternative A, 13 accessible shorelines would remain open to off-road use by conventional motor vehicles only (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, Hite Boat Ramp, and White Canyon). The operation of any OHVs or street-legal ATVs would continue to be prohibited in the 13 shoreline areas. However, because alternative A would maintain current management practices related to the accessible shorelines, there could be occasional off-road use of unauthorized areas, further impacting vegetation in the following ways: direct physical impacts from off-road use through crushing on vegetation species, and indirect

impacts from altering the soil structure to a level that cannot support vegetation and possibly transporting nonnative, invasive species into areas where they currently do not exist.

Many vegetation communities in the area of the accessible shorelines are newly colonized and primarily consist of a number of exotic vegetation species as identified in chapter 3, as previous native vegetation was eliminated when the lake was inundated. The new vegetation has then been previously disturbed and considerably impacted by off-road use. Disturbance has ranged from minimal impacts, such as minor physical damage (e.g., light vegetation crushing where the survival of the individual vegetation plants [or local survival of the vegetation species] is not in question), to vegetation being completely destroyed. Although the majority of vegetation in these areas has been removed or destroyed as a result of off-road use and lake fluctuations, some vegetation communities do still exist. These communities typically consist primarily of native blackbrush, sand sagebrush, and shadscale. Because conventional motor vehicles are permitted to travel off-road, depart Glen Canyon roads and drive directly to the shoreline, and park in designated areas, the vegetation communities that exist in these areas would continue to be directly physically impacted through being crushed, with severe adverse impacts such as complete vegetation destruction possible.

Continued off-road use and potential use would likely negatively impact soils through compaction, the creation of gullies in the soil and the increased potential for erosion, and therefore the prevention or weakening of the soil's ability to distribute minerals and water to vegetation communities. The weakening of the soil structure also weakens the physical support of vegetation, causing further damage to vegetation, with the severity of the impacts depending on the severity of the impacts on soils. Continued off-road use also leaves open the possibility of nonnative, invasive species being brought into the areas, causing further stresses to existing native species and resulting in further adverse impacts on vegetation. In addition, there is some damage to vegetation at several shorelines above 3,700 feet by illegal off-road use, especially at Farley Canyon. The potential for illegal off-road use at these areas could continue to result in vegetation crushing and destruction to primarily blackbrush and shadscale equating to adverse impacts on vegetation.

The accessible shoreline areas were established at a time when Lake Powell was at or near full pool. When the water level of Lake Powell is at these higher elevations, each designated ORV area is bounded by natural topographical features, resulting in a confined space for off-road use. Because the Lake Powell water level has dropped in recent years, more topography has been exposed at the ORV areas. In some instances the designated ORV area is no longer bounded by natural features, resulting in land beyond the designated area being accessed by ORVs as off-road recreational visitors seek access to the lake.

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively discontinue the off-road use of shoreline areas. Currently off-road use has been temporarily discontinued at Warm Creek, Crosby Canyon, and Bullfrog North and South due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. Such closures would curtail the potential for additional acres of vegetation to be impacted by off-road driving. In areas that have previously not been affected by off-road use, vegetation is often present and undisturbed. Off-road use in these areas when lake levels decrease would cause damage to these vegetation communities, with impacts ranging from minimal, such as limited areas of vegetation being crushed by vehicles but not to the extent where the survivability of the species is impacted, to more intense, such as the complete destruction and removal of a species in the area. The Paiute Farms and Nokai Canyon accessible shorelines (approximately 1,400 acres of the approximately 5,900 acres of accessible shoreline) are not officially open, although they are currently being accessed. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access resulting in beneficial impacts on vegetation.

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on approximately 72 miles of paved GMP roads and all unpaved GMP roads, approximately 365 miles, at Glen Canyon, with the exception of the Orange Cliffs Unit, where street-legal ATVs are not authorized for use. ATVs that do not meet the street-legal requirements under Utah and Arizona code would not be authorized to operate on any unpaved GMP road in Glen Canyon

No impacts on vegetation would result from vehicle use occurring on paved GMP roads, because paved roadways contain no vegetation. It is assumed that all vehicles will remain on the roadways during travel and will not impact vegetation that exists along the roadway edges. Impacts on vegetation along designated Glen Canyon unpaved GMP roads would likely be contained to already disturbed areas, where there is currently minimal vegetation, with the highest proportion of impacts directly within 33 feet (10 meters) of the road centerlines. Indirect impacts would occur between 33 feet (10 meters) and approximately 200 feet (60 meters) on either side of the road centerline. Vegetation that exists along roadway edges could be physically impacted through crushing or destruction from vehicle pass-bys and shoulder pull-offs. Impacts as a result of these actions would be minimal as long as the vehicles remain on the existing roads. Direct and indirect impacts on soils on either side of the road would continue and would reduce the ability of soils to provide habitat for vegetation. However, because the vegetation in the area has been previously impacted and motor vehicle use (conventional motor vehicles and street-legal ATVS) would continue to be contained to the already disturbed unpaved GMP designated roads where minimal vegetation exists, no new notable harm to vegetation would occur. Direct impacts would occur primarily to blackbrush and shadscale, impacting approximately 791 and 595 acres respectively. However, when compared to these vegetation types as a whole as presented above for accessible shorelines, the overall amount of vegetation impacted is relatively small.

Ferry Swale

In Ferry Swale, in the area of Vermilion Cliffs there are areas with unauthorized user-created routes over which ORVs travel before crossing onto federal lands administered by the BLM. Under the no-action alternative, approximately 53 miles of these user-created ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs.

Under alternative A, approximately 1 acre of shadscale and 1 acre of fourwing saltbush would be adversely impacted by vegetation crushing, destruction, the reduced ability of soils to provide habitat for vegetation species along the 53 miles of designated ORV routes. However, vegetation in the area of the designated ORV routes is limited, as much of the area consists of rock outcrops and previously existing vegetation is scarce based on prior disturbance and destruction from previous off-road use. Based on soil compaction and the established nature of existing ORV routes, impacts on vegetation would likely be contained to the edges of already disturbed areas. As a result, the continued use of conventional motor vehicles, OHVs, and street-legal ATVs would not result in notable harm to soils on these surfaces.

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect vegetation. A number of these activities have led to beneficial impacts on vegetation, and these impacts would continue into the future from the development and implementation of the following plans or actions.

- The 1979 Glen Canyon GMP and a planned new GMP, which set forth to appropriately manage Glen Canyon resources, including native vegetation.

- The release and effects of tamarisk beetles to control the invasive tamarisk, and the Escalante Watershed Partnership, which is removing the invasive species Russian Olive.
- 1981 Environmental Assessment/Development Concept Plan for Lone Rock Beach (Lone Rock Beach EA/DCP), 1988 Environmental Assessment/Development Concept Plans for Lake Powell's Accessible Shorelines (Accessible Shorelines EA/DCP), 1986 Environmental Assessment/Development Concept Plan for San Juan Marina at Paiute Farms (EA/DCP), 2008 Uplake Development Concept Plan/Environmental Assessment (Uplake DCP/EA) which provide guidance for development and use in various locations across Glen Canyon and work to control invasive vegetation species and minimize impacts on natural vegetation.
- Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan which determines how the backcountry areas of Glen Canyon should be managed and provides direction on the management and protection of vegetation.
- Development of the Interim Management Plan for Lone Rock Beach Play Area, which determined the existing use of the play area by ORVs.

Site-specific adverse impacts may also result from these management plans that physically impact vegetation or reduce the ability of vegetation to survive, primarily through including where ORVs can be operated and which accessible shoreline areas are open to visitor use. For vegetation communities in areas where off-road use is permitted, those vegetation species may experience adverse physical impacts from crushing and adverse impacts from the loss of the ability of soils to provide for these species, which can occur through off-road and visitor use and as a result of the tamarisk beetles.

Additional actions include the development of the BLM Arizona Strip Office Travel Management Plan, development and operation of the Amangiri Resort, and the Lake Powell Pipeline Project. These actions physically impacted and continue to impact vegetation in the footprint of construction and through visitor activities, measurably reducing the amount of native vegetation species in the vicinity of Glen Canyon, resulting in severe site-specific adverse impacts.

Current and future BLM projects include the update and implementation of resource management plans and travel management plans for the Monticello and Hanksville field offices. These projects would have beneficial impacts on vegetation, similar to the existing management plans.

The Programmatic EIS for Oil Shale and Tar Sands Development in Utah would lead to adverse impacts on vegetation in and around the footprint of the sites and associated activities of the sites. Current and future projects within Glen Canyon include the development and implementation of group use permits for Hole-in-the-Rock Road. Such projects would provide beneficial impacts by limiting the amount of users and ORVs in the area and their potential impacts on vegetation. Severe site-specific adverse impacts would result from allowing access to the area, potentially impacting vegetation.

Actions like the installation of Portable Decontamination Facility for zebra mussels and Fee Station Improvements at Lone Rock Beach would likely provide some site-specific severe adverse impacts on vegetation, through the physical removal or damage to vegetation in or around the footprint of the sites. It is expected however, that all sites would avoid existing natural vegetation to minimize potential adverse effects. The new GMP, interim ORV plan, and experimental and management plan for Glen Canyon Dam would provide both beneficial and adverse impacts on vegetation depending on the amount of vegetation affected and the amount protected.

Improvements to road and ORV routes for utility access by the Coconino County, Arizona DOT, special use permits for filming and photography, illegal off-road use both at Glen Canyon and on adjacent lands, the reintroduction of bighorn sheep, grazing, associated vehicle use, and administrative off-road use all have the potential to have site-

specific adverse impacts on vegetation in the footprints of grazing and animal movements, route improvements, and in the footprint of off-road use.

Rising and falling water levels as a result of natural fluctuation and dam operations exposes both more and less of the shorelines. When the shoreline is exposed, vegetation is exposed and subjected to possible severe site-specific adverse impacts from off-road use. When the shoreline submerged, severe adverse impacts result from submerging and destroying vegetation.

The potentially adverse impacts resulting from activities and actions as noted above would likely be severe, although site specific, and not significant to the overall region. These actions, in combination with the continuation of adverse impacts on vegetation by ORV activities under alternative A, would result in long-term adverse cumulative impacts on vegetation within Glen Canyon, with alternative A slightly contributing.

Alternative B: No Off-road Use

Lone Rock Beach

Under alternative B, off-road use at Lone Rock Beach would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs; and the area restored to natural conditions. Vegetation at Lone Rock Beach would benefit by having the opportunity to recover in the absence of motor vehicle disturbance. Previously disturbed vegetation communities would have the opportunity to recover and beneficial impacts on soils would further benefit vegetation communities, allowing new communities the opportunity to grow in the improved soil conditions. These benefits would extend to approximately 250 acres at Lone Rock Beach. However, because of the severity of previous disturbance, primarily from the vegetation communities being eliminated by fluctuating water levels and from off-road use, beneficial impacts on vegetation may not be realized for a substantial length of time, if at all. In addition, the spread of nonnative, invasive species to these areas through ORVs would be reduced by the prohibition of these vehicles, resulting in further long-term beneficial impacts.

Lone Rock Beach Play Area

Similar to Lone Rock Beach, off-road use at the Lone Rock Beach Play Area would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs; and the area restored to natural conditions. Impacts at Lone Rock Beach Play Area would be similar to those at Lone Rock Beach.

Accessible Shorelines

Discontinuing off-road use at all 15 accessible shorelines (approximately 7,300 acres in total) at Glen Canyon under alternative B would allow for vegetation that has historically been impacted by off-road use to recover. Currently existing vegetation is primarily made up of exotic species because previous vegetation has been eliminated when the lake was inundated. However, both exotic and native vegetation that remains and that has been impacted would no longer be crushed by motor vehicle use. In addition, soil that has been previously impacted would regain the ability to provide habitat for native vegetation, though recovery time would depend on vegetation type as well as amount and degree of previous disturbance. Beneficial effects from the removal of motor vehicle disturbance would vary between shorelines based on the amount of previous impacts from off-road use to vegetation. However, it is expected that because of the already sparse vegetation in these areas and the difficulty of survival for vegetation in the climate of Glen Canyon while competing with exotic species, beneficial impacts on native vegetation may not be realized for a substantial length of time.

Travel on GMP Roads in Glen Canyon

Under alternative B, conventional motor vehicles and street-legal ATVs would be allowed to operate on all paved and unpaved GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit, where street-legal ATVs would not be allowed. Vegetation would continue to be impacted as described for alternative A.

Ferry Swale

No off-road use would be allowed in Ferry Swale to access adjacent BLM lands. Vegetation that has historically been impacted by off-road use, primarily consisting of fourwing saltbush and shadscale, would recover. In the same way as described previously in this section for Lone Rock Beach, Lone Rock Beach Play Area, and the accessible shorelines, vegetation in Ferry Swale would benefit from the recovery time provided by the cessation of off-road activities in Glen Canyon u. It is important to note that the cessation of off-road use could result in the increase of exotic species in the area as these species would also benefit from the recovery time. In the event of exotic species colonizing the area, there could be severe adverse impacts on native vegetation.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to affect vegetation would occur, and impacts would be the same as described under alternative A. The impacts of these actions, in combination with the adverse impacts on vegetation under alternative B, would result in long-term, site-specific severe adverse cumulative impacts on vegetation, with alternative B having a minimal contribution. Under alternative B, beneficial impacts on vegetation would occur, and when combined with the beneficial impacts of the cumulative actions, would provide long-term cumulative benefits to vegetation.

Alternative C: Increased Motorized Access

Lone Rock Beach

Impacts on vegetation at Lone Rock Beach under alternative C would be similar to the impacts described for this area under the no-action alternative. However, impacts would be somewhat reduced with the implementation of mitigation measures including an ORV permit, improved signs, communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, closures, and additional restrictions on vehicle type or other alterations to use. Under this alternative, impacts on vegetation would continue to occur with ongoing off-road use, resulting in long-term adverse impacts.

Lone Rock Beach Play Area

Impacts on vegetation at Lock Rock Beach Play Area under alternative C would be similar as those described under the no-action alternative. Under this alternative, long-term adverse impacts on vegetation would continue to occur with ongoing unrestricted off-road use at the play area. Similar to Lone Rock Beach, impacts on vegetation at the play area would be somewhat reduced with the implementation of mitigation measures including an ORV permit, improved signs, communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, closures, and additional restrictions on vehicle type or other alterations to use.

Accessible Shorelines

Under alternative C, a total of 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles, OHVs, and street-legal ATVs by permit, subject to water-level closures. This alternative could result in the increased potential for localized impacts on an additional 7,300 acres

of designated shorelines, with some areas containing vegetation, with the greatest impacts on blackbrush (416 acres), sand sagebrush (933 acres) and shadscale (612 acres), all relatively small portions of the overall vegetation community presence as discussed under alternative A. In addition, vegetation at these shorelines is newly colonized and primarily of exotic vegetation species because previous vegetation was eliminated when the lake was inundated. However, some native species do still exist. The degree of impacts could be severe in specific areas with already weakened vegetation that has previously been crushed but still exists, which is therefore more susceptible to being completely destroyed. Similarly, soils that are currently experiencing reductions in their ability to provide habitat for vegetation may have this ability further inhibited. In addition, in areas where high quantities of vegetation exist there is a potential for severe localized adverse impacts based on the larger number of vegetation communities possibly affected.

The addition of OHVs and street-legal ATVs at accessible shorelines, combined with continued off-road use by conventional motor vehicles, would lead to an increase in physical damages through crushing of vegetation, increase the possibility for the spread of nonnative, invasive species, and increase damage to the soil structure, reducing the ability of soils to provide for vegetation. These impacts would occur at and near the accessible shoreline sites.

Under this alternative, impacts on vegetation on accessible shoreline areas would be reduced through mitigation measures, similar to those that would be implemented at Lone Rock Beach and the play area. The implementation of a permit system would result in revenue to provide education and awareness to ORV users regarding proper off-road use, resulting in the potential for a reduction of adverse impacts on vegetation from off-road use.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on all GMP roads in Glen Canyon including the Orange Cliffs Unit. Similar to alternatives A and B, vegetation on and along the unpaved GMP roads would remain physically impacted by ongoing use, resulting in long-term adverse impacts. Primary vegetation types directly impacted are blackbrush (791 acres) and shadscale (595 acres), both relatively small portions when compared to the amount of these vegetation types at Glen Canyon as a whole. The potential for the spread of nonnative, invasive species and the loss of the soil's ability to provide habitat for vegetation communities would continue under this alternative. Impacts under alternative C is expected to be greater than those presented under alternatives A or B due to the addition of OHVs on roads and OHVs and street-legal ATVs in Orange Cliffs Unit. Impacts on vegetation in the Orange Cliffs area would be similar to those presented above; however, because impacts would be spread over a larger area, impacts as a result of this alternative would be more regional than localized when compared to alternatives A or B. No impacts on vegetation are expected as a result of vehicle use on paved GMP roads as these roads contain no vegetation, and it is assumed that vehicles would travel on the roadways and not adversely impact existing vegetation outside the roadway boundaries.

Ferry Swale

Off-road use (by conventional motor vehicles, OHVs, and street-legal ATVs) would be authorized on approximately 15 miles of designated ORV routes in Ferry Swale. The designation of approximately 15 miles of ORV routes could increase damage to vegetation. In areas of designated ORV routes, vegetation would be even more susceptible to physical damage and vegetation that was not previously disturbed would now be disturbed as a result of trail widening, with the highest proportion of impacts directly within 12 feet of the route centerlines, primarily impacting shadscale (approximately 1 acre). In addition, damage to soils and the increased potential for soil erosion as a result of runoff from compacted areas could have further detrimental impacts on vegetation on and adjacent to routes. Under this alternative, designating ORV routes in Ferry Swale would result in continued damage to vegetation in concentrated areas. In addition, there would be an increased risk of nonnative, invasive species

entering the area and of a decline in the ability of the soil to provide habitat for the shadscale and golden buckwheat vegetation communities. Overall impacts would be long-term and adverse.

Mitigation measures under this alternative would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. An ORV permit would also be required by ORV users. These measures would likely reduce adverse impacts on vegetation to some degree by limiting driving outside of designated ORV routes and thereby limiting the potential for direct physical impacts and limiting impacts on soils. Limiting impacts allows for soils to recover and provide for vegetation communities outside of designated areas. In addition, the restoration of native plants would provide some beneficial impacts as the planting of native plants works to prevent and diminish the presence of exotic plants that would otherwise colonize the area and outcompete native plants.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect vegetation would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with localized adverse impacts on vegetation at accessible shorelines, Lone Rock, and Lone Rock Beach Play Area under alternative C, would result in long-term, adverse cumulative impacts on vegetation, with alternative C having a sizeable impact. Under alternative C, no severe adverse impacts would occur at Ferry Swale and on unpaved GMP roads and, when combined with the adverse impacts of cumulative actions, would result in no severe adverse impacts with alternative C having a slight contribution.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Under alternative D, Lone Rock Beach would be open only to conventional motor vehicles, only. OHVs and street-legal ATVs would not be allowed. Vegetation communities at Lone Rock Beach were previously eliminated when the lake was inundated, killing all native species and being recolonized by primarily exotic species. Vegetation at Lone Rock Beach would benefit from a reduction of motor vehicle use. Vegetation in impacted areas of Lone Rock Beach would recover because vegetation could be allowed to reestablish in areas of former impacts and the potential for further impacts would be diminished. Impacts on vegetation at Lone Rock Beach from the continued use of conventional motor vehicles would still occur but would not be expected to be substantial.

Lone Rock Beach Play Area

Under alternative D, off-road use by all motor vehicles would be permanently discontinued in the Lone Rock Beach Play Area and the area would be restored to natural conditions. Impacts on vegetation at the play area would be the same as under alternative B.

Accessible Shorelines

Under alternative D, off-road use at a total of 11 accessible shoreline areas would be discontinued permanently, whereas four accessible shorelines (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp, totaling approximately 1,100 acres) would be open only to conventional motor vehicles by permit, subject to water-level closures. Vegetation at the 11 accessible shorelines is primarily made up of exotic species as native species were previously eliminated when the lake was inundated. Under this alternative, the prohibition of off-road use would allow the vegetation at these 11 locations to recover, resulting in beneficial impacts on vegetation. The ability of the vegetation to recover and the time needed to do so would depend on the amount of damage existing in each of the accessible shoreline areas. The cessation of off-road use would allow vegetation in impacted areas to recover due to the absence of vegetation crushing by vehicles. The removal of disturbance would also have beneficial impacts on

soils, which would increase the ability of the soil to provide habitat for vegetation communities. It can be anticipated, however, that the loss of 11 accessible shoreline areas to off-road use could result in impacts on resources at the four other sites because the demand for access and visitation to those sites would increase. However, because the majority of conventional motor vehicle users typically already use these four sites, the specific impacts from intensified use could include a slightly higher potential for vegetation destruction, as well as an increased amount of vegetation potentially being physically damaged through crushing from increased off-road use. Soil could lose the ability to provide habitat for vegetation and the spread of nonnative, invasive species would increase, resulting in substantial to severe levels of impacts depending on the amount of traffic. Vegetation types impacted in these four accessible shorelines include blackbrush (166 acres), fourwing saltbrush (219 acres), and shadscale (215 acres), all relatively minor portions of these vegetation types when compared to Glen Canyon as a whole.

Mitigation measures for the four authorized accessible shorelines under this alternative would be the same as under alternative C, and would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on vegetation to some degree by limiting driving outside of designated ORV areas. Overall impacts at the four remaining accessible shorelines would be long-term and adverse, based on the potential of substantial destruction of vegetation species.

Travel on GMP Roads in Glen Canyon

Under alternative D, there would be no direct impacts on vegetation on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on vegetation from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

Under alternative D, no off-road use would be allowed in Ferry Swale. Impacts would be the same as under alternative B.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to affect vegetation would occur, and impacts would be the same as described for alternative A. As a result of discontinuation and non-designation of ORV routes, however, adverse impacts on vegetation would be greatly reduced compared to those described under alternative A. The impacts of these actions, in combination with the beneficial impacts under alternative D and when mixed with the beneficial impacts of the cumulative actions, would result in long-term cumulative benefits to vegetation. The severe adverse impacts on vegetation at the three remaining accessible shorelines under alternative D would result in long-term, likely severe adverse cumulative impacts on vegetation, with alternative D having a slight impact.

Alternative E: Mixed Use

Lone Rock Beach

Impacts on vegetation at Lone Rock Beach under alternative E would be similar to the impacts described for the area under alternative C. The designation of 20 acres of the beach as a vehicle-free zone would provide a slight beneficial impact on vegetation, but no substantial beneficial effects on vegetation on the whole would accrue over time from this restriction as much of the vegetation has been previously destroyed, leaving little vegetation remaining for recovery. The cessation of motor vehicle use in these 20 acres would produce benefits to soils from the loss of physical destruction and allow for greater soil productivity in the area.

Lone Rock Beach Play Area

Impacts on vegetation at Lone Rock Beach Play Area under alternative E would be the same as the impacts described for the area under alternative C.

Accessible Shorelines

Under alternative E, off-road use would be permanently discontinued at one accessible shoreline area (Warm Creek), and 14 areas would be open to motor vehicle use by permit (12 existing areas plus Paiute Farms and Nokai Canyon which would be open to conventional motor vehicles and street-legal ATVs only [approximately 6,000 acres]) subject to water-level closures. At these areas vegetation communities are primarily made up of exotic species because previous vegetation communities were eliminated when the lake was inundated. Under this alternative, the permanent discontinuation of vehicle entry into the Warm Creek shoreline access site would allow vegetation at this location to recover. In addition, at these locations the likelihood of nonnative, invasive species spreading could be reduced and the soil would regain its ability to provide habitat for vegetation communities.

The loss of only one shoreline access area is not anticipated to result in substantial impacts on resources at the 14 other sites as a result of increased demand for access and visitation to those sites. Damage to vegetation at the 12 accessible shoreline areas, as well as Paiute Farms and Nokai Canyon, would not intensify notably beyond current levels. However, with the continued off-road use at the accessible shoreline areas, vegetation would remain physically impacted and damaged, the likelihood of nonnative, invasive species spreading would be increased, and the ability of soil to provide habitat for vegetation would decrease. The additional mitigating measure of a permit system and associated components to better control off-road use and educate users would reduce the intensity of such impacts. Primary vegetation types impacted include blackbrush (688 acres) and shadscale (1,561 acres), both relatively small portions of these vegetation groups when compared to Glen Canyon as a whole.

Mitigation measures under this alternative would be the same as under alternatives C and D, and would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on vegetation to some degree by limiting driving outside of designated ORV areas.

Travel on GMP Roads in Glen Canyon

Under alternative E conventional motor vehicles and street-legal ATVs would be authorized to operate on all paved GMP roads in Glen Canyon. OHVs and street-legal ATVs would also be authorized on unpaved GMP roads, with the exception of the Orange Cliffs Unit where OHVs and street-legal ATVs would not be allowed. Vegetation in these areas would remain physically impacted from ongoing off-road use, the inclusion of OHVs and street-legal ATVs in addition to conventional motor vehicles, and the crushing of vegetation, with the highest proportion of impacts directly within 33 feet of the road centerlines. The highest intensity of impacts would occur on blackbrush (791 acres) and shadscale (595 acres), both relatively small amounts when compared to Glen Canyon as a whole. The likelihood of nonnative, invasive species spreading through motor vehicle use would be increased and the ability of soils to provide habitat for vegetation would be decreased. Overall impacts on vegetation would be long-term and adverse. No direct impacts on vegetation are expected as a result of vehicle use on paved GMP roads as these roads contain no vegetation and it is assumed that vehicles would travel on the roadways and not adversely impact existing vegetation outside the roadway boundaries.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 15 miles of designated ORV routes in the Ferry Swale area. Impacts on vegetation would be the same as those under alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to affect vegetation would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the severe adverse impacts on Lone Rock Beach and Lone Rock Beach Play Area and the adverse impacts on Ferry Swale and unpaved GMP under alternative E, would result in severe adverse cumulative impacts on vegetation with alternative E having a slight affect. The severe beneficial impacts on vegetation at the two accessible shorelines where off-road use would be discontinued and the beneficial impacts on unpaved GMP roads under alternative E, when combined with the beneficial impacts of cumulative actions would results in beneficial impacts with alternative E having a slight affect.

Conclusion

Table 30 provides additional detail regarding the acres of various vegetation types disturbed under each alternative.

Table 30: Summary of Impacts on Vegetation Communities*

Select Vegetation Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Accessible Shorelines (acres impacted)					
Blackbrush	416	0	688	166	Same as alternative C
Blackbrush-Shadscale	58		Same as alternative A	0	Same as alternative A
Fourwing Saltbrush	345		Same as alternative A	219	288
Fremont Cottonwood	279		Same as alternative A	0	Same as alternative A
Shadscale	612		1,684	215	1,561
Sand Sagebrush	933		Same as alternative A	0	Same as alternative A
Total	**2,643**	**0**	**3,987**	**601**	**3,808**
Unpaved GMP Roads (acres impacted)					
Big Sagebrush	Direct: 8 Indirect: 38	Same as alternative A	Same as alternative A	0	Same as alternative A
Blackbrush	Direct: 791 Indirect: 3,857	Same as alternative A	Direct: 916 Indirect: 4,479		Same as alternative A
Blackbrush-Shadscale	Direct: 135 Indirect: 734	Same as alternative A	Same as alternative A		Same as alternative A
Fourwing Saltbrush	Direct: 410 Indirect: 1,934	Same as alternative A	Direct: 581 Indirect: 2,750		Same as alternative A
Mat Saltbrush	Direct: 98 Indirect: 484	Same as alternative A	Same as alternative A		Same as alternative A
Pinyon-Juniper	Direct: 425 Indirect: 2,095	Same as alternative A	Direct: 744 Indirect: 3,665		Same as alternative A
Sand Sagebrush	Direct: 53 Indirect: 266	Same as alternative A	Same as alternative A		Same as alternative A

Select Vegetation Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Shadescale	Direct: 50 Indirect: 237	Same as alternative A	Direct: 99 Indirect: 470		Same as alternative A
Shadscale	Direct: 595 Indirect: 2,855	Same as alternative A	Direct: 639 Indirect: 3,084		Same as alternative A
Torrey-Mormon-Tea	Direct: 19 Indirect: 76	Same as alternative A	Direct: 37 Indirect: 151		Same as alternative A
Total	**Direct: 2,821** **Indirect: 14,091**	**Direct: 2,821** **Indirect: 14,091**	**Direct: 3,310** **Indirect: 16,121**	**0**	**Direct: 2,821** **Indirect: 14,091**
Ferry Swale (acres impacted)					
Fourwing Saltbush	Direct: 1 Indirect: 23	0	Direct: 0 Indirect: 0	0	Direct: 0 Indirect: 0
Shadscale	Direct: 1 Indirect: 20		Same as alternative A		Same as alternative A
Total	**Direct: 2** **Indirect: 43**	**0**	**Direct: 1** **Indirect: 20**	**0**	**Direct: 1** **Indirect: 20**

*Note: For the purpose of supporting the narrative discussion, only pertinent vegetation types are provided in the table. These are the most common and highly representative of vegetation generally found within the park unit. Direct impacts apply to vegetation contained within 12 feet (3.6576 meters) on either side of designated ORV route centerlines at Ferry Swale and within 33 feet (10.0584 meters) on either side of road centerlines on paved and unpaved GMP roads. Indirect impacts apply to vegetation contained within an area between 12 feet (3.6576 meters) and 196.85 feet (60 meters) on either side of route centerlines at Ferry Swale and between 33 feet (10.0584 meters) and 196.85 feet (60 meters) on either side of road centerlines on GMP roads.

As described above, impacts to vegetation from off-road use and on-road OHV use, may include crushing of foliage, root systems and seedlings, the uprooting of small plants, and the disruption of large plant root systems by shearing and compaction of desert soils (Luckenback and bury 1983). The severity of impacts to vegetation varies by type of use, vegetation, and location. Understanding the significance of these impacts requires a closer look at the context in which these intense impacts occur.

Impacts to vegetation, like soils, is not expected to be severe or significant on paved and unpaved GMP roads, because roadways have been designed and engineered to be driven upon, and vegetation existing along these routes have been disturbed previously through blading, compaction, and other earthmoving activities required for road construction and routine maintenance. Impacts would continue to vegetation remaining in the roads and along the roadway edges and would further reduce the ability of soils to provide habitat. Primary vegetation types impacted include blackbrush and shadscale, however the amount of area impacted (916 acres and 639 acres respectively) is relatively small.

Off road use at accessible shorelines would also cause adverse impacts described above to vegetation. These impacts would be highly noticeable, apparent, and severe at the higher use accessible shorelines, such as Bullfrog North and South and Stanton Creek. Past off-road use at these areas contribute to degraded soils and vegetation and make impacts at these locations more severe. Vegetation types with the highest impacts would be blackbrush, sand sagebrush, and shadscale. Impacts along accessible shorelines are concentrated to certain authorized areas within authorized accessible shorelines where few vegetation communities remain and those that do remain are typically nonnative, with use generally not extending beyond authorized areas.

Impacts to vegetation at Lone Rock Beach and Play area are extremely severe. Farb–Pagina type soils found in these areas are subjected to repeated disturbance and the soil structure has been significantly altered. Because of the significant damage to the soil structure, limited vegetation is found in this area. For this reason, Glen Canyon

has intentionally confined off-road use of this type to the play area in order to ensure that this level of impact does not occur in any other location in Glen Canyon. Off-road use at the play area severely impacts roughly 120 acres.

Impacts on vegetation in Ferry Swale under alternative A, where approximately 53 miles of ORV routes would be designated, are not likely to be significant because, while the direct impacts of off-road use would continue, vehicle travel would be constrained to formalized routes and illegal use would be monitored. Similarly, impacts on vegetation as a result of alternatives C and E (where 15 miles would be designated as ORV routes) are not anticipated to be significant. Although there is vegetation in these ORV routes, the amount impacted would be exceptionally small, approximately 1 acre, when compared to the remainder of Glen Canyon.

In conclusion, in some areas, like the Ferry Swale and the Lone Rock Beach areas soils are likely significantly degraded from past and present uses such as grazing and legal and illegal off-road use. Future uses in this area, such as the Lake Powell Pipeline construction and ongoing maintenance of existing utilities have created and would likely continue to create severe impacts to vegetation. Significant adverse impacts on vegetation are likely already occurring regardless of whether any off-road use is authorized. Alternatives A, C, D, and E, which would authorize off-road use, would contribute to those significant impacts on vegetation. However, the authorization of off-road use and on-road OHV use within Glen Canyon by itself is not significant, because adverse impacts to vegetation from these uses would contribute only a small fraction of the overall adverse vegetation impacts. The total footprint of impacts on vegetation from off-road use estimated under alternative C, the alternative authorizing the most use, (from direct and indirect impacts along unpaved GMP and ORV routes in Ferry Swale and at accessible shorelines) is 19,970 acres. This represents less than 2% of the total 1,249,934 acres of soils within the park unit. Impacts to vegetation along accessible shorelines make up a tiny part of the 2,000 mile shoreline of Lake Powell. And finally, narrowing the context to vegetation type, the vegetation type most impacted by off-road use and on-road OHV use under any alternative is the blackbrush, sand sagebrush, and shadscale vegetation types. Even under the alternative authorizing the most use, less than 1% any of these vegetation types are impacted by use that would be authorized under this plan.

WILDLIFE AND WILDLIFE HABITAT

GUIDING REGULATION AND POLICIES

The NPS Organic Act, which directs parks to conserve wildlife unimpaired for future generations, is interpreted by the agency to mean that native animal life should be protected and perpetuated as part of a park's natural ecosystem.

As with plants, NPS *Management Policies 2006* directs NPS to maintain all native animal populations in parks as part of the natural ecosystem, including the natural abundance, diversity, dynamics, distribution, habitats, and behaviors of native wildlife (NPS 2006a, Section 4.4.1). The Park Service is directed to minimize human impacts on native animal populations, communities, and ecosystems, as well as the biological and evolutionary processes that sustain them (NPS 2006a, Section 4.4.1.2).

The Glen Canyon Strategic Plan (NPS 2007e) states, "The climate and physical features of Glen Canyon NRA have created local environments favorable to the reservation of scientifically important objects, sites, populations, habitats or communities that are significant in and of themselves or provide opportunities to add to our understanding of past or ongoing events."

METHODOLOGY AND ASSUMPTIONS

For the purposes of this analysis, only those wildlife species and their habitats known to be present in Glen Canyon and that may experience some level of impact as a result of management actions are addressed in this section. The

primary method for assessing impacts on wildlife species was to determine which species may inhabit areas likely to be affected by the management actions described in this plan/DEIS.

For each alternative, potential impacts on wildlife and wildlife habitat were evaluated based on the pattern of proposed use at Glen Canyon National Recreation Area, resulting from what areas are open to off-road use and other recreational uses and for what duration, and the nature of habitats and species present. Primary steps in assessing impacts on wildlife and wildlife habitat were to determine (1) the potential for species to occur in habitats likely to be affected by management actions described in the alternatives; (2) current and future use and distribution of ORVs by alternative and their adherence to NPS rules and regulations; (3) habitat impact or alteration caused by the alternatives; and (4) disturbance potential of the action and the potential to directly or indirectly affect wildlife or wildlife habitat as a result of off-road use activities.

The professional judgment of NPS staff, published literature, and information from scientists from NPS, U.S. USFWS, and Utah Division of Wildlife Resources was used to determine the likely effects on species present in Glen Canyon. Although not specific to Glen Canyon, the analysis relied on documentation of impacts of relatively early use of ORVs in desert ecosystems similar to those at Glen Canyon. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Federally and state-listed species (including state species of concern) are addressed in the "Special-status Species" section of this chapter.

Context

The geographic study area for wildlife and wildlife habitat is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

Alternative A: No Action

Relatively early use of ORVs in desert ecosystems, like those found at Glen Canyon, can be destructive, causing long-lasting damage to terrestrial and aquatic ecosystems, wildlife, soils, and hydrologic flows (New Mexico EMNRD et al. 2008). Studies of off-road use in the southwest have reported adverse impacts on wildlife and wildlife habitat due to fragmentation, habitat destruction, harassment, noise, and direct mortality. For example, amphibians and reptiles have been crushed to death or injured by off-road use on public lands (Bury and Luckenbach 2002). In desert ecosystems, reptiles, especially snakes, are known to favor roads and trails as thermoregulation sites, which puts them at risk of death from vehicles running over them (Rosen and Lowe 1994; Rudolph 2000). ORVs have been demonstrated to decrease population densities of reptiles, small mammals, and bird populations. In general, habitat fragmentation reduces the size of patches of desert, forest, shrublands, wetlands, and grasslands. This reduces the total area of contiguous habitat available for wildlife species, especially birds, and increases the isolation of the habitat (Campbell and Johns n.d.), resulting in changes to forage and cover, flows of energy and nutrients, and even the microclimate of the area. Other adverse effects of habitat fragmentation include genetic effects and the potential for local extinctions, shifts to invasive species, and increased likelihood of uncharacteristic predation as well as increased exploitation by humans (New Mexico EMNRD et al. 2008).

Other risks range from injury during escape responses to the more-severe habitat avoidance and nest abandonment. Havlick (2002) cited studies that indicated wildlife including birds, reptiles, and large ungulates respond to disturbance with accelerated heart rate and metabolic function, and suffer from increased levels of stress. These factors can lead to displacement, mortality, and reproductive failure. For example, it is possible that an increase in the frequency of tail loss among lizards could result from stress caused by increased off-road use. Tail loss is an escape mechanism usually correlated to predator density and stress. This impact is significant because females without tails produce fewer eggs than those with tails. Thus, tail loss could likely lead to reduced

survivorship and fecundity (Luckenbach and Bury 1983). Further research regarding the adverse effects of human recreational activities among bird species has shown nest desertion and temporary abandonment, and changes in foraging habits (Joslin and Youmans 1999). Bowles (1995, cited in New Mexico EMNRD et al. 2008) notes that noise is an environmental stressor that can induce startle responses, aversion, and maladaptive behaviors; cause changes in habitat use, communication, predation, foraging, energetic, courtship, breeding, and reproduction; and produce stress responses such as changes in heart rate and energy consumption, and hearing loss.

Luckenbach and Bury (1983) explored the effects on wildlife by comparing ORV areas with areas that excluded off-road use. They found non-ORV areas had 1.8 times the number of species, 3.5 times the number of individuals, and 5.8 times more biomass of reptiles than the ORV-impacted areas. Similar results were reported for rodent populations. Brooks (1999, 2000) similarly reported that nocturnal rodent density and diversity, breeding bird abundance and species richness, and lizard abundance and species richness were higher in areas that restricted off-road use compared to areas open to off-road use. ORV-related impacts on amphibian and reptile species were identified in Montana and include indirect impacts on populations via habitat destruction, chemical contamination and sedimentation, and the creation of migration barriers. Studies of small mammals have reported adverse effects from motorized vehicle use, including population reduction, habitat modification, forage/cover removal, echolocation disturbance, and energy expenditure (Joslin and Youmans 1999).

ORV noise has been shown to damage hearing sensitivity and predator detection in kangaroo rats and fringe-toed lizards (Brattstrom and Bondello 1983). In addition, spadefoot toads are known to be sensitive to ORV noise activity, because they can break aestivation, or “summer sleep,” based on sounds that mimic thunderstorm activity, such as engine noises (Schubert and Smith 2000). Noise from ORVs has been found to interfere with songbird breeding and territorial displays (Berry 1980), as well as inhibiting the senses of other animals that depend on hearing and vibration detection to survive (Berry 1980; Bury 1980); for example, bats and certain reptiles.

Additional research has focused on the effects of erosion and trampled vegetation due to visitors, and the associated impacts on wildlife habitat values (Joslin and Youmans 1999; Monz et al. 2003). Based on these results, wildlife groups found within Glen Canyon of particular interest and deemed likely to be affected by off-road use include nesting and feeding shore and wading birds, nesting and foraging raptors, and small reptiles, amphibians, and mammals.

Lone Rock Beach

Off-road driving has occurred at Lone Rock Beach since before formal establishment of the recreation area in 1972, resulting in long-term adverse impacts on wildlife from permanent changes in species’ ranges and foraging/breeding habits. Therefore, new disturbances from continued off-road use may be detectable, but would not be considerable as many species avoid areas of heavy off-road use. Adverse impacts at Lone Rock Beach would be localized and limited to designated ORV areas. Within these areas, species and habitat disturbance would continue to be apparent and species mortality could occur, especially for smaller mammals, amphibians, and reptiles.

The no-action alternative would result in localized adverse impacts on approximately 250 acres of wildlife and wildlife habitat at Lone Rock Beach from continued off-road use, by conventional motor vehicles, OHVs, and street-legal ATVs. Motor vehicles may only be operated from the operator’s camping location to the Lone Rock Beach Play Area only to access the play area. Off-road use at Lone Rock Beach could result in species disturbance and displacement, as well as habitat destruction and vehicle-wildlife collisions.

Birds nesting on or near the ground at Lone Rock Beach (e.g., black-throated sparrow, sage sparrow, mourning dove, loggerhead shrike) would likely be more vulnerable to the effects of motorized vehicles, due to direct exposure of nests and young to visitors and motorized vehicles. Vehicle-wildlife collisions or frequent escape response events (e.g., flushing) could increase species injury or mortality. Shorebirds that use Lone Rock Beach for

foraging and resting are at particular risk because they are some of the longest distance migratory birds and, as such, the energy demands of migration are extreme (Madsen 1995). Disturbance results in birds being forced to flush while they are foraging or resting. Frequent escape flights result in a reduction in time spent foraging and a reduction in fuel stores spent during times of flying (Stolen 2003). The level of impact this causes is dependent upon the species and the level of disturbance. Although some species may be deterred from using the beach area in heavy off-road use areas, there is ample habitat throughout the rest of the area that is suitable for foraging and resting to minimize the overall impacts on shorebirds.

Peregrine falcons are known to nest on Lone Rock Beach and occasionally forage over the ORV area (Spence n.d.). Lone Rock Beach includes potential habitat for burrowing owl, which is a sparse summer resident of deep sandy slopes and rock outcrops in the Wahweap area (NPS n.d.a; Spence n.d.).

Short- and long-term adverse impacts on birds in the area would result from the noise created by ORVs. As described above, noise is an environmental stressor that can induce startle responses, aversion, and maladaptive behaviors; cause changes in habitat use, communication, predation, foraging, bioenergetics, courtship, breeding, and reproduction; and produce stress responses such as changes in heart rate and energy consumption.

Lone Rock Beach Play Area

The no-action alternative would result in localized adverse impacts on wildlife and wildlife habitat at the Lone Rock Beach Play Area from the continued high-intensity unrestricted use of conventional motor vehicles, OHVs, and street-legal ATVs at this 180-acre area. Impacts on wildlife from off-road use include species disturbance and displacement, habitat destruction, and vehicle-wildlife collisions causing species injury or mortality. Birds nesting or foraging in the area (e.g., peregrine falcon, burrowing owl) would be more vulnerable to the effects of motorized vehicles at the play area, due to exposure of nests and young to visitors and noise from motorized vehicles. Similar to Lone Rock Beach, ORVs have been used at Lone Rock Beach Play Area since before formal establishment of the recreation area in 1972, resulting in long-term adverse impacts on wildlife from permanent changes in species' ranges and foraging/breeding habits. Therefore, new disturbances from continued off-road use may be detectable, but would not be considerable as many species avoid areas of heavy off-road use.

Accessible Shorelines

Off-road use under alternative A would result in continued impacts on a relatively limited portion of the Lake Powell shoreline in comparison to the entire approximately 2,000 miles of shoreline available at Glen Canyon. Alternative A, would result in localized adverse impacts on wildlife and wildlife habitat at accessible shorelines from continued off-road use. Under alternative A, 13 accessible shoreline areas would remain open to conventional motor vehicle use (approximately 5,900 acres), subject to water level closures. The operation of any OHV or street-legal ATV would not be allowed at the 13 shoreline areas. These accessible shoreline areas are not play areas (climbing hills in vehicles, driving at high speeds, and similar behavior would not be authorized), but rather areas intended to provide public conventional motor vehicle access to the Lake Powell shoreline for purposes of primitive recreational use. The public would be allowed to depart the road and drive directly to the shoreline and park in designated areas. As a result, adverse impacts on wildlife and wildlife habitat would be localized within ORV areas.

A variety of common species have the potential to occur at or near all shoreline areas, including rodents, lizards, snakes, rabbits, coyotes, foxes, and bobcats. Impacts on wildlife from off-road use include species disturbance and displacement, habitat destruction, and vehicle-wildlife collisions causing species injury or mortality. Birds nesting on or near the ground at accessible shoreline areas would likely be more vulnerable to the effects of motorized vehicles, due to direct exposure of nests and young to visitors and motorized vehicles. Some of the more vulnerable species include the lark sparrow, horned lark, burrowing owl, and lesser nighthawk that build their nests on the ground or use rodent burrows, as well as loggerhead shrikes and black-throated sparrows that build their nests in

low shrubs (Medin 1986 and Berry 1980). Migratory shorebirds could be vulnerable to motorized vehicle disturbance, resulting in birds being forced to flush while they are foraging or resting. Although some species may be deterred from using the accessible shoreline areas with heavier vehicle use, adverse impacts are expected to be limited because there is ample undisturbed habitat available in other areas along the shoreline and within Glen Canyon. Bird species would likely use those areas and avoid areas of known disturbance. For shorebirds, in particular, most accessible shorelines are associated with mud flats, sandy sites, and other areas (side canyons) that support a significant portion of available migratory shorebird habitat around Lake Powell.

Locally, along open areas, species and habitat disturbance would continue and species mortality could occur, especially for smaller mammals (e.g., mice, rats, rabbits, chipmunks) and amphibian and reptile species (e.g., lizards, snakes). As indicated in studies of off-road use in other arid ecosystems, even if all ORV users stay on designated routes, ORVs can cause erosion and stream sedimentation, transport invasive species, raise dust clouds, and disrupt and damage wildlife, as well as reduce effective habitat (New Mexico EMNRD et al. 2008). In general, routes created by ORV users can cause a patchwork of disrupted habitat often correlated with reduced ecosystem productivity (Trombulak and Frissell 2000; New Mexico EMNRD et al. 2008).

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively discontinue use of shoreline areas. Currently, Warm Creek, Crosby Canyon, and Bullfrog Creek North and South are temporarily closed due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. Reopening these areas could result in adverse impacts similar to those described above; however, the temporary closure of shoreline areas would minimize impacts on wildlife and wildlife habitat from off-road use by temporarily removing a source of localized disturbance. The Paiute Farms and Nokai Canyon accessible shorelines are not officially open, but are currently being accessed. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access, resulting in beneficial impacts on wildlife and wildlife habitats.

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on all GMP roads in Glen Canyon (there are approximately 365 miles of unpaved GMP roads and 72 miles of paved GMP roads at Glen Canyon), with the exception of the Orange Cliffs Unit, where street-legal ATVs are prohibited. Alternative A would result in long-term adverse impacts on wildlife and wildlife habitat from the use of conventional motor vehicles and street-legal ATVs on GMP roads. However, because habitat in the area has been previously impacted and would continue to be contained to the already disturbed GMP roads, impacts would be localized and minimal. Locally, along open roads, habitat disturbance and fragmentation would continue and species mortality could occur, especially for smaller mammals (e.g., mice, rats, rabbits, chipmunks) and amphibian and reptile species (e.g., lizards, snakes). Even if motor vehicles stayed on the unpaved GMP roads, they could cause erosion and stream sedimentation, transport invasive species, raise dust clouds, disrupt and damage wildlife, and reduce effective habitat (New Mexico EMNRD et al. 2008). In addition, an increase in the ambient noise level caused by traffic can reduce the distance over which acoustic signals uses for communication, navigation, avoiding danger, and finding food against a background of noise, can be detected (Parris and Schneider 2009). In general, the higher the ambient noise level, the shorter the distance from which other sounds can be heard. This concept is expressed in terms of listening area and alerting distance. In terms of impact metrics, a 3 decibels (dBA) increase in the natural ambient level is an important indicator of potential impact because it results in a 30% reduction in alerting distance for wildlife. For example, under natural ambient conditions, an owl perched in a tree may be able to hear a mouse scurrying through the brush anywhere within an area of 100 square meters of the perch. If a noise event increases the ambient level by 3 dBA, the area in which the owl can hear a mouse would decrease to approximately 70 square meters. A more detailed discussion on noise impacts is described in the “Soundscapes” section of this plan/DEIS. Prohibiting street-legal ATV use in the Orange Cliffs Unit would reduce noise-related impacts and could benefit birds (e.g., lesser nighthawk) and other species that use the wilderness habitat.

Ferry Swale

In Ferry Swale, in the area of Vermilion Cliffs, there are zones with unauthorized user-created routes over which ORVs travel before crossing onto federal lands administered by the BLM. Under alternative A, approximately 53 miles of unauthorized ORV visitor-routes would be authorized and designated for use by conventional motor vehicles, OHVs, and street-legal ATVs.

Under alternative A, wildlife in Ferry Swale would continue to experience habitat disturbance and fragmentation and species mortality could occur, especially for smaller mammals, amphibians, and reptiles. In general, routes created by ORV users can cause a patch of disrupted habitat often correlated with reduced ecosystem productivity (New Mexico EMNRD et al. 2008). Travel along the routes could cause erosion and stream sedimentation, transport invasive species, raise dust clouds, increase noise disturbances, or disrupt and damage wildlife (e.g., vehicle-wildlife collisions) (New Mexico EMNRD et al. 2008). In addition, the ability of soils along these open routes to provide suitable vegetated habitat for certain species along the 53 miles of designated ORV routes would be reduced. However, vegetation in the area of the designated ORV routes is limited, as much of the area consists of rock outcrops and existing vegetated habitat is scarce based on prior disturbance and removal from previous off-road use. Impacts on wildlife and their habitat would likely be contained to the edges of already disturbed areas. As a result, the continued use of conventional motor vehicles, OHVs, and street-legal ATVs would not result in notable harm to wildlife along these designated ORV routes.

Cumulative Impacts

Other past, present, and reasonably foreseeable future actions within and around Glen Canyon have the potential to impact wildlife and wildlife habitat. In recent years, the rising and falling water levels as a result of natural fluctuations and dam operations have exposed more or less of the accessible shoreline areas, impacting habitat available for native wildlife. Following these events, several popular accessible shoreline areas have been closed due to accessibility issues, resulting in beneficial impacts on wildlife and wildlife habitat by temporarily removing a source of disturbance (i.e., off-road use) in affected areas. Due to fluctuating lake levels, several vegetative communities are not able to establish along the shoreline; thus, limiting shoreline habitat. A wide variety of activities exist in Glen Canyon that have resulted in and continue to result in adverse impacts on wildlife and wildlife habitat. These activities include unauthorized off-road use on adjacent lands, recreational hunting and livestock grazing as allowed by the enabling legislation for Glen Canyon National Recreation Area, and special use permits for filming and photography. Unauthorized off-road use leads to disrupted and fragmented habitat, species disturbance, and direct mortality of wildlife. Recreational hunting and grazing also result in localized habitat and species disturbance (and direct mortality in the case of recreational hunting). Grazing activities, if not properly managed, can result in the reduction and degradation of available wildlife habitat due to damage or loss of vegetation resources, soil compaction, and erosion. The adverse impacts of special use permits on wildlife and wildlife habitat are much less considerable than unauthorized off-road use, since these activities are monitored and managed by NPS staff. Military overflights from nearby bases can also result in short-term limited adverse impacts on wildlife and wildlife habitat, depending on the duration and elevation of flights. Impacts may range from minor behavioral responses, such as flight/fright response, to severe changes in habitat utilization (Radle 2007).Future fee station improvements at Lone Rock Beach could result in short-term localized adverse impacts on wildlife in that area from construction-related noise, staging of equipment, and the increased presence of NPS staff and workers in areas of construction. Wildlife commonly habituates to constant noise and human disturbance levels, provided they are not harassed by people working at the site. Most wildlife would be expected to return once construction activities diminish and work is completed. Because habitat in this area has already been disturbed, few remaining species would be injured or disturbed during construction.

Short-term adverse impacts on wildlife and wildlife habitat likely resulted from the 1986 Paiute Farms/San Juan Marina DCP/EA and the 2008 Uplake DCP/EA from implementation of these plans, including construction-related noise, staging of equipment, and the increased presence of NPS staff and workers in areas of construction. Adverse

impacts such as injury, mortality, and habitat disturbance/avoidance, were localized and likely had more effect on species that occur along the shoreline (e.g., shorebirds, smaller mammals).

Beneficial impacts on wildlife and wildlife habitat have occurred, and continue to occur, from development and implementation of the 1979 Glen Canyon GMP, which identifies four management zones and management strategies for resource protection and visitor use in these zones. Planning for a new GMP would further benefit wildlife and wildlife habitat over the long term by implementing improved strategies for resource protection. Development and implementation of the 1988 Accessible Shorelines EA/DCP and 1981 Lone Rock Beach EA/DCP have resulted in long-term benefits for wildlife and wildlife habitat within Glen Canyon. These plans manage Lake Powell's shorelines in order to reduce resource degradation, visitor use conflicts, and safety hazards, resulting in long-term benefits for wildlife and wildlife habitat at accessible shoreline areas (including Lone Rock Beach). Similarly, there are several plans that describe management of recreational use within Glen Canyon—uses that could result in short-term adverse impacts on wildlife and wildlife habitat—but also share the goal of protecting resources and educating visitors on these resources, resulting in long-term benefits to wildlife and wildlife habitat:

- 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan, which determined how the backcountry areas of Glen Canyon should be managed.
- Interim off-highway vehicle (OHV) management plans at Lone Rock Beach and play area, and at accessible shorelines (2007).
- Programmatic EA for Organized Group Activities along Hole-in-the-Rock Road, which will analyze the environmental consequences of organized group activities that exceed existing group size limits along the Hole-in-the-Rock Road corridor.

Other park plans and projects have resulted in or have the potential to result in both adverse and beneficial impacts on wildlife and wildlife habitat within Glen Canyon. These include the release of tamarisk leaf beetles (*Diorhabda* spp.) to control tamarisk (*Tamarix* spp.). The tamarisk leaf beetle was released as a biological control agent in certain areas of the west in 2001 to help manage tamarisk, which is a highly invasive plant that grows along the Colorado River and in riparian habitats throughout the southwest (NPS 2009d). Although the beetle was not released in Glen Canyon, it has arrived and thrives at various locations throughout Glen Canyon. Tamarisk is known to displace native trees like cottonwood and willow, create poor habitat for birds and other wildlife, increase soil salinity, and increase risk of fire; therefore, continued defoliation of tamarisk will result in long-term beneficial impacts on wildlife and wildlife habitat (NPS n.d.g). However, there are concerns in managing tamarisk: defoliation may lead to site conditions that favor the establishment of other invasive nonnative plants, defoliation may negatively impact some insect and wildlife species, and an increased short-term fire hazard may result if the majority of tamarisk is killed in an area and dense stands of dead stems remain (NPS n.d.g). Therefore, although beneficial impacts would result over the long term, localized short-term adverse impacts on wildlife and native habitat are likely to result from the removal of tamarisk.

Similar to tamarisk, Russian olive (*Elaeagnus angustifolia*) was brought into the area as erosion control after the Dust Bowl in the 1930s. Since then, this species has spread, replacing native vegetation in Escalante and Boulder, and along the Escalante River. In general, Russian olive causes river channelization and is shading the river corridor, cooling the water temperature. Since 2000, volunteers have been working on Russian olive removal and restoration of the Escalante River watershed (Escalante River Watershed Partnership 2011). Although short-term adverse impacts are likely to result from removal efforts (i.e., noise and physical disturbances from volunteers removing trees), beneficial impacts have resulted and will continue to result for native wildlife and habitat from the removal of Russian olive along the Escalante River.

In 2007, zebra mussels, an aquatic invasive species known to significantly alter aquatic ecosystems, were discovered in Lake Mead, Utah (NPS n.d.f). This invasive species aggressively spreads and readily establishes on hard

substrates and surfaces, causing food chain disruption and economic damage by clogging intake pipes of water treatment and power plants as well as boat engine cooling systems (NPS n.d.f). Since their discovery in Lake Mead, zebra mussel infestations have been discovered in Lakes Mohave and Havasu. Currently, Lake Powell and the upper Colorado River basin are believed to be free of zebra mussels; however, quagga mussels have been located in Lake Powell. Mussels would pose a major threat to Lake Powell and the upper Colorado River if they were to become established in those areas. Mussel decontamination stations are already in place at all of the marinas within Glen Canyon (NPS n.d.f). Additionally, there is planned installation of a portable decontamination facility. Although installation/construction of decontamination facilities can temporarily disrupt wildlife nearby, ensuring that mussels are not introduced in Lake Powell and the upper Colorado River basin results in long-term beneficial impacts on wildlife and wildlife habitat, especially wildlife that depend on aquatic habitats for foraging and/or breeding (e.g., shorebirds, other local mussel populations).

Christmas bird counts within Glen Canyon result in long-term benefits for wildlife and wildlife habitat. Although the presence of NPS staff and researchers in the field likely results in minimal short-term adverse impacts (e.g., noise and crushing of vegetation), tracking population trends and species presence in Glen Canyon results in improved species management for future plans and projects.

The USFWS designation of critical habitat for the Mexican spotted owl in 2004, which includes habitat within Glen Canyon, benefits other wildlife within Glen Canyon by protecting species that utilize the same habitat as the owl. Similarly, the Utah DNR Statewide Pronghorn Management Plan (Utah DNR 2009) and BLM's updated resources management plans benefit wildlife and wildlife habitat in Glen Canyon by guiding management of natural resources and habitat in the region.

Other projects and planning actions by federal and state agencies have resulted in or would likely result in short-term adverse impacts on wildlife and wildlife habitat from implementation, including an update to the 1996 Long Term Experimental and Management Plan for Glen Canyon Dam (Bureau of Reclamation), development and update of the BLM's Travel Management Plan, and road/ORV route improvements for utility access by the Arizona DOT (Coconino County); however, over the long term, these projects and actions result in beneficial impacts for wildlife and wildlife habitat from improved management and protection of resources.

Short- and long-term adverse impacts are likely to result from future planning efforts by the state of Utah and the BLM. These future actions include a draft programmatic EIS and possible land use amendments for allocation of oil shale and tar sands resources on lands administered by the BLM in Colorado, Utah, and Wyoming, which would analyze several alternatives for land allocation and resource management. Additionally, the Utah State Board of Water Resources is proposing to build approximately 160 miles of pipeline between Lake Powell Glen Canyon dam and Cedar City. Although both plans/projects would include mitigation to protect wildlife and wildlife habitat, they could result in short- and long-term substantial impacts on wildlife and wildlife habitat from habitat destruction and fragmentation, species disturbance and mortality, and habitat avoidance.

Current and future operations of the Amangiri Resort, located on 600 acres in Canyon Point, Utah, would likely result in adverse impacts on wildlife and wildlife habitat in Glen Canyon. Construction of the resort led to habitat destruction and likely species displacement, resulting in long-term, less than considerable impacts. The resort offers a wide variety of activities for guests, and all visitors to the resort can partake in all the visitor use opportunities Glen Canyon offers. Some visitor activities (e.g., hiking, scenic flights) would continue to result in short-term adverse impacts on wildlife and wildlife habitat within Glen Canyon from species and habitat disturbance. However, impacts would be localized and minimal, because the resort occupies only a small area (in comparison to Glen Canyon as a whole) on the western edge of Glen Canyon.

The overall impact of these past, present, and reasonably foreseeable future actions would be short- and long-term adverse and considerable, as well as long-term beneficial. When combined with the long-term detectable adverse

impacts of alternative A, considerable long-term adverse and long-term beneficial cumulative impacts would result for wildlife and wildlife habitat in the area of analysis.

Alternative B: No Off-road Use

Lone Rock Beach

Alternative B would result in long-term beneficial impacts on wildlife and wildlife habitat at Lone Rock Beach from the discontinued use of this area to off-road use. Discontinuing off-road use at Lone Rock Beach would remove an existing source of disturbance for wildlife and wildlife habitat, allowing these areas to be restored to natural conditions. For the peregrine falcon and other birds in the area (e.g., burrowing owl, black-throated sparrow, sage sparrow, mourning dove, loggerhead shrike), considerable long-term beneficial impacts would result from reduced noise disturbance. Although these beneficial impacts would be localized at Lone Rock Beach at first, as the area recovers to more natural conditions, long-term beneficial impacts could be experienced Glen Canyon-wide as increased habitat becomes available for wildlife within Glen Canyon (e.g., lizards, snakes, rodents, rabbits, birds, coyotes, foxes, bobcats).

Lone Rock Beach Play Area

Alternative B would result in long-term beneficial impacts on wildlife and wildlife habitat at Lone Rock Beach Play Area from the discontinued use of this area to off-road use. Discontinuing off-road use at the play area would remove an existing source of disturbance for wildlife and wildlife habitat (including noise from ORVs), allowing these areas to be restored to natural conditions. The beneficial impacts would be localized at first, but over the long term, beneficial impacts could be experienced Glen Canyon-wide as potential habitat become available for wildlife within Glen Canyon (e.g., lizards, snakes, rodents, rabbits, birds, coyotes, foxes, and bobcats).

Accessible Shorelines

Alternative B would result in long-term beneficial impacts on wildlife and wildlife habitat at accessible shoreline areas from the discontinued use of 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) to off-road use (approximately 7,300 acres). The permanent closure of these accessible shoreline areas would remove an existing source of disturbance for wildlife and wildlife habitat (including noise from ORVs), allowing these areas to be restored to natural conditions. The beneficial impacts would be localized at first, but over the long term, beneficial impacts could be experienced Glen Canyon-wide because potential habitat would be available for wildlife within Glen Canyon (e.g., lizards, snakes, rodents, rabbits, birds, coyotes, foxes, bobcats).

Travel on GMP Roads in Glen Canyon

Impacts on wildlife from use of unpaved GMP roads under alternative B would be similar to those under alternative A, where conventional motor vehicles and street-legal ATVs would continue to operate on unpaved GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit where street-legal ATVs would not be authorized. No additional impacts on wildlife or habitat would result from vehicle use on paved GMP roads as these roads have an asphalt top and no new soils or vegetation would be disturbed. It is assumed that vehicles will travel on the roadways and will not contribute to disturbances along roadway edges. Speed limits would be established whereby reducing the speed limit on unpaved GMP roads to 25 miles per hour (mph) (or as posted) from the current 45 mph. This action may help lessen some of the adverse impacts of motor vehicle use along GMP roads by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, studies have shown that enforcing speed limits of 25 mph or less on gravel roads has a dramatic impact on lessening the fine particles (dust) that higher speeds kick up into the atmosphere (Countess 2006). Dust is harmful to living things and can inhibit the growth of plants (Trombulak

and Frissell 2000). Additionally, dirt settling into wetlands, creeks, and irrigation ditches adds to measurable sediment buildup, which can impact species habitat as the sediment is moved downstream into rivers and streams (Bratvold 2011). Prohibiting street-legal ATV use in the Orange Cliffs Unit would reduce noise-related impacts (see discussion of noise reduction benefits in the "Soundscapes" section of this plan/DEIS) and could benefit birds (e.g., lesser nighthawk) and other species that use the wilderness habitat from noise-related impacts.

Ferry Swale

Off-road use would not be authorized in Ferry Swale to access adjacent BLM lands. This would lead to a reduction in habitat disturbance and fragmentation and species mortality, especially for smaller mammals and amphibian and reptile species. Additionally, there would be a reduction in erosion and stream sedimentation, the transport of invasive species, and dust clouds.

Cumulative Impacts

Impacts on wildlife and wildlife habitat from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as those described for alternative A. The overall impact of these past, present, and future actions on wildlife and wildlife habitat would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the long-term beneficial impacts under alternative B, would result in slight long-term adverse and considerable long-term beneficial cumulative impacts on wildlife and wildlife habitat in the area of analysis.

Alternative C: Increased Motorized Access

Lone Rock Beach

The impacts of alternative C on wildlife and wildlife habitat at Lone Rock Beach would be similar to those described for alternative A. The speed limit would remain at 15 mph and quiet hours would be implemented. Enforcing the speed limit of 15 mph and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., common kingsnake, night snake, owls) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing motor vehicle user education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

The impacts of alternative C on wildlife and wildlife habitat at Lone Rock Beach Play Area would similar to those described for alternative A. Impacts on wildlife and wildlife habitat would be localized and adverse from continued off-road use from conventional motor vehicles, OHVs, and street-legal ATVs to include species disturbance and displacement, as well as habitat destruction and vehicle-wildlife collisions. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Accessible Shorelines

The impacts of alternative C on wildlife and wildlife habitat at accessible shorelines would be similar to those described for alternative A, except that 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open (approximately 7,300 acres) to conventional motor vehicles, OHVs, and street-legal ATVs,

subject to water level closures. Although Paiute Farms and Nokai Canyon are not officially open under the 1988 EA, they are currently being accessed. Therefore, adverse impacts of officially opening these two shorelines may be detectable, but would not be considerable, because many species in those areas have likely adapted to some level of off-road use, resulting in few new disturbances. As described for alternative A, species and habitat disturbance would continue and species mortality could occur, especially for smaller mammals (e.g., mice, rats, rabbits, chipmunks) and amphibian and reptile species (e.g., lizards, snakes).

Under alternative C, enforcing a speed limit of 15 mph at shoreline areas and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., common kingsnake, night snake) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to operate on all GMP roads resulting in adverse impacts on wildlife and wildlife habitat that are similar to those described for alternative A, but at potentially greater levels as a result of the addition of OHVs allowed on roads and OHVs and street-legal ATVs being allowed in Orange Cliffs Unit. Impacts on wildlife and habitat in the Orange Cliffs area would be similar to those presented above; however, because impacts would be realized over a larger area, impacts of this alternative would be more regional than localized.

Similar to alternative B, under alternative C, speed limits would be established on unpaved GMP roads. Setting the speed limit on unpaved GMP roads at 25 mph (or as posted) may help lessen some of the adverse impacts of motor vehicle use along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). By allowing OHV and street-legal ATV use in the Orange Cliffs Unit would increase noise-related impacts and could adversely impact birds (e.g., lesser nighthawk) and other species that use the wilderness habitat.

Ferry Swale

Under alternative C, approximately 15 miles of ORV routes would be designated. This would likely result in additional impacts on wildlife and wildlife habitat in the vicinity of those designated routes due to increased traffic. Adverse impacts would be localized and more detectable in areas where fewer disturbances have occurred. Short-term impacts of legalizing additional routes at Ferry Swale include species injury and mortality, as well as the physiological effects of escape responses. Long-term impacts include continued habitat disturbance and fragmentation, as well as potential changes in nesting and foraging habits.

The speed limit on designated ORV routes, for all vehicles, would be 25 mph or as posted, which may help lessen some of the adverse impacts of off-road use along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Permits would be required for use on all designated ORV routes, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Cumulative Impacts

Impacts on wildlife and wildlife habitat from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future

actions on wildlife and wildlife habitat would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the detectable long-term adverse impacts under alternative C, would result in long-term considerable adverse and long-term beneficial cumulative impacts on wildlife and wildlife habitat in the area of analysis.

Alternative D: Decreased Motorized Access

Lone Rock Beach

The impacts of alternative D on wildlife and wildlife habitat at Lone Rock Beach would be similar to those described for alternative C, except that OHVs and street-legal ATVs would not be allowed on the beach resulting in slightly less adverse impacts on wildlife and wildlife habitat from the decreased use. Prohibiting OHVs and street-legal ATVs at the beach may lessen some of the adverse impacts of off-road use on the beach, but this area would still be accessed by visitors for recreational use resulting in continued disturbance to wildlife and wildlife habitat in the area.

As described for alternative C, enforcing a speed limit of 15 mph and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., common kingsnake, night snake, owls) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

The impacts of alternative D on wildlife and wildlife habitat at Lone Rock Beach Play Area would be the same as those described for alternative B, resulting in long-term beneficial impacts on wildlife and wildlife habitat in the area as a result of the discontinuation of off-road use.

Accessible Shorelines

Under alternative D, off-road use at a total of 11 accessible shoreline areas would be discontinued permanently, whereas four areas (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp, totaling approximately 1,100 acres) would be open only to conventional motor vehicles by permit, subject to water-level closures. Long-term benefits to wildlife and wildlife habitat would result from discontinued off-road use of the 11 accessible shorelines as sources of habitat and species disturbance would be removed. The 11 shoreline areas would be restored to natural conditions and recovery of these areas could eventually reduce habitat fragmentation, especially for less transient species such as smaller mammals, reptiles, and amphibians, resulting in localized beneficial impacts. For the four accessible shorelines that would be open to conventional motor vehicles, the same localized adverse impacts would result as those described for alternative C. Locally, along open routes and areas, species and habitat disturbance would continue and species mortality could occur, especially for smaller mammals, amphibians, and reptiles.

As described for alternative C, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help mitigate some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Additionally, nocturnal species (e.g., common kingsnake, night snake) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required

for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Travel on GMP Roads in Glen Canyon

Under alternative D, there would be no direct impacts on wildlife and wildlife habitat on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on wildlife and wildlife habitat from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

The impacts of alternative D on wildlife and wildlife habitat at Ferry Swale would be the same as those described for alternative B, resulting in long-term benefits to wildlife species in the area due to the discontinuation of off-road use in the area. This could lead to a reduction in habitat disturbance and fragmentation and species mortality within Glen Canyon, especially for smaller mammals and amphibian and reptile species. Additionally, there would be a reduction in erosion and stream sedimentation, the transport of invasive species, and dust clouds.

Cumulative Impacts

Under alternative D, impacts on wildlife and wildlife habitat from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. As a result of discontinuation and non-designation of ORV routes, however, the overall impacts on wildlife and wildlife habitat would be greatly reduced compared to those described for alternative A. The impacts of cumulative actions, in combination with the detectable long-term beneficial impacts on wildlife resources under alternative D, would result in long-term beneficial cumulative impacts on wildlife and wildlife habitat in the area of analysis.

Alternative E: Mixed Use

Lone Rock Beach

Impacts of alternative E on wildlife and wildlife habitat at Lone Rock Beach would be the same as those described for alternatives C, except that approximately 20 acres of the beach would be designated as a vehicle-free zone. Restricting vehicle use within this zone could minimize some of the adverse impacts of off-road use on the beach by reducing noise, but this area could still be accessed by visitors for recreational use resulting in continued disturbance to wildlife in the area. Impacts on wildlife and wildlife habitat would still be long term, localized and adverse from continued use of the beach and ORVs accessing the area, to include species disturbance and displacement, as well as habitat destruction and vehicle-wildlife collisions.

Enforcing a speed limit of 15 mph and implementing quiet hours after 10:00 p.m. may also help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Additionally, nocturnal species (e.g., common kingsnake, night snake, owls) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

Impacts of alternative E on wildlife and wildlife habitat at Lone Rock Beach Play Area would be the same as those described for alternative C. Impacts on wildlife and wildlife habitat would be localized and adverse from continued off-road use, to include species disturbance and displacement, as well as habitat fragmentation and vehicle-wildlife

collisions. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Accessible Shorelines

The impacts of alternative E on wildlife and wildlife habitat at accessible shorelines areas would be similar to those described for alternative C, except that off-road use at Warm Creek would be discontinued, and Paiute Farms Nokai Canyon would be officially authorized for off-road use. Under alternative E, conventional motor vehicles and street-legal ATV use would be permitted at all accessible shoreline areas (approximately 6,000 acres). Prohibiting off-road use at Warm Creek would likely result in beneficial impacts from reduced traffic, noise, and emissions. Habitat near Warm Creek would be restored to natural conditions over the long term, resulting in localized, long-term benefits to wildlife occurring in that area. The authorized use of Paiute Farms and Nokai Canyon, would result in adverse impacts on wildlife occurring in those areas; however, the impacts would be minimal because these areas are currently being accessed so new disturbance is not likely to occur. A variety of common species have the potential to occur at or near all shoreline areas, including rodents, lizards, snakes, rabbits, coyotes, foxes, and bobcats.

As described for alternative C, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Additionally, nocturnal species (e.g., common kingsnake, night snake) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Travel on GMP Roads in Glen Canyon

Under alternative E, conventional motor vehicles and street-legal ATVs would be authorized to operate on paved GMP roads while conventional motor vehicles, OHVs and street-legal ATVs would be authorized to operate on unpaved GMP roads. No OHVs or street-legal ATVs would be allowed on any road segments of the Orange Cliffs Unit. The impacts of alternative E on wildlife and wildlife habitat from the use of motor vehicles on GMP roads would be similar as those described for alternative C. No additional impacts on wildlife habitat would result from vehicle use on paved GMP roads because these roads have an asphalt top and no new soils or vegetation would be disturbed. It is assumed that vehicles will travel on the roadways and not contribute to disturbances along roadway edges.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 15 miles of designated ORV routes in the Ferry Swale area. Impacts of alternative E on wildlife and wildlife habitat would be the same as those described for alternative C. Permits would be required for all designated ORV routes, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Cumulative Impacts

Impacts on wildlife and wildlife habitat from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future actions on wildlife and wildlife habitat would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the detectable long-term adverse impacts under alternative E, would

result in long-term detectable adverse and long-term beneficial cumulative impacts on wildlife and wildlife habitat in the area of analysis.

CONCLUSION

Compared to alternative A, alternative B would provide the most protection to wildlife and wildlife habitat through the prohibition of all off-road use. Under alternative B, the discontinuation of off-road use of the accessible shoreline areas, Lone Rock Beach, the Lone Rock Beach Play Area, and in Ferry Swale would allow previously disturbed areas the opportunity to recover and would increase the amount of habitat available for wildlife in Glen Canyon. Similarly, alternative D would result in a lower potential for impacts on wildlife and habitat through the prohibition of OHVs and street-legal ATVs throughout Glen Canyon by reducing physical and noise disturbance and, in some cases, mortality to wildlife in these areas.

Under alternative C, although a permitting system would result in the better management of motorized access, increased off-road use and on-road use could result in the potential for more widespread adverse impacts on wildlife and habitat through increased motorized access by conventional motor vehicles, OHVs, and street-legal ATVs, including access to the Orange Cliffs Unit. Compared to all other alternatives, alternative C would result in slightly more adverse impacts on wildlife and wildlife habitat. By officially authorizing off-road use at Paiute Farms and Nokai Canyon, designating ORV routes in Ferry Swale, and opening up GMP roads to OHVs and street-legal ATVs additional habitat and species disturbance would be detectable. The impacts of alternative E on wildlife and wildlife habitat from the use of motor vehicles on GMP roads would be similar those described for alternative C with a slight benefit of not allowing OHVs on unpaved GMP roads in the Orange Cliffs.

A variety of common species have the potential to occur in the study area including nesting and feeding shore and wading birds, nesting raptors, desert reptiles and mammals, and birds. Impacts on these wildlife from off-road use could include species disturbance and displacement, habitat destruction, and vehicle-wildlife collisions causing species injury or mortality. Species mortality would continue, especially for smaller mammals, amphibians, and reptiles. Species disturbance and displacement and vehicle-wildlife collisions would continue along roadways and edge habitat. Birds nesting on or near the ground at accessible shoreline areas would likely be more vulnerable to the effects of motorized vehicles, due to direct exposure of nests and young to visitors and motorized vehicles. Impacts in some areas would be highly noticeable, apparent, and severe, especially at specific accessible shorelines and Lone Rock Beach and Play area where soils have been severely damaged and habitat is limited.

Available wildlife habitat in Glen Canyon has been significantly impacted from past and present grazing, natural fluctuations in water levels, and illegal off-road use in isolated locations. Grazing activities, if not properly managed, can result in long-term impacts to available wildlife habitat from damage or loss of vegetation, soil compaction and erosion, and overall habitat degradation. Future uses, such as the Lake Powell pipeline construction, fee station improvements at Lone Rock Beach, and ongoing maintenance of existing utilities have physically removed or damaged existing wildlife habitat and would continue to do so in the localized respective areas regardless of off-road use or on-road vehicle travel.

However intense these impacts may be, evaluating context is necessary in order to understand the significance of the impact. For example, under alternative C, the alternative with the most use, 17 accessible shorelines would be designated, along with Lone Rock Beach and play area. Wildlife would likely be displaced at the high use areas. However, these shoreline areas make up a tiny fraction of the 2,000 miles of Lake Powell shoreline, leaving ample habitat for wildlife that chose shoreline areas. Additionally, many of the shoreline areas are likely infrequently visited, and in those areas disturbance and displacement would be limited. Additionally, impacts to wildlife from use in the Ferry Swale area constitutes approximately 1 acre of habitat in the context of the 1,249,934 acres of Glen Canyon. Finally, when evaluating the significance of impacts to wildlife on a habitat scale, it is clear that a very limited portion of habitat is impacted by uses evaluated in the plan. As noted in the vegetation section, less than 1 percent of Glen Canyon's blackbrush, sand sagebrush, and shadscale vegetation communities are impacted under

the highest use alternative. Therefore, impacts to wildlife and wildlife habitat under this plan are likely noticeable and may be severe at isolated locations, but are not likely significant in all other contexts.

SPECIAL-STATUS SPECIES

GUIDING REGULATIONS AND POLICIES

The Park Service has a responsibility to meet its obligations under the NPS Organic Act and the federal Endangered Species Act of 1973 to conserve listed species and prevent detrimental effects on listed, threatened, or candidate species as a result of any proposed action. The Endangered Species Act mandates that all federal agencies consider the potential effects of their actions on threatened and endangered species and species of special concern. If NPS determines that an action may adversely affect a federally listed species, consultation with the USFWS is required to ensure that the action would not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat.

NPS *Management Policies 2006* (NPS 2006a) state that the potential effects of agency actions will also be considered on state or locally listed species. Pursuant to Utah Division of Wildlife Resources Administrative Rule R657-48, wildlife species that are federally listed, are candidates for federal listing, or for which a conservation agreement is in place automatically qualify for the Utah Sensitive Species List. In addition to these species, the list includes "wildlife species of concern," which are species for which credible scientific evidence exists to substantiate a threat to continued population viability. Arizona lists "wildlife species of concern" for species whose occurrence in Arizona is or may be in jeopardy. Rare plants are listed in Arizona under one of five categories (highly safeguarded, salvage restricted, export restricted, salvage assessed, and harvest restricted).

METHODOLOGY AND ASSUMPTIONS

State- and federally listed species and designated critical habitat were identified through informal consultation with the USFWS and a review of state databases maintained by the Arizona Game and Fish Department and the Utah Department of Natural Resources. A list of species that are known to be present or that may exist in Glen Canyon was requested from the USFWS; the response from the Arizona Ecological Field Services Office and database searches is included in "Appendix A: Consultation and Coordination."

For the purposes of this analysis, only those species known to be present in Glen Canyon and that may experience some level of impact as a result of management actions are addressed in this section. The primary method for assessing impacts on listed species was to determine which species may inhabit areas likely to be affected by the management actions described in this plan/DEIS, and to use the professional judgment of NPS staff, informed by outside experts and available scientific literature, to evaluate the level of potential impacts on these species.

Animal Species

Sensitive animal species of particular interest and deemed likely to be affected by off-road use in Glen Canyon include nesting and feeding shore and wading birds, nesting raptors, desert reptiles and mammals, and birds. A complete list of special-status animal species analyzed in this plan/DEIS and the potential effect of this plan on those species are included in table 31.

Plant Species

Although Glen Canyon possesses a significant variety of sensitive vegetation, species of particular concern are those located below 5,000 feet (1,524 meters), in the areas of off-road use. Vegetation in these areas is dominated by blackbrush, and shadscale, with smaller populations of sandsage grassland and Torrey-Mormon-tea occurring. To

assess potential effects on desert vegetation, the planning team developed a GIS map utilizing vegetative community layers to show which vegetative communities exist in ORV routes and areas and that have the most potential to be affected.

State-listed species determined in chapter 3 to not be affected by the management actions under this plan/DEIS are not included in the impacts analysis (see chapter 3, table 6). However, as stated in chapter 3, all federally listed species were analyzed, including those that would not be affected by management actions. A complete list of special-status plant species analyzed in this plan/DEIS is included in table 31.

TABLE 31: POTENTIAL IMPACTS ON SPECIAL-STATUS SPECIES AT GLEN CANYON NATIONAL RECREATION AREA

Common Name	Scientific Name	Status	State (Utah, Arizona, or both)	Potential Overall Effect of this plan/DEIS
Mammals				
Townsend's big-eared bat	*Corynorhinus townsendii*	State species of concern	Both	
Spotted bat	*Euderma maculatum*	State species of concern	Both	
Western red bat	*Lasiurus blossevillii*	State species of concern	Both	
Western small-footed myotis	*Myotis ciliolabrum*	State species of concern	Both	
Fringed myotis	*Myotis thysanodes*	State species of concern	Both	
Long-legged myotis	*Myotis volans*	State species of concern	Both	
Yuma myotis	*Myotis yumanensis*	State species of concern	Both	
Big free-tailed bat	*Nyctinomops macrotis*	State species of concern	Both	
Desert bighorn sheep*	*Ovis canadensis nelsoni*	State species of concern	Both	MA-NLAA
Silky pocket mouse	*Perognathus flavus*	State species of concern	Utah	
Kit fox*	*Vulpes macrotis*	State species of concern	Utah	MA-NLAA
Reptiles				
Glossy snake*	*Arizona elegans*	State species of concern	Arizona	MA-NLAA
Western banded gecko	*Coleonyx variegatus*	State species of concern	Arizona	
Glen Canyon chuckwalla*	*Sauromalus obesus*	State species of concern	Both	MA-NLAA
Desert night lizard*	*Xantusia vigilis*	State species of concern	Utah	MA-NLAA
Amphibians				
Northern leopard frog	*Rana pipiens*	State species of concern	Both	
Birds				
Southwestern willow flycatcher*	*Empidonax traillii extimus*	Federally endangered	—	NE
California condor*	*Gymnogyps californianus*	Federally endangered	—	MA-NLAA

Common Name	Scientific Name	Status	State (Utah, Arizona, or both)	Potential Overall Effect of this plan/DEIS
Brown pelican*	*Pelecanus occidentalis*	Federally endangered	—	MA-NLAA
Mexican spotted owl*	*Strix occidentalis lucida*	Federally threatened	—	MA-NLAA
Yellow-billed cuckoo*	*Coccyzus americanus*	Federal candidate species	—	NE
Golden eagle*	*Aquila chrysaetos*	State species of concern	Both	MA-NLAA
Burrowing owl*	*Athene cunicularia*	State species of concern	Both	MA-NLAA
Peregrine falcon	*Falco peregrinus*	State species of concern	Both	
Pinyon jay*	*Gymnorhinus cyanocephalus*	State species of concern	Both	MA-NLAA
Bald eagle*	*Haliaeetus leucocephalus*	State species of concern	Both	MA-NLAA
Belted kingfisher	*Megaceryle alcyon*	State species of concern	Arizona	
Long-billed curlew*	*Numenius americanus*	State species of concern	Both	MA-NLAA
Virginia's warbler	*Oreothlypis virginiae*	State species of concern	Utah	
Lucy's warbler	*Oreothlypis luciae*	State species of concern	Both	
Osprey	*Pandion haliaetus*	State species of concern	Both	
American white pelican*	*Pelecanus erythrorhynchos*	State species of concern	Utah	MA-NLAA
Bell's vireo	*Vireo bellii*	State species of concern	Both	
Gray vireo*	*Vireo vicinior*	State species of concern	Both	MA-NLAA
Great blue heron*	*Ardea herodias*	Glen Canyon species of concern	—	MA-NLAA
Dusky flycatcher	*Empidonax oberholseri*	Glen Canyon species of concern	—	
Orange-crowned warbler	*Oreothlypis celata*	Glen Canyon species of concern	—	
Plants				
Brady pincushion cactus*	*Pediocactus bradyi*	Federally endangered	—	NE
Navajo sedge*	*Carex specuicola*	Federally threatened	—	NE
Jones' cycladenia*	*Cycladenia humilis* var. *jonesii*	Federally threatened	—	NE
American spikenard	*Aralia racemosa*	State species of concern	Both	
Harrison's milkvetch	*Astragalus harrisonii*	State species of concern	Utah	
Copper Canyon milkvetch*	*Astragalus cutleri*	State species of concern	Utah	MA-NLAA
Ferron's milkvetch	*Astragalus musiniensis*	State species of concern	Utah	

Common Name	Scientific Name	Status	State (Utah, Arizona, or both)	Potential Overall Effect of this plan/DEIS
Atwood's camissonia	*Camissonia atwoodii*	State species of concern	Utah	
California sawgrass	*Cladium californicum*	State species of concern	Utah	
Higgins biscuitroot	*Cymopterus higginsii*	State species of concern	Utah	
Hole-in-the-Rock prairie clover	*Dalea flavescens* var. *epica*	State species of concern	Both	
Zion shooting star	*Dodecatheon pulchellum* var. *zionense*	State species of concern	Utah	
Kachina daisy*	*Erigeron kachinensis*	State species of concern	Utah	MA-NLAA
Alcove daisy	*Erigeron zothecinus*	State species of concern	Utah	
Paria spurge*	*Euphorbia nephradenia*	State species of concern	Utah	MA-NLAA
Cataract gilia*	*Gilia imperialis*	State species of concern	Utah	MA-NLAA
Tropic goldeneye*	*Heliomeris soliceps*	State species of concern	Utah	MA-NLAA
Satintail grass	*Imperata brevifolia*	State species of concern	Utah	
Western hophornbeam*	*Ostrya knowltonii*	State species of concern	Both	MA-NLAA
Alcove rock daisy*	*Perityle specuicola*	State species of concern	Utah	MA-NLAA
Howell's phacelia*	*Phacelia howelliana*	State species of concern	Both	MA-NLAA
Nipple phacelia*	*Phacelia mammillarensis*	State species of concern	Both	MA-NLAA
Alcove bog-orchid	*Platanthera zothecina*	State species of concern	Both	
Mojave indigo-bush	*Psorothamnus arborescens* var. *pubescens*	State species of concern	Both	
Whiting's indigo-bush*	*Psorothamnus thompsoniae* var. *whitingii*	State species of concern	Both	MA-NLAA
New Mexico raspberry*	*Rubus neomexicanus*	State species of concern	Utah	MA-NLAA
Jane's globemallow*	*Sphaeralcea janeae*	State species of concern	Utah	MA-NLAA
Rocky Mountain maple	*Acer glabrum*	Glen Canyon species of concern	—	
Bigtooth maple	*Acer grandidentatum*	Glen Canyon species of concern	—	
Desert mountain lilac*	*Ceanothus vestitus var. franklinii*	Glen Canyon species of concern	—	MA-NLAA
Red-osier dogwood	*Cornus sericea*	Glen Canyon species of concern	—	

Common Name	Scientific Name	Status	State (Utah, Arizona, or both)	Potential Overall Effect of this plan/DEIS
Utah brittle-fern	*Cystopteris utahensis*	Glen Canyon species of concern	—	
Cotton top	*Echinocactus polycephalus*	Glen Canyon species of concern	—	
Ross's spurge	*Euphorbia aaron-rossii*	Glen Canyon species of concern	—	
Rice cutgrass	*Leersia oryzoides*	Glen Canyon species of concern	—	
American bugleweed	*Lycopus americanus*	Glen Canyon species of concern	—	
Dunebroom	*Parryella filifolia*	Glen Canyon species of concern	—	
Tompkins phacelia*	*Phacelia pulchella* var. *sabulonum*	Glen Canyon species of concern	—	MA-NLAA
Floating pondweed	*Potamogeton natans*	Glen Canyon species of concern	—	
Hoptree	*Ptelea trifoliata*	Glen Canyon species of concern	—	
Douglas fir*	*Pseudotsuga menziesii*	Glen Canyon species of concern	—	MA-NLAA
Smooth sumac	*Rhus glabra*	Glen Canyon species of concern	—	
Blue-eyed grass	*Sisyrinchium demissum*	Glen Canyon species of concern	—	

Source: Spence 2012a; Sweatland pers. comm. 2010a.

*Species carried forward for analysis in chapter 4, including all federally listed species and state-listed species with the potential to be affected by the ORV Management Plan alternatives (Spence pers. comm. 2012b).

— = Species not listed in either Utah or Arizona.

NE = no effect

MA-NLAA = may affect, not likely to adversely affect

Context

The geographic study area for special-status animal and plant species and their habitats is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

Alternative A: No Action

As described in the "Wildlife and Wildlife Habitat" section, documentation of relatively early use of ORVs in desert ecosystems, like those at Glen Canyon, found that ORVs were destructive, causing long-lasting damage to land and aquatic ecosystems, wildlife, soils, and hydrologic flows (New Mexico EMNRD et al. 2008). Studies of off-road recreation in the southwest have reported adverse impacts on sensitive species due to fragmentation, habitat destruction, harassment, noise, and direct mortality (Bury and Luckenbach 2002). ORVs have been demonstrated to decrease population densities of reptiles, small mammals, and bird populations. In general, habitat fragmentation reduces the size of patches of desert, forest, shrublands, wetlands and grasslands. This reduces the

total area of contiguous habitat available for wildlife species, especially birds, and increases the isolation of the habitat (Campbell and Johns n.d.), resulting in changes to forage and cover, flows of energy and nutrients, and even the microclimate of the area.

Other risks range from injury during escape responses to the more-severe habitat avoidance and nest abandonment. Further research regarding the adverse effects of human recreational activities among bird species has shown nest desertion and temporary abandonment, and changes in foraging habits (Joslin and Youmans 1999). As described in the "Wildlife and Wildlife Habitat" section, noise is an environmental stressor that can induce startle responses, aversion, and maladaptive behaviors; cause changes in habitat use, communication, predation, foraging, energetic, courtship, breeding, and reproduction; and produce stress responses such as changes in heart rate and energy consumption, and hearing loss.

Brooks (1999, 2000) reported that breeding bird abundance and species richness, as well as lizard abundance and species richness were higher in areas that restricted off-road use compared to areas where off-road use is allowed. Off-road use-related impacts on amphibian and reptile species include indirect impacts on populations via habitat destruction, chemical contamination and sedimentation, and the creation of migration barriers. Studies of small mammals have reported adverse effects from motorized vehicle use, including population reduction, habitat modification, forage/cover removal, and energy expenditure (Joslin and Youmans 1999).

ORV noise has been shown to damage hearing sensitivity and predator detection in small mammals and reptile species (Brattstrom and Bondello 1983). Noise from ORVs has also been found to interfere with songbird breeding and territorial displays (Berry 1980).

As described in the "Vegetation" section, off-road use affects desert vegetation in two ways: (1) As soils are damaged they lose the ability of to support desert vegetation; and (2) ORVs cause direct damage that includes crushing of foliage, root systems, and seedlings, uprooting of small plants, and disruption of large plant root systems by shearing and compaction of desert soils.

Deserts and arid regions are generally considered areas of low productivity. Vegetation is slow growing and sparse, a reflection of the environmental stresses present in arid and semi-arid environments. Damage to desert vegetation can be immediate and long lasting. For example, some plant species, such as those found in sagebrush-steppe communities, may take decades to reestablish after a disturbance (Allen 1995).

Scientific studies have reported a highly negative response by perennial desert vegetation to most types and intensities of off-road use. Smaller plants can be destroyed at very low levels of off-road use, and larger, more resilient plants will succumb to damage following repeated impacts (Bury 1980; Luckenbach and Bury 1983).

The introduction and spread of invasive species by ORVs is also a concern. Invasive species are a significant threat, displacing native flora and threatening biodiversity and overall productivity of the desert environment. Off-road use has been shown to contribute to the introduction and establishment of invasive or nonnative species by expansion or creation of routes; disturbance to previously undisturbed soils; and direct transportation of seeds into new areas (Switalski and Jones 2008). In general, ORVs may not account for ecologically significant nonnative seed dispersal, but they have been shown to transport seeds (Rooney 2005).

Lone Rock Beach

Lone Rock Beach is currently open to conventional motor vehicles, OHVs, and street-legal ATVs. Vehicles may be operated from the operator's camping location to the Lone Rock Beach Play Area only to access the play area. The impacts of off-road use on special-status species that occur at Lone Rock Beach would result in habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement (Bury 1980).

Mammals

Off-road use at Lone Rock Beach could result in disturbance and displacement of kit foxes, which are known to occur in the Lone Rock Beach area (Utah DNR n.d.a), as well as continued habitat destruction and potential vehicle-wildlife collisions, though these occurrences are currently rare. However, this species is primarily nocturnal and typically avoids humans and human-made noise (NatureServe 2009). Therefore, adverse impacts would be localized and limited.

As described in the "Wildlife and Wildlife Habitat" section in chapter 3, important habitat for desert bighorn sheep within Glen Canyon includes Red, White, and Gypsum Canyons, as well as Waterpocket Fold east of the Escalante River (Singer et al. 2000). As a result, continued off-road use at Lone Rock Beach is not expected to affect desert bighorn sheep.

Reptiles

Off-road use-related impacts on reptile species include both direct (e.g., vehicle-wildlife collisions and noise-related impacts) and indirect impacts on populations (e.g., habitat destruction, chemical contamination and sedimentation, and the creation of migration barriers). The only special-status reptile with the potential of being impacted by off-road use at Lone Rock Beach is the chuckwalla (NPS 2011b). Locally, habitat disturbance and fragmentation would continue and species mortality could occur, resulting in adverse impacts that may be detectable, but not considerable. As described in the "Special-status Species" section in chapter 3, distribution of desert night lizard within Glen Canyon is limited and does not include the Lone Rock Beach (NPS 2011b); therefore, off-road use at Lone Rock Beach would not affect this species. Similarly, the glossy snake is known to occur in the Wahweap area near Ferry Swale (NPS 2011b), therefore, off-road use at Lone Rock Beach is not expected to affect this species.

Birds

The no-action alternative would result in localized short- and long-term adverse impacts on special-status birds at Lone Rock Beach. Motorized vehicle use can result in adverse impacts on bird species, including physiological disturbance, displacement, nest abandonment, and habitat avoidance and destruction (Bury and Luckenbach 2002; Campbell and Johns n.d.; and Joslin and Youmans 1999). Special-status bird species likely to occur (or with the potential to occur) in the area of Lone Rock Beach include golden and bald eagle, long-billed curlew, burrowing owl, brown and American white pelican, great blue heron, and California condor (NPS n.d.a). As described in chapter 3, the golden eagle may occasionally forage over the Lone Rock Beach ORV area because there is a territory on Castle Rock. However, it is unlikely that off-road use at Lone Rock Beach would have substantial impacts on raptors, including the golden and bald eagle, in this particular area as there are extensive areas around Lone Rock Beach that are off limits to off-road use that provide suitable habitat for use by raptors (Spence n.d.). Similarly, California condors, burrowing owls, great blue heron, and American white pelicans are considered rare at Lone Rock Beach (Spence n.d.), and adverse impacts would likely be slight. The long-billed curlew typically occurs at Lone Rock Beach during spring migration and avoids contact with people, resulting in minimal impacts from off-road use (Spence pers. comm. 2012b). Any ORV-related impacts on affected special-status bird species at Lone Rock Beach may be detectable, but would be localized and not considerable.

Alternative A would result in no effect to the southwestern willow flycatcher, Mexican spotted owl, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach (NPS n.d.a).

Plants

Impacts of off-road use to special-status plants at Lone Rock Beach are expected to be negligible or undetectable because there are no special-status plants known to occur in this area due to lack of suitable habitat (Spence pers. comm. 2012b).

Lone Rock Beach Play Area

The play area is a fence-enclosed 180-acre area that is open to high-intensity off-road use. It is the only location in Glen Canyon where all vehicles (conventional motor vehicles, OHVs, and street-legal ATVs) can be operated in an unrestricted manner. As described in the "Vegetation" section of this plan/DEIS, much of the vegetation and habitat in this area has been destroyed from constant motorized vehicle use.

Mammals

As described for Lone Rock Beach, off-road use in the play area could result in disturbance and displacement for kit foxes, which are known to occur in the Lone Rock Beach Play Area (Utah DNR n.d.a), as well as continued habitat destruction and potential vehicle-wildlife collisions. As a result, the impacts of continued off-road use in this area may be detectable, but would be localized and would not be considerable because kit foxes typically avoid areas of heavy off-road use (NatureServe 2009).

As described above for Lone Rock Beach, effects to bighorn sheep would be negligible, because this area is not preferred habitat for this species.

Reptiles

It is unlikely that off-road use at Lone Rock Beach Play Area would adversely affect special-status reptile species within Glen Canyon. As described above for Lone Rock Beach, distribution of night lizard within Glen Canyon is limited and does not include the Lone Rock Beach Play Area, so off-road use at the play area is not expected to affect this species. Similarly, the chuckwalla is common along shorelines, but not known to occur in desert habitat because it prefers rocky sites (NPS 2011b). As described above for Lone Rock Beach, the glossy snake is known to occur in the Wahweap area near Ferry Swale; therefore, although impacts of off-road use to this species are possible, they are unlikely at the Lone Rock Beach Play Area.

Birds

As described above for Lone Rock Beach, the no-action alternative would result in localized short- and long-term adverse impacts on special-status birds at Lone Rock Beach Play Area. Continued off-road use could result in physiological disturbance, displacement, and habitat avoidance and destruction for the golden and bald eagle, burrowing owl, and California condor. Impacts on burrowing owl, California condor, and American white pelican are expected to be slight, because these species are considered rare in this area of Glen Canyon (Spence, LaRue, and Grahame 2011). Similarly, adverse impacts are expected to be minimal to the golden and bald eagle, because these species are more likely to avoid areas of heavy use. Therefore, any ORV-related impacts on affected special-status bird species may be detectable, but would be localized and not considerable at Lone Rock Beach Play Area.

Alternative A would result in no effect to the southwestern willow flycatcher, brown pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach Play Area (NPS n.d.a).

Plants

Impacts of off-road use to special-status plants at Lone Rock Beach Play Area are expected to be negligible because there are no special-status plants known to occur in this area due to lack of suitable habitat.

Accessible Shorelines

Under alternative A, 13 accessible shoreline areas would remain open, subject to water level closures, to off-road use by conventional motor vehicles. The operation of OHVs or street-legal ATVs would not be authorized in the 13 ORV areas. The 13 ORV areas would not be play areas (climbing hills in vehicles, driving at high speeds, and similar behavior would not be authorized), but rather areas intended to provide public conventional motor vehicle access to the Lake Powell shoreline for purposes of primitive recreational use. The public would only be allowed to depart the road and drive directly to the shoreline and park in designated ORV areas. However, because alternative A would maintain current management practices related to accessible shorelines, the shorelines would not be marked and defined in a manner consistent with the control of off-road use for the protection of resources.

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively discontinue use of shoreline areas. Currently Warm Creek, Crosby Canyon, and Bullfrog Creek North and South are temporarily closed due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. Reopening these areas would result in adverse impacts on mammals, reptiles, birds, and plants as described below; however, the temporary closure of shoreline areas would minimize impacts on affected special-status species from off-road use by temporarily removing a source of localized disturbance. The Paiute Farms and Nokai Canyon accessible shorelines are not officially open, although they are currently being accessed by users. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access, resulting in beneficial impacts on special-status species.

Mammals

Impacts on kit foxes would be localized and adverse from the continued use of conventional motor vehicles at accessible shorelines, to include species disturbance and displacement as well as habitat destruction and potential vehicle-wildlife collisions. However, the only shorelines where adverse impacts on this species are anticipated are Crosby Canyon and Warm Creek (Spence pers. comm. 2012b). Additionally, this species is highly adaptive and tends to avoid humans and human-made noise (NatureServe 2009). Therefore, off-road use at accessible shorelines would result in very limited, localized adverse impacts on kit foxes.

As described in the “Wildlife and Wildlife Habitat” section in chapter 3, desert bighorn sheep prefer rocky cliffs away from human activity. However, this species is known to occur at lower elevation areas, which provide temporary access to foraging and lambing resources (Singer et al. 2000). Accessible shorelines in Glen Canyon where bighorn sheep are more likely to occur include White Canyon, Red Canyon, Blue Notch, and Farley Canyon; however, it is possible for them to occur at any accessible shoreline area. Although alternative A may result in continued habitat avoidance and temporary disturbance, overall long-term impacts on bighorn sheep from continued off-road use at accessible shorelines would be limited because it is likely that desert bighorn sheep avoid shoreline areas with heavy use. This area of avoidance constitutes a small percentage of the approximately 2,000 miles of available Lake Powell shoreline.

Reptiles

As described above for Lone Rock Beach, continued off-road use at accessible shorelines could result in localized adverse impacts on sensitive reptiles within Glen Canyon. ORV-related impacts on reptile species include both direct (e.g., vehicle-wildlife collisions and noise-related impacts) and indirect impacts on populations (e.g., habitat

destruction, chemical contamination and sedimentation, and the creation of migration barriers). As described in the "Special-status Species" section in chapter 3, the chuckwalla is very common along rocky shorelines. Therefore, short- and long-term adverse impacts on this species are expected from direct mortality, disturbance, and habitat loss and fragmentation; however, impacts would be localized. Dirty Devil is the only accessible shoreline where the night lizard may occur; however, this species is nocturnal and suitable habitat exists elsewhere in undisturbed areas. Therefore, overall adverse impacts on this species from off-road use at accessible shorelines would be localized and limited. As described above for Lone Rock Beach, the glossy snake is known to occur in the Wahweap area near Ferry Swale, so off-road use at Lone Rock Beach is not expected to affect this species.

Birds

The no-action alternative could result in short- and long-term adverse impacts on special-status birds at accessible shorelines within Glen Canyon. As described above, risks to birds from off-road use range from injury during escape responses to the more-severe habitat avoidance and nest abandonment. Birds can respond to disturbance with accelerated heart rate and metabolic function, and suffer from increased levels of stress, which can lead to displacement, mortality, and reproductive failure (Taylor n.d.). Additionally, noise from ORVs can cause changes in communication, predation, foraging, courtship, breeding, and reproduction (Bury 1980). Adverse impacts would be localized at accessible shoreline areas. Special-status birds with the potential to occur near accessible shoreline areas include the long-billed curlew, great blue heron, brown and American white pelican, and golden and bald eagle (Spence 2012a, b). However, these species likely avoid areas of heavy use. The California condor has the potential to occur at any location within Glen Canyon; however, this species is considered rare in Glen Canyon and likely avoids areas of heavy use. Any adverse impacts on this species at accessible shorelines would likely be slight, localized, and short term. The pinyon jay is a common widespread permanent resident in pinyon-juniper woodlands of Glen Canyon and may potentially occur in the Orange Cliffs region. The gray vireo is considered an uncommon, but widespread summer resident. These species would likely avoid areas of disturbance and therefore, any adverse impacts on these species at accessible shorelines would likely be slight, localized, and short-term.

Four accessible shorelines in Glen Canyon are within designated critical habitat for the Mexican spotted owl (Bullfrog North and South, Stanton Creek, and Dirty Devil). Although off-road use would continue at these shorelines under the no-action alternative, the owl is not known to use habitat in these areas (NPS 2007a; Spence 2012a). Adverse impacts on this species may be detectable, but would be localized and would be limited to noise-related impacts.

Alternative A would result in no effect to the southwestern willow flycatcher and yellow-billed cuckoo because these federally listed species are not known to occur at accessible shoreline areas (NPS n.d.a). Brown and American white pelican and great blue heron have been observed at accessible shoreline areas where disturbance would continue. Adverse impacts on these species may be detectable, but would be localized and would be limited to noise-related impacts.

Plants

Many vegetative communities in the area of the accessible shorelines have been previously disturbed and substantially impacted by off-road use. Disturbance has ranged from limited impacts (i.e., localized trampling) to vegetation being completely destroyed or removed. Although the majority of vegetation in these areas has been removed or destroyed as a result of off-road use, some vegetative communities do still exist. The only special-status plant species with the potential to be impacted by off-road use at accessible shorelines is Paria spurge, which may occur at Bullfrog North and South (Spence pers. comm. 2012b) and possibly within Wayne, Garfield, and Kane counties. However, impacts would be localized and in the context of Glen Canyon, impacts on this species would be limited.

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on all GMP roads in Glen Canyon (there are approximately 365 miles of unpaved GMP roads and 72 miles of paved GMP roads at Glen Canyon), with the exception of the Orange Cliffs Unit where street-legal ATVs are prohibited.

Mammals

The continued use of conventional motor vehicles and street-legal ATVs on the majority of paved and unpaved GMP roads within Glen Canyon could result in adverse impacts on bighorn sheep and kit foxes. Locally, along roads, habitat disturbance and fragmentation would continue and species mortality could occur. Motor vehicles can raise dust clouds, disrupt and damage wildlife, and reduce effective habitat (New Mexico EMNRD et al. 2008). However, because habitat in Glen Canyon has been previously impacted and vehicle use would continue to be contained to the already disturbed GMP roads, impacts would be localized. Additionally, kit foxes are rare during the day and tend to avoid humans and human-caused noise; therefore, any adverse impacts on this species are expected to be limited. Bighorn sheep routinely cross the Warm Creek Road between Big Water and Warm Creek to access the lake. Although this species prefers rocky cliffs away from human activity, impacts on bighorn sheep may occur, but would likely be minimal. This area of avoidance constitutes a small percentage of the approximately 2,000 miles of available Lake Powell shoreline.

Reptiles

The continued use of conventional motor vehicles and street-legal ATVs on GMP roads within Glen Canyon could adversely affect the desert night lizard. Locally, along roads, habitat disturbance and fragmentation would continue and species mortality could occur, resulting in adverse impacts. However, recorded distribution for this species is limited to small portions of the Warm Creek-Grand Bench, Wilson Mesa, and Orange Cliffs regions of Glen Canyon (NPS n.d.c). Additionally, this species is nocturnal. Therefore, any adverse impacts that would result are limited to only a few unpaved GMP roads within Glen Canyon. As described above for Lone Rock Beach, the glossy snake is known to occur in the Wahweap area near Ferry Swale (NPS n.d.c), so motor vehicle use on GMP roads is not expected to affect this species. Similarly, the chuckwalla prefers shoreline habitat, so motor vehicle use on GMP roads is not expected to affect this species.

Birds

Alternative A would result in short- and long-term adverse impacts on several special-status bird species from the continued use of conventional motor vehicles and street-legal ATVs on GMP roads within Glen Canyon. Locally, along roads, habitat and species disturbance would continue, and species mortality could occur. Bird species with the potential to be impacted include the California condor, burrowing owl, bald and golden eagle, and Mexican spotted owl. Motor vehicles can raise dust clouds, disrupt wildlife, and reduce effective habitat.

Several GMP roads within Glen Canyon cross designated critical habitat for the Mexican spotted owl. This species is known to occur in a small area south of the Orange Cliffs region. Prohibiting street-legal ATV use in the Orange Cliffs Unit could benefit the Mexican spotted owl and other bird species in the area, by limiting habitat disturbance and noise-related impacts.

Alternative A would result in no effect to the southwestern willow flycatcher, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur along unpaved GMP roads.

Plants

Alternative A would result in short- and long-term adverse impacts on special-status plants from the continued use of conventional motor vehicles and street-legal ATVs on GMP roads. Species likely to be affected by motorized vehicle use on GMP roads include tropic goldeneye, Copper Canyon milkvetch, Kachina daisy, cataract gilia, Western hophornbeam, alcove rock daisy, Howell's phacelia, nipple phacelia, Whiting's indigo-bush, New Mexico raspberry, Jane's glowbemallow, desert mountain lilac, and Tompkins phacelia. Several of these species are known to occur along or near Warm Creek Road, including tropic goldeneye, Tompkins phacelia, and nipple phacelia. Others occur in the Clay Hills Crossing area (e.g., Copper Canyon milkvetch and Whiting's indigo-bush). Impacts on these species would likely be contained to previously disturbed areas, resulting in localized effects that may be detectable. Continued impacts on soils would reduce the ability of soils to provide for vegetation; however, because vegetation in the area has been previously impacted and vehicle use would continue to be contained to the already disturbed GMP roads, no new notable harm to vegetation would occur, including at the Orange Cliff Unit.

Ferry Swale

Under alternative A, approximately 53 miles of ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs. Wildlife and wildlife habitat in Ferry Swale would continue to experience adverse impacts from continued disturbances related to off-road use occurring along the 53 miles of designated ORV routes. However, because habitat in the area has been previously impacted and vehicle use would continue to be contained to the already designated routes, no new notable harm to wildlife or habitat would occur.

Mammals

In general, routes created by ORV users can cause a patchwork of disrupted habitat often correlated with reduced ecosystem productivity (Trombulak and Frissell 2000; New Mexico EMNRD et al. 2008). For the kit fox, impacts of authorized off-road use along designated ORV routes in Ferry Swale may be detectable (e.g., habitat fragmentation, species disturbance, and vehicle-wildlife collisions), but would be localized and would not be considerable as kit foxes tend to avoid humans and human-made noise (NatureServe 2009). Additionally, kit foxes are nocturnal and are rarely seen during the day, which is when the majority of off-road use occurs.

Although a herd of desert bighorn sheep lives in the Paria Canyon-Vermilion Cliffs area, less than 15 miles southwest of Ferry Swale, impacts from authorized off-road use at Ferry Swale would likely not affect desert bighorn sheep, because this species typically avoid Highway 89 and areas of Ferry Swale east to Lake Powell.

Reptiles

As described in the "Special-status Species" section in chapter 3, snakes are known to favor roads and trails as thermoregulation sites, which put them at risk of being injured or killed by motorized vehicles. Off-road use at Ferry Swale could result in adverse impacts on the glossy snake. Locally, along designated ORV routes, habitat disturbance and fragmentation would continue and species injury or mortality could occur, resulting in adverse impacts. Distribution of the night lizard within Glen Canyon is limited and does not include the Ferry Swale area, so off-road use at Ferry Swale would have no effect on this species. Similarly, the chuckwalla prefers shoreline habitat, so off-road use at Ferry Swale would have no effect on this species.

Birds

Alternative A could result in localized short- and long-term adverse impacts on special-status birds at Ferry Swale (e.g., burrowing owl, golden and bald eagle, and California condor). The burrowing owl often occurs on corral posts or at stock ponds in the Ferry Swale area (NPS 2007a); therefore, it is expected that species disturbance

would result from off-road use (i.e., noise-related impacts). However, any resulting short- and long-term adverse impacts would be localized and minimal due to their limited distribution in the Ferry Swale area. Although it is possible for the condor to occur at any location within Glen Canyon, it is a rare species in Glen Canyon. Standard mitigation measures (as mentioned for Accessible Shorelines above) would be used if this species were to appear in an area with off-road use. Therefore, any adverse impacts that could result for the condor are expected to be localized and negligible. Although the long-billed curlew has been recorded in the Wahweap area, this species prefers shoreline habitat, so impacts on this species are unlikely (NPS n.d.a; Spence, LaRue, and Grahame 2011).

Alternative A would result in no effect to the southwestern willow flycatcher, brown and American white pelican, Mexican spotted owl, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Ferry Swale.

Plants

Impacts of off-road use to special-status plants at Ferry Swale are expected to be negligible because there are no special-status plants known to occur in this area due to lack of suitable habitat (Spence, pers. comm., 2012).

Cumulative Impacts

Other past, present, and reasonably foreseeable future actions within and around Glen Canyon have the potential to impact special-status species. In recent years, the rising and falling water levels as a result of natural fluctuations and dam operations have exposed more or less of the accessible shoreline areas, impacting habitat available for sensitive species. Following these events, several popular accessible shoreline areas have been closed due to accessibility issues, resulting in beneficial impacts on special-status species by temporarily removing a source of disturbance (i.e., off-road use) in affected areas. However, falling water levels also result in short-term adverse impacts on special-status species by limiting water resources. Due to fluctuating lake levels, several vegetative communities are not able to establish along the shoreline; thus, limiting shoreline habitat.

A wide variety of activities exist in Glen Canyon that have resulted in and continue to result in adverse impacts on wildlife and wildlife habitat. These activities include unauthorized off-road use on adjacent lands, recreational hunting and livestock grazing as allowed by Glen Canyon's enabling legislation, and special use permits for filming and photography. Unauthorized off-road use leads to disrupted and fragmented habitat, species disturbance, and direct mortality of special-status wildlife and plants. Recreational hunting and grazing also result in localized habitat and species disturbance (and direct mortality in the case of recreational hunting), but the adverse impacts of special use permits on special-status species and their habitat are much less considerable than unauthorized off-road use, since these activities are monitored and managed by NPS staff. Military overflights from nearby bases can also result in short-term limited adverse impacts on special-status species and their habitat, depending on the duration and elevation of flights. Impacts may range from minor behavioral responses, such as flight/fright response, to severe changes in habitat utilization (Radle 2007).

Future fee station improvements at Lone Rock Beach could result in short-term localized adverse impacts on special-status species in that area (e.g., kit fox, chuckwalla, golden eagle, long-billed curlew, California condor, burrowing owl) from construction-related noise, staging of equipment, and the increased presence of NPS staff and workers in areas of construction. Wildlife commonly habituate to constant noise and human disturbance levels, provided they are not harassed by people working at the site. Most wildlife would be expected to return once construction activities diminish and work is completed. Because habitat in this area has already been disturbed, few remaining species would be injured or disturbed during construction.

Short-term adverse impacts on special-status species likely resulted from the 1986 Paiute Farms/San Juan Marina DCP/EA and the 2008 Uplake DCP/EA from implementation of these plans, including construction-related noise,

staging of equipment, and the increased presence of NPS staff and workers in areas of construction. Adverse impacts such as injury, mortality, and habitat disturbance/avoidance, were localized and likely had more effect on special-status species occurring along the shoreline species (e.g., kit fox, chuckwalla, sensitive shorebirds).

Beneficial impacts on special-status species have occurred, and continue to occur, from development and implementation of the 1979 Glen Canyon GMP, which identifies four management zones and management strategies for resource protection and visitor use in these zones. Planning for a new GMP would further benefit special-status species over the long term by implementing improved strategies for resource protection. Development and implementation of the 1988 Accessible Shorelines EA/DCP and 1981 Lone Rock Beach EA/DCP have resulted in long-term benefits for special-status species within Glen Canyon. These plans define management of Lake Powell shorelines in order to reduce resource degradation, visitor use conflicts, and safety hazards, resulting in long-term benefits for special-status species at accessible shoreline areas (including Lone Rock Beach). Similarly, there are several plans that direct management recreational use within Glen Canyon—uses that could result in short-term adverse impacts on special-status species—but also share the goal of protecting resources and educating visitors on these resources, resulting in long-term benefits to special-status species:

- 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan, which determined how the backcountry areas of Glen Canyon should be managed.
- Interim OHV management plans at Lone Rock Beach and play area, and at accessible shorelines (2007)
- Programmatic EA for Organized Group Activities along Hole-in-the-Rock Road, which will analyze the environmental consequences of organized group activities that exceed existing group size limits along the Hole-in-the-Rock Road corridor.

Other park plans and projects have resulted in or have the potential to result in both adverse and beneficial impacts on special-status species within Glen Canyon. These include the release of tamarisk beetles (*Diorhabda* spp.) to control tamarisk (*Tamarix* spp.). The tamarisk leaf beetle was released as a biological control agent in certain areas of the west in 2001 to help manage tamarisk, which is a highly invasive plant that grows along the Colorado River and in riparian habitats throughout the southwest (NPS 2009d). Although the beetle was not released in Glen Canyon, it has arrived and thrives at various locations throughout Glen Canyon. Tamarisk is known to displace native trees like cottonwood and willow, create poor habitat for birds and other wildlife, increase soil salinity, and increase risk of fire; therefore, continued defoliation of tamarisk will result in long-term beneficial impacts on special-status species (NPS n.d.g). However, there are concerns in managing tamarisk: defoliation may lead to site conditions that favor the establishment of other invasive nonnative plants, defoliation may negatively impact some insect and wildlife species, and an increased short-term fire hazard may result if the majority of tamarisk is killed in an area and dense stands of dead stems remain (NPS n.d.g). Therefore, although beneficial impacts would result over the long term, localized short-term adverse impacts on special-status species are likely to result from the removal of tamarisk.

Similar to tamarisk, Russian olive (*Elaeagnus angustifolia*) was brought into the area as erosion control after the Dust Bowl of the 1930s. Since then, this species has spread, replacing native vegetation in Escalante and Boulder, and along the Escalante River. In general, Russian olive causes river channelization and is shading the river corridor, cooling the water temperature. Since 2000, volunteers have been working on Russian olive removal and restoration of the Escalante River watershed (Escalante River Watershed Partnership 2011). Although short-term adverse impacts are likely to result from removal efforts (i.e., noise and physical disturbances from volunteers removing trees), beneficial impacts have resulted and will continue to result for special-status species from the removal of Russian olive along the Escalante River. In 2007, zebra mussels, an aquatic invasive species known to significantly alter aquatic ecosystems, were discovered in Lake Mead, Utah (NPS n.d.f). This invasive species aggressively spreads and readily establishes on hard substrates and surfaces, causing food chain disruption and economic damage by clogging intake pipes of water treatment and power plants as well as boat engine cooling

systems (NPS n.d.f). Since their discovery in Lake Mead, zebra mussel infestations have been discovered in Lakes Mohave and Havasu. Currently, Lake Powell and the upper Colorado River basin are believed to be free of zebra mussels; however, quagga mussels have been located in Lake Powell. Mussels would pose a major threat to Lake Powell and the upper Colorado River if they were to become established in those areas. Mussel decontamination stations are already in place at all of the marinas within Glen Canyon (NPS n.d.f). Additionally, there is planned installation of a portable decontamination facility. Although installation/construction of decontamination facilities can temporarily disrupt special-status species nearby (e.g., kit fox, chuckwalla, golden and bald eagle, burrowing owl, long-billed curlew), ensuring that mussels are not introduced in Lake Powell and the upper Colorado River basin results in long-term beneficial impacts on special-status species, especially sensitive species that depend on aquatic habitats for foraging and/or breeding (e.g., brown and American white pelican, golden and bald eagle, great blue heron).

Christmas bird counts within Glen Canyon result in long-term benefits for special-status bird species. Although the presence of park staff and researchers in the field likely results in minimal short-term adverse impacts (e.g., noise and crushing of vegetation), tracking population trends and species presence in Glen Canyon results in improved species management for future plans and projects. Similarly, special-status species inventories for bald eagle, Brady's pincushion cactus, and desert bighorn sheep result in long-term benefits for those species by tracking population trends and species presence in Glen Canyon and guiding species management for future plans and projects. Potential closures or seasonal closures in the future for lambing areas for desert bighorn sheep would result in considerable long-term benefits for bighorn sheep by providing relief from recreational disturbances.

The USFWS designation of critical habitat for the Mexican spotted owl in 2004, which includes habitat within Glen Canyon, benefits the Mexican spotted owl, as well as other sensitive species within Glen Canyon by protecting species that utilize the same habitat as the owl (e.g., California condor, burrowing owl, bald and golden eagle). Additionally, reintroduction of the California condor to the Colorado Plateau by the USFWS has resulted in long-term beneficial impacts on this species by providing the opportunity for population recovery.

Utah DNR's Statewide Pronghorn Management Plan and BLM's updated Resources Management Plans benefit special-status species in Glen Canyon by guiding management of natural resources and habitat in the region.

Other projects and planning actions by federal and state agencies have resulted in or would likely result in short-term adverse impacts on special-status species from implementation, including an update to the 1996 Long Term Experimental and Management Plan for Glen Canyon Dam (Bureau of Reclamation), development and update of the BLM's Travel Management Plan, and road/ORV route improvements for utility access by the Arizona DOT (Coconino County); however, over the long term, these projects and actions result in beneficial impacts for special-status species from improved management and protection of park resources.

Short- and long-term adverse impacts are likely to result from future planning efforts by the state of Utah and the BLM. These future actions include a draft programmatic EIS and possible land use amendments for allocation of oil shale and tar sands resources on lands administered by the BLM in Colorado, Utah, and Wyoming, which would analyze several alternatives for land allocation and resource management. Additionally, the Utah State Board of Water Resources is proposing to build approximately 160 miles of pipeline between Lake Powell Glen Canyon dam and Cedar City. Although both plans/projects would include mitigation to protect special-status species, they could result in short- and long-term substantial impacts on special-status species from habitat destruction and fragmentation, species disturbance and mortality, and habitat avoidance.

Current and future operations of the Amangiri Resort, located on 600 acres in Canyon Point, Utah, could result in adverse impacts on special-status species in Glen Canyon. Construction of the resort led to habitat destruction and likely species displacement, resulting in long-term, less than considerable impacts. The resort offers a wide variety of activities for guests, and all visitors to the resort can partake in all the visitor use opportunities Glen Canyon offers. Some visitor activities (e.g., hiking, scenic flights) would continue to result in short-term adverse impacts on

special-status species within Glen Canyon from species and habitat disturbance. However, impacts would be localized and minimal, because the resort occupies only a small area (in comparison to Glen Canyon as a whole) on the western edge of Glen Canyon.

The overall impact of these past, present, and reasonably foreseeable future actions would be short- and long-term adverse and considerable, as well as long-term beneficial. When combined with the long-term detectable adverse impacts of alternative A, considerable long-term adverse and long-term beneficial cumulative impacts would result for special-status species in the area of analysis.

ALTERNATIVE B: NO OFF-ROAD USE

Lone Rock Beach

Mammals

Alternative B would result in long-term beneficial impacts on kit foxes at Lone Rock Beach from the discontinued use of this area to off-road use. The permanent closure of Lone Rock Beach would remove an existing source of disturbance (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance), allowing this area to be restored to natural conditions. The beneficial impacts would be localized at Lone Rock Beach, but over the long term, impacts would be experienced Glen Canyon-wide because kit foxes would no longer have to avoid potential habitat in these areas. Beneficial impacts on bighorn sheep may result, but would likely be negligible due to their preference for rocky cliffs and higher-elevation habitat within Glen Canyon.

Reptiles

The closure of Lone Rock Beach would result in localized, long-term benefits for the chuckwalla. The permanent closure of Lone Rock Beach would remove an existing source of disturbance (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance), allowing recovery of this area to occur.

Birds

Long-term beneficial effects would result for special-status bird species (e.g., golden and bald eagle, long-billed curlew, burrowing owl, brown and American white pelican, great blue heron, and California condor) from the closure of Lone Rock Beach. As described at the beginning of alternative A, breeding bird abundance and species richness have been found to be higher in areas that restrict off-road use compared to areas where off-road use is allowed (Brooks 1999, 2000). Initial benefits would likely be short-term and localized (i.e., the removal of a form of manmade noise at accessible shorelines); however, benefits to special-status species over the long term would be experienced Glen Canyon-wide from reduced habitat fragmentation.

Alternative B would result in no effect to the southwestern willow flycatcher, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach.

Plants

The permanent closure of Lone Rock Beach would result in no impacts on special-status plant species because there are no special-status plants known to occur in this area, and even upon recovery, no suitable habitat would exist for these species. However, some long-term beneficial impacts could occur from allowing this area to naturally recover. Removing a source of disturbance to native vegetation and reducing fragmentation would allow native vegetation to reestablish itself in this area and help reduce the potential spread of invasive plants to other areas of the recreation area where special-status species plant species do occur.

Lone Rock Beach Play Area

Mammals

Alternative B would result in long-term beneficial impacts on kit foxes at Lone Rock Beach Play Area from the permanent closure of this area to off-road use. The permanent closure of the play area would remove an existing source of disturbance (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance), allowing this area to be restored to natural conditions. The beneficial impacts would be localized, but over the long term, impacts could be experienced Glen Canyon-wide because species would no longer have to avoid potential habitat in these areas. Beneficial impacts on bighorn sheep may result, but would likely be negligible due to their preference for rocky cliffs and higher-elevation habitat within Glen Canyon.

Reptiles

Impacts on the chuckwalla would be similar at Lone Rock Beach Play Area as those described for Lone Rock Beach. The permanent closure of Lone Rock Beach Play Area would remove an existing source of disturbance (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance), allowing this area to be restored to natural conditions. Benefits would be localized at first, but over the long term benefits would be experienced Glen Canyon-wide from reduced habitat disturbance and fragmentation.

Birds

Long-term beneficial effects would result for special-status bird species (e.g., golden and bald eagle, burrowing owl, and California condor) from the closure of the Lone Rock Beach Play Area. As described above for Lone Rock Beach, breeding bird abundance and species richness have been found to be higher in areas that restrict off-road use compared to areas where off-road is allowed (Brooks 1999, 2000). Initial benefits would likely be short-term and localized (i.e., the removal of a form of manmade noise at accessible shorelines); however, benefits to special-status species over the long term could be experienced Glen Canyon-wide from reduced habitat fragmentation.

Alternative B would result in no effect to the southwestern willow flycatcher, brown and American white pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach Play Area.

Plants

The permanent closure of the Lone Rock Beach Play Area would result in no impacts on special-status plant species because there are no special-status plants known to occur in this area, and even upon recovery, no suitable habitat would exist for these species. However, some long-term beneficial impacts would occur from allowing this area to naturally recover. Removing a source of disturbance to native vegetation and reducing fragmentation would allow native vegetation to reestablish itself in this area and help reduce the potential spread of invasive plants to other areas where special-status species plant species do occur.

Accessible Shorelines

Under alternative B, off-road use at 15 accessible shorelines (approximately 7,300 acres) within Glen Canyon would be discontinued, thereby removing existing sources of disturbance and its resulting impacts (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance) and allowing habitat in impacted areas of accessible shorelines to recover. Because vegetation would be reestablished in areas of former impact, sensitive species will likely occupy those areas over the long term. Although initial benefits would be short-term and localized (i.e., the removal of a form of manmade noise at accessible shorelines), benefits to special-status species over the long-term would be experienced Glen Canyon-wide from reduced habitat fragmentation.

Mammals

As described above, the discontinued use of 15 accessible shorelines would result in both short- and long-term beneficial impacts for kit foxes and bighorn sheep, by removing existing sources of disturbance from off-road use (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance) and allowing habitat in impacted areas of accessible shorelines to recover. Beneficial impacts on bighorn sheep would result from the closure of 15 accessible shoreline areas because more undisturbed habitat (e.g., foraging, drinking) would be available for this species.

Reptiles

The discontinued use of accessible shorelines would result in long-term benefits for the chuckwalla. Benefits would be localized at first (at accessible shorelines), but over the long term benefits could be experienced Glen Canyon-wide from reduced habitat fragmentation. As described for alternative A in the "Accessible Shorelines" section, the night lizard may occur at Dirty Devil. Therefore the closure of this shoreline to off-road use would result in localized long-term beneficial impacts on this species.

Birds

Long-term beneficial effects would result for special-status bird species (e.g., the long-billed curlew, bald eagle, California condor, and Mexican spotted owl) from the discontinued use of 15 accessible shorelines in Glen Canyon. The pinyon jay is a common widespread permanent resident in pinyon-juniper woodlands of Glen Canyon and may potentially occur in the Orange Cliffs region. The Gray vireo is considered an uncommon, but widespread summer resident. These species would likely avoid areas of disturbance and therefore, any adverse impacts on these species at accessible shorelines would likely be slight, localized, and short term. Discontinued use of the accessible shorelines would benefit these species by reducing disturbance and habitat fragmentation.

As described at the beginning of alternative A, breeding bird abundance and species richness have been found to be higher in areas that restricted off-road use compared to areas where off-road use is allowed (Brooks 1999, 2000). Initial benefits would likely be short term and localized (i.e., the removal of a form of manmade noise at accessible shorelines); however, benefits to special-status species over the long term would be experienced Glen Canyon-wide from reduced habitat fragmentation. Alternative B would result in no effect to the southwestern willow flycatcher yellow-billed cuckoo because these federally listed species are not known to occur near accessible shoreline areas.

Plants

Long-term beneficial effects would result for Paria spurge from the closure of 15 accessible shorelines in Glen Canyon. This species only occurs in Bullfrog North and South areas. Closing off Bullfrog North and South would benefit this species by permanently removing a source of continuous disturbance within these ORV areas.

Travel on GMP Roads in Glen Canyon

Impacts of alternative B on special-status species from the use of on GMP roads where conventional motor vehicles and street-legal ATVs would continue to operate on GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit where street-legal ATVs would not be authorized, would be similar to those under alternative A. No additional impacts on wildlife or habitat would result from vehicle use occurring on paved GMP roads because these roads have an asphalt top and no new soils or vegetation would be disturbed. It is assumed that vehicles will travel on the roads and not contribute to disturbances along roadway edges. Speed limits would be established whereby reducing the speed limit on GMP roads to 25 mph (or as posted). This action may help lessen some of the adverse impacts of motor vehicle use along designated routes as slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. reducing the level of noise and impacts related to vehicle travel

at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Ferry Swale

Under alternative B, off-road use would not be allowed in Ferry Swale to access adjacent BLM lands. Beneficial impacts would result from a reduction in habitat disturbance and fragmentation and species mortality for the kit fox, glossy snake, burrowing owl, California condor, and golden and bald eagle, the only sensitive species known to occur in this area.

Cumulative Impacts

Impacts on special-status species from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future actions on special-status species would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the long-term beneficial impacts under alternative B, would result in slight long-term adverse and considerable long-term beneficial cumulative impacts on special-status species in the area of analysis.

Alternative C: Increased Motorized Access

Lone Rock Beach

The impacts of alternative C on special-status species (including mammals, reptiles, birds, and plants) at Lone Rock Beach would be similar to those described for alternative A, except that speed limits and quiet hours after 10:00 p.m. would be enforced and implemented. Enforcing a speed limit of 15 mph at Lone Rock Beach and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., kit fox) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

The impacts of alternative C on affected special-status species (including mammals, reptiles, birds, and plants) at Lone Rock Beach Play Area would be the same as those described for alternative A.

Accessible Shorelines

Under alternative C, approximately 7,300 acres at 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs by permit. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Mammals

The impacts of alternative C on special-status mammals at accessible shorelines would be similar to those described for alternative A, except that 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs by permit. As described

under the no-action alternative, Paiute Farms and Nokai Canyon are currently being accessed. Therefore, impacts of officially opening Paiute Farms and Nokai Canyon would likely be negligible because kit foxes and bighorn sheep have likely adapted to some level of off-road use.

Under alternative C, implementing a speed limit of 15 mph at shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use to special-status mammals by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, the kit fox, which is primarily nocturnal, would benefit from the removal of a source of disturbance after 10:00 p.m.

Reptiles

The impacts of alternative C on special-status reptile species at accessible shorelines within Glen Canyon would be the similar to those described for alternative A, except that 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be allowed for use by conventional motor vehicles, OHVs, street-legal ATVs. As described above, Paiute Farms and Nokai Canyon are currently being accessed. Therefore, new disturbances would be limited from officially authorizing use at Paiute Farms and Nokai Canyon. As described for alternative A, species and habitat disturbance would continue and species mortality could occur for the chuckwalla; however, this species has likely adapted to some level of off-road use at Paiute Farms and Nokai Canyon. Additionally, implementing a speed limit of 15 mph at shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

The night lizard and glossy snake would not be affected by the official opening of Pauite Farms and Nokai Canyon, because these species are not likely to occur in these areas due to lack of suitable habitat (e.g., low elevations, lack of open sandy sites, and lack of large trees/logs).

Birds

The impacts of alternative C on special-status birds at accessible shorelines (e.g., long-billed curlew, golden and bald eagle, and California condor) within Glen Canyon would be similar to those described for alternative A, except that 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be allowed for use by conventional motor vehicles, OHVs, and street-legal ATVs. Although these areas are not officially open under the 1988 Accessible Shorelines EA/DCP, they are currently being accessed. Therefore, impacts of officially opening Paiute Farms and Nokai Canyon may be detectable for the long-billed curlew, but would not be considerable because this species has likely adapted to some level of off-road use. Risks to birds from off-road use range from injury during escape responses to the more-severe habitat avoidance and nest abandonment; however, impacts would be localized to open routes and areas.

Implementing a speed limit of 15 mph at shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use on special-status birds by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collision, dust particles, and sediment buildup). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Alternative C would result in no effect to the southwestern willow flycatcher, brown and American white pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur along accessible shoreline areas. Brown and American white pelican and great blue heron have been observed at accessible shoreline areas where disturbance could occur, but impacts on these waterbirds would be reduced with implementation of noise and speed restrictions.

Plants

The impacts of alternative C on special-status plants at accessible shorelines within Glen Canyon would be similar to those described for alternative A. Although 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be opened to conventional motor vehicles, OHVs, and street-legal ATVs, no special-status plant species are known to occur at these locations.

Travel on GMP Roads in Glen Canyon

The impacts of alternative C on affected special-status species (including mammals, reptiles, birds, and plants) from the use of conventional motor vehicles, OHVs, and street-legal ATVs on unpaved GMP roads would be similar to those described for alternative A, except that speed limits would be reduced on GMP roads and OHVs and street-legal ATVs would be authorized for use on GMP roads to include roads in the Orange Cliffs Unit. Decreasing the speed limit on GMP roads to 25 mph (or as posted) may help lessen some of the adverse impacts of off-road use along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Allowing conventional motor vehicles, OHVs, and street-legal ATVs on GMP roads in the Orange Cliffs Unit may affect certain bird and plant species. Habitat for the southwestern willow flycatcher, Mexican spotted owl, pinyon jay, and gray vireo may be present in the Orange Cliffs Unit. Adverse impacts would be localized and more detectable in areas where fewer disturbances have occurred due to prior access restrictions. These species would likely avoid areas of new disturbance (noise, traffic) and therefore, any adverse impacts on these would likely be slight, localized, and short term.

Plant species likely to be affected by motorized vehicle use on GMP roads, including in the Orange Cliffs Unit, include tropic goldeneye, Copper Canyon milkvetch, Kachina daisy, cataract gilia, Western hophornbeam, alcove rock daisy, Howell's phacelia, nipple phacelia, Whiting's indigo-bush, New Mexico raspberry, Jane's glowbemallow, desert mountain lilac, and Tompkins phacelia. Continued impacts on soils would reduce the ability of soils to provide for vegetation; however, because vegetation in the area has been previously impacted and vehicle use would continue to be contained to the already disturbed GMP roads, no new notable harm to vegetation would be expected occur, including in the Orange Cliff Unit.

Ferry Swale

Under alternative C, approximately 15 miles of ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs. Permits would be required for all designated ORV routes, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Mammals

Although these user-created routes currently exist, designating ORV routes may likely result in additional impacts on native habitat for kit foxes in the vicinity of those routes because more traffic would be expected. Adverse impacts would be localized and more detectable in areas where fewer disturbances have occurred. Short-term impacts on kit foxes of legalizing additional routes in Ferry Swale include the physiological effects of escape responses. Long-term impacts include further habitat destruction and fragmentation, as well as possible changes in breeding and foraging habits. As described for alternative B, Ferry Swale, setting the speed limit on unpaved GMP roads to 25 mph (or as posted) may help lessen some of the adverse impacts of off-road use to kit foxes along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

As described for alternative A, off-road use at Ferry Swale would likely not affect desert bighorn sheep, because this species typically avoids areas of noise and disturbance. Although a herd of desert bighorn sheep lives in the Paria Canyon-Vermilion Cliffs area, less than 15 miles southwest of Ferry Swale, impacts from designating ORV routes at Ferry Swale would likely not affect desert bighorn sheep, because this species typically avoids Highway 89 and areas of Ferry Swale east to Lake Powell. This area of avoidance constitutes a small percentage of the approximately 2,000 miles of available Lake Powell shoreline.

Reptiles

As described above for mammals, adverse impacts on the glossy snake, the only special-status reptile to occur in the area, would be localized and more detectable in areas where fewer disturbances have previously occurred. Short-term impacts of legalizing additional routes in Ferry Swale on the glossy snake include injury and mortality, as well as the physiological effects of escape responses. Long-term impacts on the glossy snake include additional habitat destruction and fragmentation, as well as changes in breeding and foraging habits. Setting the speed limit on designated ORV routes to 25 mph may help lessen some of the adverse impacts of off-road use to glossy snakes along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Birds

As described above for mammals, adverse impacts on special-status birds (e.g., burrowing owl, golden and bald eagle, and California condor) would be localized and more detectable in areas where fewer disturbances have previously occurred. Short-term impacts of legalizing additional routes in Ferry Swale include species disturbance, as well as the physiological effects of escape responses. Long-term impacts include additional habitat destruction and fragmentation, as well as changes in nesting and foraging habits. Setting the speed limit on designated ORV routes to 25 mph (or as posted) may help lessen some of the adverse impacts of off-road use to special-status birds along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Alternative C would result in no effect to the Mexican spotted owl, southwestern willow flycatcher, brown and American white pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur in the Ferry Swale area.

Plants

Impacts are expected to be negligible to none because there are no special-status plants known to occur in the Ferry Swale area due to lack of suitable habitat (Spence, pers. comm., 2012).

Cumulative Impacts

Impacts on special-status species from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future actions on special-status species would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the detectable long-term adverse impacts under alternative C, would result in long-term considerable adverse and long-term beneficial cumulative impacts on special-status species in the area of analysis.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Mammals

The impacts of alternative D on special-status mammals at Lone Rock Beach would be similar to those described for alternatives A and C, except that OHVs and street-legal ATVs would not be authorized resulting in slightly less adverse impacts on the kit fox. Prohibiting OHVs and street-legal ATVs at the beach may mitigate some of the adverse impacts of off-road use on the beach, because OHVs and street-legal ATVs are louder than conventional motor vehicles and the number of vehicles present on the beach would likely be reduced. However, this area would still be accessed by visitors for recreational use resulting in continued disturbance. Impacts on kit foxes would be minimal as there is suitable habitat in other areas nearby and kit foxes typically avoid humans and human-made noise (NatureServe 2009). Additionally, enforcing a speed limit of 15 mph at shoreline areas and implementing quiet hours after 10:00 p.m. would help minimize some of the adverse impacts of off-road use to kit foxes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Because kit foxes are primarily nocturnal species, creating quiet hours would remove of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Like alternatives A and C, impacts on bighorn sheep at Lone Rock Beach would likely be negligible, because this species prefers habitat in other areas of Glen Canyon.

Reptiles

The impacts of alternative D on special-status reptiles at Lone Rock Beach would be similar to those described for alternatives A and C, except that OHVs and street-legal ATVs would not be authorized on the beach resulting in slightly less adverse impacts on the chuckwalla. Prohibiting OHVs and street-legal ATVs at the beach may minimize some of the adverse impacts of off-road use on the beach because OHVs and street-legal ATVs are generally louder than conventional motor vehicles and the number of vehicles present on the beach would likely be reduced. However, this area would still be accessed by visitors for recreational use resulting in continued disturbance to this species. Enforcing a speed limit of 15 mph at Lone Rock Beach and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use to the chuckwalla by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Like alternative A, negligible effects would result for the night lizard and glossy snake because these species do not occur in the Lone Rock Beach area.

Birds

The impacts of alternative D on special-status birds at Lone Rock Beach would be similar to those described for alternatives A and C, except that OHVs and street-legal ATVs would not be authorized on the beach resulting in slightly less adverse impacts on affected birds (e.g., golden and bald eagle, brown and American white pelican, burrowing owl, long-billed curlew, great blue heron, and California condor). Prohibiting OHVs and street-legal ATVs at the beach may mitigate some of the adverse impacts of off-road use on the beach, because OHVs and street-legal ATVs are generally louder than conventional motor vehicles and the number of vehicles present on the beach would likely be reduced. However, this area would still be accessed by visitors for recreational use resulting in continued disturbance to sensitive birds in the area. Enforcing a speed limit of 15 mph at Lone Rock Beach and

implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use to special-status birds by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Alternative B would result in no effect to the Mexican spotted owl, southwestern willow flycatcher, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach.

Plants

The impacts of alternative D on special-status plants at Lone Rock Beach would be the same as those described for alternatives A and C; impacts are expected to be negligible to none because there are no special-status plants known to occur in this area due to lack of suitable habitat (Spence, pers. comm., 2012).

Lone Rock Beach Play Area

Discontinuing off-road use at Lone Rock Beach Play Area under alternative D, would result in the same impacts on special-status species as those described for alternative B, resulting in long-term beneficial impacts on special-status species at Lone Rock Beach Play Area (e.g., kit fox, golden and bald eagle, burrowing owl, California condor).

Accessible Shorelines

Under alternative D, off-road use at 11 accessible shorelines would be discontinued and the ORV areas allowed to recover to natural conditions. Four accessible shoreline areas (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp) would remain open only to conventional motor vehicles by permit, subject to water-level closures. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Mammals

Long-term benefits to special-status mammals (i.e., kit fox and desert bighorn sheep) would result from permanent closure of 11 accessible shorelines to off-road use as a source of habitat and species disturbance would be removed, allowing these areas to recover. Recovery of these areas could eventually reduce habitat fragmentation, resulting in localized beneficial impacts. For the four accessible shorelines that remain open (approximately 1,100 acres) to conventional motor vehicles, the same localized adverse impacts would result as those described for alternative A. Locally, along open routes and areas, species and habitat disturbance could occur, but impacts on kit foxes would likely be minimal, because this species is primarily nocturnal and generally avoids humans and human-made noise.

Under alternative D, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use at open shoreline areas by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Additionally, the kit fox, which is primarily nocturnal, would benefit from the removal of a source of disturbance after 10:00 p.m.

Reptiles

Long-term benefits to the chuckwalla would result from permanent closure of these 11 accessible shorelines to off-road use as a source of habitat and species disturbance would be removed, allowing these areas to recover. Recovery of these areas could eventually reduce habitat fragmentation resulting in localized beneficial impacts for the chuckwalla. For the four accessible shorelines that remain open (approximately 1,100 acres) to conventional

motor vehicles, the same localized adverse impacts would result as those described for alternative A. Locally, along open routes and areas, species and habitat disturbance would continue and species mortality could occur.

As described for alternatives A and C, Dirty Devil is the only accessible shoreline where the night lizard may occur. Because this shoreline would remain open under alternative D, the same minimal localized adverse impacts as described for alternative A would result for the night lizard. Implementing a speed limit of 15 mph and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use at open shoreline areas by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, the night lizard, a nocturnal species, would benefit from the removal of a source of disturbance after 10:00 p.m.

Birds

Long-term benefits to special-status birds (e.g., long-billed curlew, golden and bald eagle, and California condor) would result from permanent closure of the 11 accessible shoreline areas to off-road use because a source of habitat and species disturbance (e.g., noise) would be removed, resulting in localized beneficial impacts on sensitive bird species. For the four accessible shorelines that remain open (approximately 1,100 acres) to conventional motor vehicles, the same localized adverse impacts would result as those described for alternative A. Locally, along open routes and areas, species and habitat disturbance could occur, but impacts would be minimal, because it is likely that sensitive birds avoid these areas.

The closure of Bullfrog North and South would contribute to long-term benefits for the Mexican spotted owl, because these shoreline areas occur within the critical habitat for this species. However, Stanton Creek, Dirty Devil, and Hite Boat Ramp shorelines are also within critical habitat and would remain open for use by conventional motor vehicles, resulting in continued disturbance to potential habitat for the Mexican spotted owl.

Implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use at open shoreline areas by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Alternative D would result in no effect to the southwestern willow flycatcher, brown and American white pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur near accessible shoreline areas. Brown and American white pelican and great blue heron have been observed at accessible shoreline areas where disturbance could occur, but impacts would be reduced, because it is likely that these species would avoid these areas and relocate to the nearby restored (closed) areas.

Plants

Long-term benefits to Paria spurge could result from permanent closure of Bullfrog North and South because a source of disturbance would be removed, allowing these areas to recover. Recovery of these areas could eventually reduce habitat fragmentation, resulting in localized beneficial impacts. Alternative D would have no effect on the remaining special-status plants, because these species are not known to occur at accessible shoreline areas in Glen Canyon.

Travel on GMP Roads in Glen Canyon

Under alternative D, only conventional motor vehicles would be authorized to operate on all GMP roads in Glen Canyon.

Mammals

Under alternative D, there would be no direct impacts on special-status mammals on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on special-status species from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Reptiles

Under alternative D, there would be no direct impacts on special-status reptiles on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on special-status species from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Birds

Under alternative D, there would be no direct impacts on special-status birds on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on special-status species from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Plants

Under alternative D, there would be no direct impacts on special-status plants on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on special-status species from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

The impacts of alternative D on special-status species at Ferry Swale would be the same as those described for alternative B because no ORV routes would be designated and off-road use would not be authorized. This would lead to a reduction in habitat disturbance and fragmentation and species mortality for the kit fox, glossy snake, burrowing owl, California condor, and golden and bald eagle, the only sensitive species known to occur in this area.

Cumulative Impacts

Under alternative D, impacts on special-status species from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. As a result of discontinuation and non-designation of ORV routes, however, the overall impacts on special-status species would be greatly reduced compared to those described for alternative A. The impacts of cumulative actions, in combination with the detectable long-term beneficial impacts on special-status species under alternative D, would result in long-term beneficial cumulative impacts on special-status species in the area of analysis.

Alternative E: Mixed Use

Lone Rock Beach

Although 20 acres of Lone Rock Beach would be designated as a vehicle-free zone, the impacts of alternative E on affected special-status species at the beach would be similar to those described for alternative C. Impacts on special-status species (e.g., kit fox, long-billed curlew, chuckwalla, California condor, burrowing owl, great blue heron, brown and American white pelican, and golden and bald eagle) would be localized and adverse from the continued off-road use by conventional motor vehicles, OHVs, and street-legal ATVs, to include species disturbance and displacement, as well as vehicle-wildlife collisions. Restricting vehicle use at a specific area of the

beach may minimize some of the adverse impacts of off-road use on the beach, but this area would still be accessed by visitors for recreational use, resulting in continued disturbance to sensitive species in the area.

Enforcing a speed limit of 15 mph and implementing quiet hours after 10:00 p.m. may help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., kit fox) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

Impacts of alternative E on special-status species (including mammals, reptiles, birds, and plants) at Lone Rock Beach Play Area would be the same as those described for alternative C. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Accessible Shorelines

The impacts of alternative E on special-status species at accessible shorelines would be similar to, but less intense, those described for alternative C, because off-road use at Warm Creek would be discontinued and OHVs would not be allowed. Similar to alternative C, Paiute Farms and Nokai Canyon would be authorized for use by conventional motor vehicles and street-legal ATVs. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Mammals

Habitat near Warm Creek would be allowed to recover to natural conditions over the long term, resulting in long-term benefits for kit foxes and desert bighorn sheep. The authorization of Paiute Farms and Nokai Canyon for use by conventional motor vehicles and street-legal ATVs would result in negligible effects to both species because neither is common in those areas. Under alternative E, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Reptiles

Habitat near Warm Creek would be restored to natural conditions over the long term, resulting in localized, long-term benefits to chuckwallas occurring in that area from a reduction in traffic, noise, and vehicle emissions. The authorization of Paiute Farms and Nokai Canyon for use by conventional motor vehicles and street-legal ATVs could result in localized adverse impacts; however, new disturbances would be limited because Paiute Farms and Nokai Canyon are currently being accessed.

Under alternative E, implementing a speed limit of 15 mph at open accessible shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Birds

Habitat near Warm Creek would be restored to natural conditions over the long term, resulting in localized, long-term benefits to sensitive birds (e.g., California condor, burrowing owl, long-billed curlew, and golden and bald eagle) occurring in that area. The authorization of Paiute Farms and Nokai Canyon for use by conventional motor vehicles and street-legal ATVs would result in limited adverse impacts, because these areas are currently being accessed. Prohibiting off-road use at Warm Creek would likely result in beneficial impacts than current conditions from reduced traffic, noise, and emissions. Under alternative E, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help minimize some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Alternative E would result in no effect on the southwestern willow flycatcher, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at accessible shoreline areas. Brown and American white pelican and great blue heron have been observed at accessible shoreline areas where disturbance could occur, but impacts would be reduced, because it is likely that these species would avoid these areas and relocate to the nearby restored (closed) areas.

Plants

The impacts of alternative E on special-status plants at accessible shorelines would be the same as alternatives A and C; no plants exist at these locations except for Paria spurge at Bullfrog North and South.

Travel on GMP Roads in Glen Canyon

The impacts of alternative E on special-status species from the use of conventional motor vehicles and street-legal ATVs on paved GMP roads and conventional motor vehicles, OHVs, and street-legal ATVs on unpaved GMP roads would be similar to, but less geographically dispersed, than those described for alternative C, because no OHVs or street-legal ATVs would be allowed on any road segments of the Orange Cliffs Unit.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 15 miles of designated ORV routes in the Ferry Swale area. Impacts of alternative E on special-status species (including mammals, reptiles, birds, and plants) would be the same as those described for alternative C.

Cumulative Impacts

Impacts on special-status species from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future actions on special-status species would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the detectable long-term adverse impacts under alternative E, would result in long-term detectable adverse and long-term beneficial cumulative impacts on special-status species in the area of analysis.

Conclusion

Compared to alternative A, alternative B would provide the most protection for special-status species and would increase the amount of habitat available within Glen Canyon. By prohibiting off-road use at accessible shorelines, Lone Rock Beach, Lone Rock Beach Play Area, and Ferry Swale management actions under alternative B would result in Glen Canyon-wide, long-term, beneficial impacts for many special-status species by allowing previously

disturbed areas the opportunity to recover. Improvement to habitat would be most notable in areas of currently heavy off-road use. Alternative D would similarly provide beneficial impacts by limiting areas authorized for off-road driving, thereby increasing available habitat for special-status species. Benefits would especially occur to species such as the chuckwalla, kit fox, desert bighorn sheep, golden and bald eagle, and long-billed curlew.

Compared to alternative A, alternative C could result in slightly more adverse impacts on affected special-status species, due to authorization of additional on-road use by OHVs and street-legal ATVs within Glen Canyon, including the Orange Cliffs Unit. However, alternative C (as well as alternative E) would not designate as many miles of ORV routes in Ferry Swale as under alternative A so special-status species in the Ferry Swale area would benefit under alternatives C and E as compared to alternative A. Additionally, monitoring and mitigation measures such as seasonal closures to protect special-status species, such as Desert Bighorn Sheep, in this area would reduce impacts. However, areas with previous user-created routes would benefit from restoration under alternative C.

Compared to alternatives A, alternative E would be slightly more protective of affected special-status species within Glen Canyon. Discontinuing off-road use at Warm Creek would result in beneficial impacts on certain special-status species (e.g., kit fox, desert bighorn sheep, long-billed curlew, golden and bald eagle, and chuckwalla) in that area by allowing previously disturbed habitat the opportunity to recover. Although Paiute Farms and Nokai Canyon would be officially opened under alternative E, impacts on special-status species occurring in those areas would be comparable to alternative A, because these shorelines are currently being accessed.

As described above, impacts to special-status species include disturbance, displacement, habitat destruction, and vehicle-wildlife collisions which may result in injury or mortality. Other impacts range from injury during escape responses to the more-severe habitat avoidance and nest abandonment. Special-status reptiles and birds nesting or resting on or near the ground at accessible shoreline areas would likely be more vulnerable to the effects of motorized vehicles, due to direct exposure of nests and young to visitors and motorized vehicles. Vehicle-wildlife collisions or frequent escape response events (e.g., flushing) could increase species injury or mortality. Shorebirds that use the area for foraging and resting are at particular risk since they are some of the longest distance migratory birds and, as such, the energy demands of migration are extreme. Disturbance results in a reduction in time spent foraging and a reduction in fuel stores spent during times of flying. The level of impact this causes is dependent upon the species and the level of disturbance. Special-status species with the highest potential for impact would be those that inhabit blackbrush, sand sagebrush, and shadscale vegetation communities like the kit fox, burrowing owl, and chuckwalla. Deserts and arid regions are generally considered areas of low productivity and damage to arid vegetation can be immediate and long lasting, especially for rare, specialized plant species.

Overall, impacts to special-status species will be localized and short-term. When evaluating the significance of impacts to special-status species, the context in which the impact occurs must be considered. While impacts may be very intense in some cases, including morality, none of the adverse impacts under any of the alternatives are expected to impact the population or viability of any of these special-status species. Use along shorelines, roads, and on ORV routes will likely be sporadic. In some cases, such as the remote shorelines, special-status species may not be disturbed for days or weeks at a time. In the context of Glen Canyon, disturbance to special-status species may not be even be detectable. When considering impacts in the context of vegetation types and availability, the impacts remain small. The primary habitat types impacted under the alternative with the most use under this plan are the blackbrush and shadscale habitat. This plan impacts less than 1% of available habitats of this type. Further, substantial unfragmented habitat remains for all of these species, despite use that may be authorized under this plan. In conclusion, none of the impacts to special-status species are expected to be significant. None of the habitats impacted under this plan is especially rare or critical for any special-status species. Disturbance is expected to be isolated to areas of use, many of which have been disturbed by vehicle use since Glen Canyon was established, thereby not creating new disturbance. Species mortality is not expected to be frequent nor will it likely impact viability of any species.

SOUNDSCAPES

GUIDING REGULATIONS AND POLICIES

An intact natural soundscape enhances visitor experience and allows for natural functioning of wildlife communication. Regarding general soundscape management, NPS *Management Policies 2006*, Section 4.9 "Soundscape Management," requires that the Park Service to "preserve, to the greatest extent possible, the natural soundscapes of parks." Additionally, NPS "will restore to the natural condition wherever possible those soundscapes that have become degraded by the unnatural sounds (noise), and will protect natural soundscapes from unacceptable impacts" (NPS 2006a). Director's Order 47: Soundscape Preservation and Management, was developed to emphasize NPS policies "that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources." This Director's Order also directs park managers to measure acoustic conditions, differentiate existing or proposed human-made sounds that are consistent with park purposes, set acoustic goals based on the sounds deemed consistent with the park purpose, and determine which noise sources are impacting the parks (NPS 2000).

Additionally, 36 CFR 2.12, "Audio Disturbance," prohibits the operation of motorized vehicles on lands administered by NPS that create noise in excess of 60 A-weighted decibels (dBA) at a distance of 50 feet from the source or, if below that noise level, noise which is unreasonable. Reasonableness is dependent on several factors including the nature and purpose of the factor's conduct, location and time of occurrence, the park's purpose and the impact the noise has on park users (36 CFR 2.12).

METHODOLOGY AND ASSUMPTIONS

The metric chosen for soundscapes impact assessment purposes was the A-weighted L_{max} (maximum sound level during the pass-by of one ORV). While consideration of other indicators could be desirable, there is insufficient information on the number of ORVs using each area/road and the precise location of the vehicles at specific times to accurately model time-dependent metrics such as L_{eq}[13] or percent time audible. The analysis of L_{max} provides a reasonable basis for comparing the sound levels resulting from the various alternatives that involve restrictions on operating areas and vehicle sound emissions limits.

In order to assess L_{max} sound levels, it was first necessary to define the noise characteristics of the ORVs operating in Glen Canyon. The characterization of ORV noise for this EIS was based on a detailed study of ORV noise emissions conducted at Lake Meredith National Recreation Area (Wyle 2011). The study at Lake Meredith developed a "composite source" to represent average noise emissions for analysis purposes. The composite source was developed based on noise monitoring 20 feet from the entrance to the Rosita Flats ORV area at Lake Meredith and included ATVs, motorcycles (both two- and four-stroke engine types), various OHVs and conventional motor vehicles. The average composite source results in a L_{max} of 80.1 dBA at a distance of six meters from the source.

The Lake Meredith study also developed a composite source for proposed limits on motor vehicle sound levels. This composite source is referred to as the "96 dBA composite source" and was also adopted for use in this EIS because the concept of imposing a 96 dBA limit (measured 0.5 meters from the tailpipe) is also under consideration

[13] L_{eq} is the constant sound level that conveys the same energy as the variable sound levels during the analysis period. Refer to chapter 3 for more information on the definitions of various soundscapes metrics.

at Glen Canyon.[14] The "96 dBA composite source" results in a L_{max} of 75.2 dBA at a distance of six meters from the source. The 95 dBA composite source is about 5 dBA quieter than the average composite source, which means it will result in a smaller impact area than the average composite source impact area.

NPS has created a spreadsheet noise analysis tool that incorporates the average composite source and the 96 dBA composite source characteristics. The spreadsheet noise analysis tool includes conventional vehicle noise spectra at 15, 25, and 55 mph based on the research conducted during the development of the Federal Highway Administration Traffic Noise Model (FHWA 1995). The conventional motor vehicle noise spectra was used in analyzing the ORV areas/roads open to conventional motor vehicles only. OHVs and street-legal ATVs are generally louder than conventional motor vehicles. ORV areas, roads and designated ORV routes shared with conventional motor vehicles were therefore conservatively modeled as OHV and street-legal ATV roads.

The spreadsheet analysis tool also accounts for the attenuation of sound with increasing distance from the source, including atmospheric effects. The data inputs include the distance from the source, relative humidity, atmospheric pressure and temperature. Physical obstructions and topography that may attenuate noise levels at the receptor location are not included, thus providing a conservative assessment of noise levels. The spreadsheet was based on attenuation over land; therefore areas of water were excluded from the analysis. The reported acreages potentially affected by motorized vehicle noise refer to land area only.

For OHVs and street-legal ATVs, the spreadsheet noise analysis tool assumes a range of vehicle speeds based on the data from Lake Meredith; it cannot be used to predict the difference in noise levels as a result of a change in speed. There is insufficient data available to characterize the effect of speed limit changes on noise at Glen Canyon. However, this limitation would not substantially change the results or relative comparisons between the alternatives. The importance of speed in overall vehicle noise levels is greatest on paved surfaces, where the total noise level at higher speeds is dominated by tire-pavement interaction. At lower speeds (such as those occurring on unpaved roads in Glen Canyon), total noise is dominated by engine noise. Speed is less important to total noise on unpaved roads. Therefore, the change in the speed limit on unpaved GMP roads under the action alternatives would have a minor effect on overall noise levels (no speed limit change is proposed on paved roads). Speed effects on noise were taken into account for areas open to conventional motor vehicles, based on the Federal Highway Administration data noted above.

The noise spreadsheet analysis tool was used to determine the distance from the source at which motor vehicle noise would decrease to be equivalent to the natural ambient level. The natural ambient sound level is the sound level that would occur in the absence of human activities. The natural ambient sound level assumption selected for the analysis based was a uniform 20 dBA across all areas of Glen Canyon, based on the monitoring data (see chapter 3). The 20 dBA natural ambient level is representative of daytime summer conditions. Although higher natural ambient levels were estimated in some areas of Glen Canyon near Lone Rock, those estimates were not considered reliable because human-caused sounds were audible for greater than 75% of the time in those locations. The 20 dBA natural ambient level is supported by the majority of the monitoring sites.

Meteorological inputs were also selected to represent summer daytime conditions in Page, Arizona (85 °F, 20% relative humidity and atmospheric pressure of 30 inches of mercury).

---

[14] The 96 dBA limit is under consideration as a potential mitigation measure for this ORV management plan/DEIS. The 96 dBA limit was selected because it is an established industry standard with a well-defined measurement protocol (SAE J1287 standard). http://www.amraracing.com/resources/SAE-J1287.pdf.
The 96 dBA limit is a practicable limit that has been used by other states, including California.
http://ohv.parks.ca.gov/?page_id=24891.

As described above, the average composite ORV source noise[15] has an L_{max} of 80.1 dBA at a distance of six meters (18 feet) from the source. Based on the input assumptions described above, it takes 8,020 feet from the source for the average composite source noise to drop down to be equal to the natural ambient level of 20 dBA. With the proposed 96 dB tailpipe noise limit, this distance is reduced to 5,460 feet. Within these distances, ORVs would result in a 3 dBA or greater increase in sound levels over the natural ambient level. This is because decibels are expressed on a logarithmic scale and cannot be added together directly. Through "decibel addition," two sources at the same sound level combine to create a total sound level 3 dBA higher (FTA 2006).

For ORV areas open to conventional motor vehicles only operating at a maximum speed of 15 mph (such as Lone Rock Beach under alternative D, and accessible shorelines under alternatives A and D), noise levels would drop to equal the natural ambient level of 20 dBA at 2,900 feet from the source. These off-road uses of conventional motor vehicles on accessible shorelines were evaluated as part of direct impacts.

As part of the assessment of cumulative impacts, conventional motor vehicle-only GMP roads were analyzed. Conventional vehicle use on GMP roads was not included as part of direct impacts because it is not the subject to management actions under this plan/DEIS. Thus, the cumulative impact scenario for each alternative includes all the direct impacts, plus the use of conventional motor vehicles on GMP roads. Although the speed limit on GMP roads varies, these roads were conservatively assumed to operate at 55 mph, though the actual speed is generally less than 45 mph (except in Orange Cliffs Unit where 15 mph is the speed limit) (NPS 2013a). At 55 mph, conventional motor vehicle noise would take 10,850 feet to drop to equal the natural ambient level.

An increase in the ambient noise level affects the ability of humans and animals to perceive other sounds within a certain distance. In general, the higher the ambient noise level, the shorter the distance from which other sounds (for example those of a songbird) can be heard. This concept is expressed in terms of listening area and alerting distance. In terms of impact metrics, a 3 dBA increase in the natural ambient level is an important indicator of potential impact because it results in a 50% reduction in listening area for humans and animals and a 30% reduction in alerting distance, as described below (NPS 2010a).

Reduction in listening area quantifies the loss of hearing ability to humans and animals as a result of an increase in ambient noise level. Under natural ambient conditions a sound is audible within a certain area around a visitor or animal. If the ambient level is increased due to a noise event, the area in which the sound is audible decreases. Table 32 and figure 30 illustrate the relationship between increased ambient and listening area reduction.

Table 32: Reduction in Listening Area and Alerting Distance Due to Increases in Ambient Levels

dBA Ambient Increase	3	6	10	20
Percent Reduction in Listening Area	50%	75%	90%	99%
Percent Reduction in Alerting Distance	30%	50%	70%	90%

[15] Based on a mix of ATVs, motorcycles (both two- and four-stroke engine types), various OHVs and conventional motor vehicles at Rosita Flats, Lake Meredith National Recreation Area (Wyle 2011).

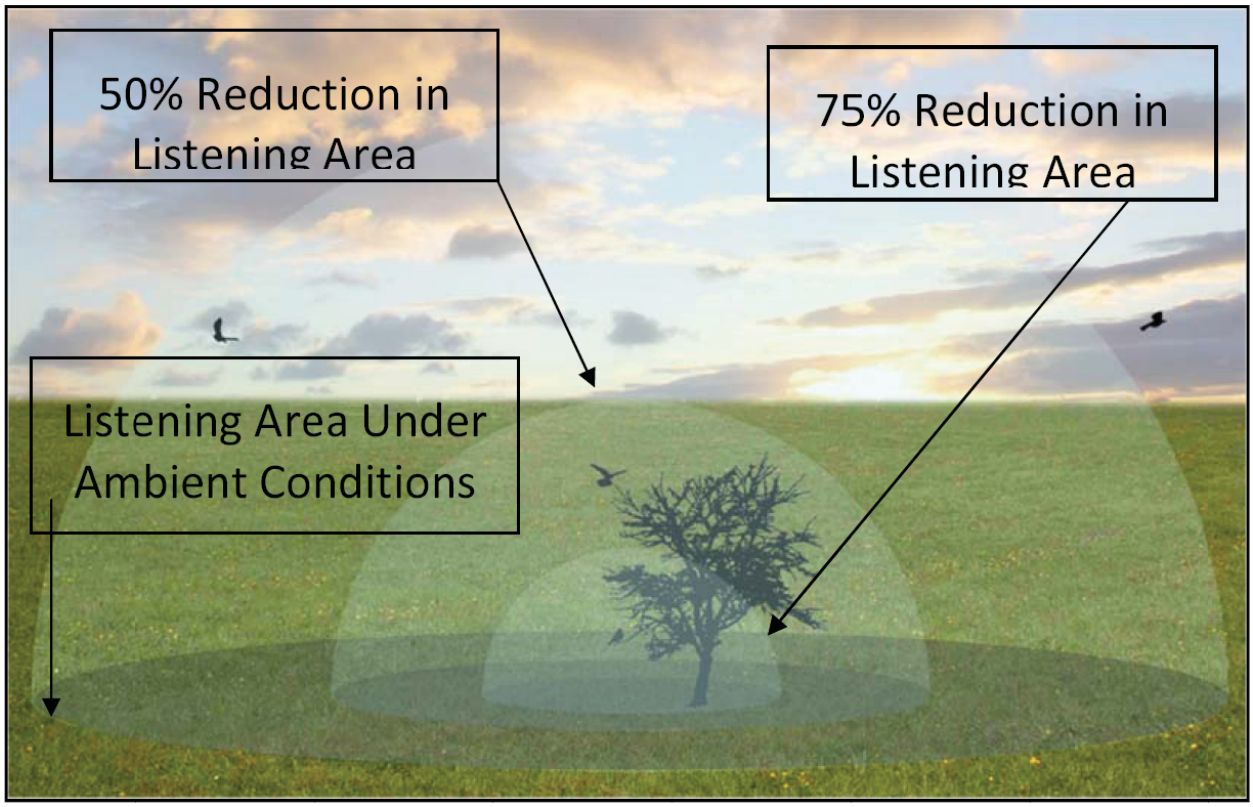


Figure 30: Reduction in Listening Area

For example, under natural ambient conditions, an owl perched in a tree may be able to hear a mouse scurrying through the brush anywhere within an area of 100-square-meters of the perch. If a noise event increases the ambient level by 3 decibels (dBA), the area in which the owl can hear a mouse would decrease by 50% to approximately 50 square meters.

Reduction in alerting distance is closely related to reduction in listening area. The residual alerting distance is equal to the square root of the residual listening area. Instead of addressing losses in terms of an area, reduction in alerting distance expresses the reduction as a linear distance from a source. For example, under natural ambient conditions, a hiker may be alerted to the sound of a flash flood at a distance of 1 mile. If a noise such as an ORV increases the ambient level by 6 dBA, the distance at which the flood could be detected would decrease by 50% to approximately 1/2 mile or 2,640 feet (NPS 2010a).

Visitors and wildlife are impacted by their failure to hear natural sounds that would have been audible in the absence of noise: a bird misses the sound of a worm, a mouse misses the footfall of a coyote, or a visitor misses the sound of a distant waterfall. Reductions in listening area and alerting distance capture these types of impacts.

Impact Calculations

The acreage of Glen Canyon that would experience a 3 dBA increase in sound levels over the existing natural ambient level due to motorized vehicles was determined for each alternative using GIS. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Direct impacts on soundscapes were assessed based on the areas where a change in management actions is being considered in this plan/DEIS. The analysis of direct impacts on soundscapes included:

- Lone Rock Beach and Lone Rock Beach Play Area (all vehicle types, including conditions where only conventional motor vehicles would be allowed (e.g., Lone Rock Beach under alternative D)).
- Accessible shorelines (all vehicle types, including conditions where only conventional motor vehicles would be allowed (e.g., alternatives A and D)).
- GMP roads (only those roads where OHVs and street-legal ATVs would be allowed, not conventional motor vehicle- only roads).
- Ferry Swale ORV routes.

The analysis of direct impacts did not include paved roads and unpaved GMP roads accessible only to conventional motor vehicles because use of this type of motor vehicle on these roads would not be changed within the scope of this plan/DEIS. However, a separate impact calculation was performed for purposes of analyzing cumulative soundscape impacts that included GMP roads allowed to be used only by conventional motor vehicles and not by OHVs or street-legal ATVs.

The direct and cumulative impact analyses were focused on determining the impact of motorized vehicle use on soundscapes within the Glen Canyon boundaries only. Given the prevalence of motor vehicle use on surrounding federal lands and the already elevated noise levels associated with such uses, analysis of impacts on areas outside the boundaries of Glen Canyon was not the focus of this study.

Context

The study area for the soundscapes impact assessment was defined as the entire Glen Canyon area.

Alternative A: No Action

As shown in figure 31a, direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs under alternative A total 362,269 acres of land (28.88% of the Glen Canyon land area). These areas could potentially experience a 3 dBA increase in natural ambient level due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur.

Lone Rock Beach and Play Area

Lone Rock Beach and the Lone Rock Beach Play Area would remain open to conventional motor vehicles, OHVs, and street-legal ATVs under alternative A. The level of use of these areas is expected to remain high and similar to existing conditions (77,000 vehicle entrances in 2011; see the “Socioeconomics” section in this chapter). Impacts would extend up to 8,020 feet away from Lone Rock Beach and the play area. All of Lone Rock Beach would be within the noise effect zone of motor vehicle use at the Lone Rock Beach Play Area under alternative A (see figure 31a). This would include impacts on the listening area of wildlife and non-motorized human uses. The duration of impacts during each day could be extensive—the play area in particular can result in nearly continuous motorized vehicle use during the day (see chapter 3). Although not accounted for in the quantitative analysis, the higher speed and frequent maneuvers conducted in the play area (vehicles operating at full throttle) contributes to relatively higher intensity of soundscape impacts in comparison to the impacts from the same vehicles operating under cruise conditions along roadways.

Accessible Shorelines

Thirteen accessible shoreline areas Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp), would remain open to conventional motor vehicles, subject to water-level closures. No OHVs or street-legal ATVs would be allowed on these shorelines. Access to Pauite Farms and Nokai Canyon would be discontinued and no direct impacts on soundscapes would occur. Impacts from conventional vehicles operating at 15 mph would extend up to 2,900 feet from each shoreline during times when the vehicles are operating. However, the typical usage pattern at the accessible shorelines is that vehicles drive to the beach and park, thus the duration of impacts would be short term and the intensity of impacts would be low. Under alternative A, occasional illegal use could occur in areas adjacent to the accessible shorelines where the designated ORV areas is no longer bounded by natural features and are exposed to off-road use where motorized vehicles are not permitted. The extent to which illegal use would occur is not known.

Travel on GMP Roads in Glen Canyon

In addition to conventional motor vehicles, street-legal ATVs would be allowed to operate on all GMP roads in Glen Canyon under alternative A, with the exception of the Orange Cliffs Unit, where street-legal ATVs would not be allowed. Street-legal ATVs would likely be substantially louder than conventional motor vehicles and would be the predominate noise source (see the Soundscapes' methodology section for sources of noise source data). Impacts would extend up to 8,020 feet away from each road during an ATV pass-by (each individual pass-by would be a short-term event). Impacts on the listening area of wildlife and non-motorized human uses would occur in adjacent areas of land, as shown in figure 31a. The extent of impacts could be greater than shown in figure 31a due to illegal off-road use. Although no data is available on exact volumes, the GMP roads (especially unpaved roads) have low traffic volumes. Therefore, the duration of street-legal ATV impacts on soundscapes would be short-term and the intensity of impacts would be low.

Ferry Swale

Soundscape impacts (3 dBA increase or greater over the natural ambient level) would extend up to 8,020 feet from the approximately 53 miles of designated ORV routes under alternative A. Most of the noise effect zones of the designated ORV routes overlap with the noise effect zones of GMP roads, however the intensity of impacts would be increased with OHV and street-legal ATV activity along the routes. The extent of impacts could be increased further should illegal occasional off-road use occur.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions both outside and within Glen Canyon have the potential to impact soundscapes in Glen Canyon. Actions by others potentially contributing to cumulative impacts on soundscapes are described below followed by the cumulative impacts conclusion for alternative A.

Cumulative Impact of Motorized Vehicle Use in Glen Canyon

The cumulative noise effect zone under alternative A would cover 38.88% of Glen Canyon land area (see figure 31b). The cumulative noise effect zone under alternative A would include unpaved GMP roads where only conventional motor vehicles are authorized (in the Orange Cliffs Unit), plus the direct impacts discussed above.

Aircraft Overflights

Monitoring data shows that jet aircraft (commercial and military) are audible on average between 19% (summer) and 28% (winter) of the time in back country areas. Propeller aircraft such as those typically used by air tour

operators are audible less often, around 3% of the time in the summer and winter (see chapter 3). Air tours are more common in certain areas of Glen Canyon, such as the Rainbow Bridge area in the summer. Overall, aircraft are the predominate source of human-caused sound in the remote backcountry areas distant from roads and waterbodies and an important contributor to cumulative impacts on soundscapes.

There are two designated air strips in Glen Canyon: Bullfrog and Hite. These are used by visitors and NPS staff.

The surface of Lake Powell is also a designated landing area, subject to certain restrictions (36 CFR 7.70).

Military bases in the vicinity of Glen Canyon include Hill Air Force Base, Nellis Air Force Base, and Creech Air Force Base. Aircraft from these military installations, as well as others in the vicinity, contribute to the ambient noise level at Glen Canyon from overflights.

One event that has increased air tours and air traffic in Glen Canyon was the 2009 development of the Amangiri Resort in Utah, near the boundaries of Glen Canyon. The Amangiri Resort is located south of U.S. 89 and approximately 1/2 mile north of the Arizona border. The resort launches hot air balloon tours directly from this site and assists guests in arranging air tours by plane from nearby airports, including Page, Arizona (Amangiri n.d). No information is available on frequency of air tours over Glen Canyon or the sound levels generated by aircraft and balloons during these events.

An Air Tour Management Plan does not currently exist for Glen Canyon. The operation of air tours over Glen Canyon is granted by FAA per the interim operating authority allowed by the National Parks Air Tour Management Act final rule (14 CFR 136) There are currently no near-term plans to develop an Air Tour Management Plan at Glen Canyon.[16]

Watercraft

Recreational watercraft (including personal watercraft) use on Lake Powell is a substantial source of human-caused noise, particularly in developed areas where watercraft can be audible 35% or more of the time during the summer. Watercraft were audible 3% of the time on average in backcountry areas (see chapter 3.

Personal watercraft use at Glen Canyon has been comprehensively addressed through the 2003 Personal Watercraft Rulemaking EIS (NPS 2003). A key outcome of this rulemaking is that all personal watercraft two-stroke carbureted engines would be prohibited at the end 2012, substantially reducing personal watercraft noise because two-stroke engines are louder than four-stroke engines. Personal watercraft noise would not be eliminated though, and would still be a prominent aspect of the soundscape on the water and near shorelines. Personal watercraft are not discernible above the natural soundscape in areas of Glen Canyon more than 1 or 2 miles away from the shoreline (NPS 2003).

2008 Uplake Development Concept Plan/Environmental Assessment

The Uplake DCP/EA involves a 15–20 year program of improvements to three marinas—Bull Frog, Halls Crossing and Hite. Collectively, these marinas are referred to as the uplake area. The planned improvements include additional employee and concessionaire housing, additional rental units for visitor overnight stays, campground expansions, an increase in the number of slips available for rental boats/personal watercraft at the marinas, and public boat launch improvements, among others. The uplake improvements would impact soundscapes temporarily

[16] http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/air_tour_management_plan/park_specific_plans/glencanyon.cfm.

during construction activities and will be mitigated by requiring contractors to maintain mufflers on construction equipment and limiting the construction hours of operation to minimize visitor use impacts (NPS 2008e, 2009c). The uplake improvements could incrementally increase long-term human impacts on natural soundscapes if the new amenities increase visitor levels.

Motorized Vehicle Use on Adjacent Federal Lands

Motorized vehicle use on roads and off-road on adjacent BLM lands (including the Grand Staircase – Escalante National Monument) can contribute to impacts on natural soundscapes within the boundaries of Glen Canyon. This includes unauthorized off-road use as well as authorized use. However, insufficient information on the timing, location and number of users of these areas is available to assess their impacts in detail.

Cumulative Impacts Conclusion

The potentially adverse impacts on soundscapes from aircraft overflights, watercraft, and motorized vehicle use on roads and off-road within Glen Canyon and on adjacent federal lands would result in long-term adverse cumulative impacts when combined with the direct impacts of alternative A.

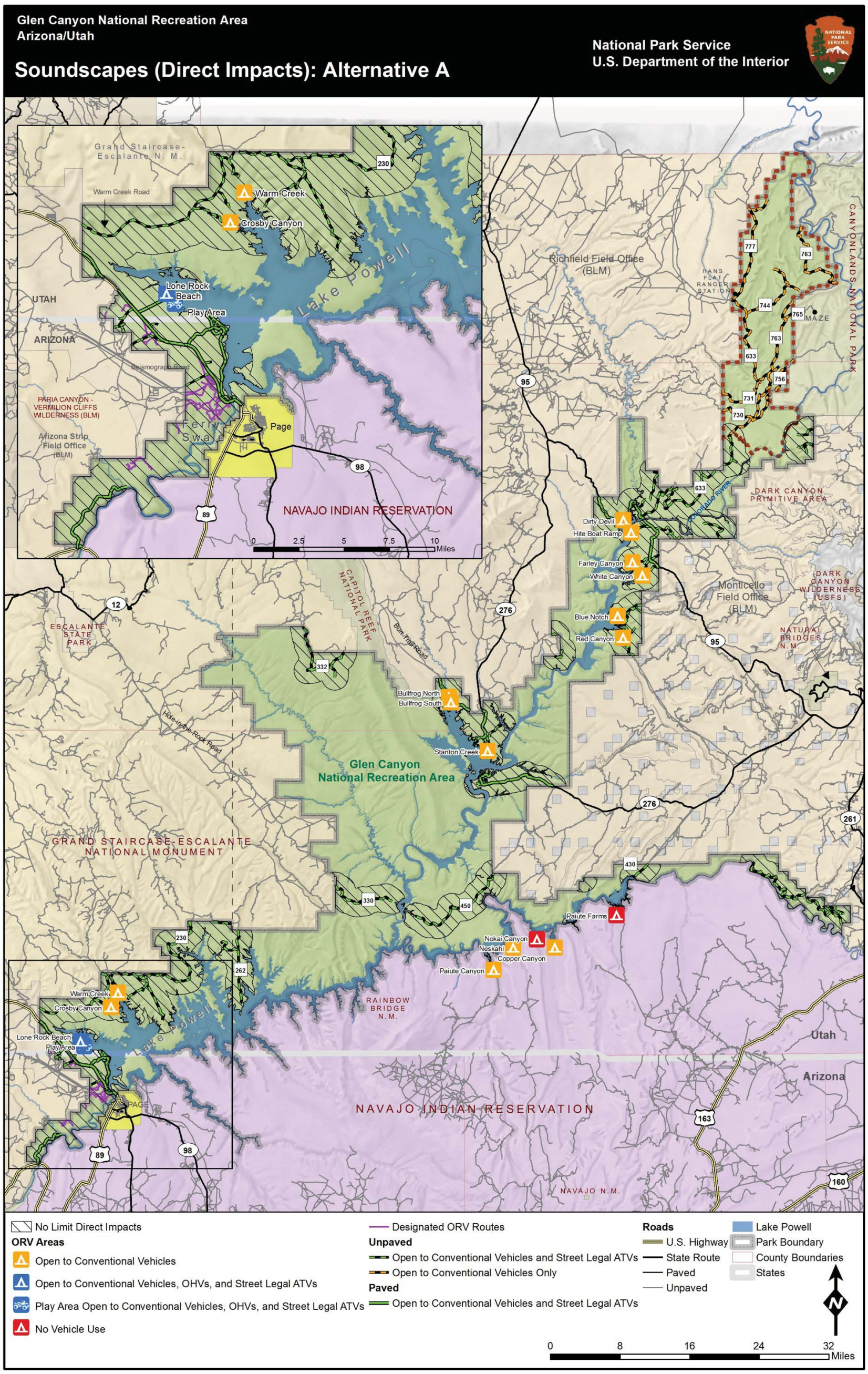


FIGURE 31A: DIRECT IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE A

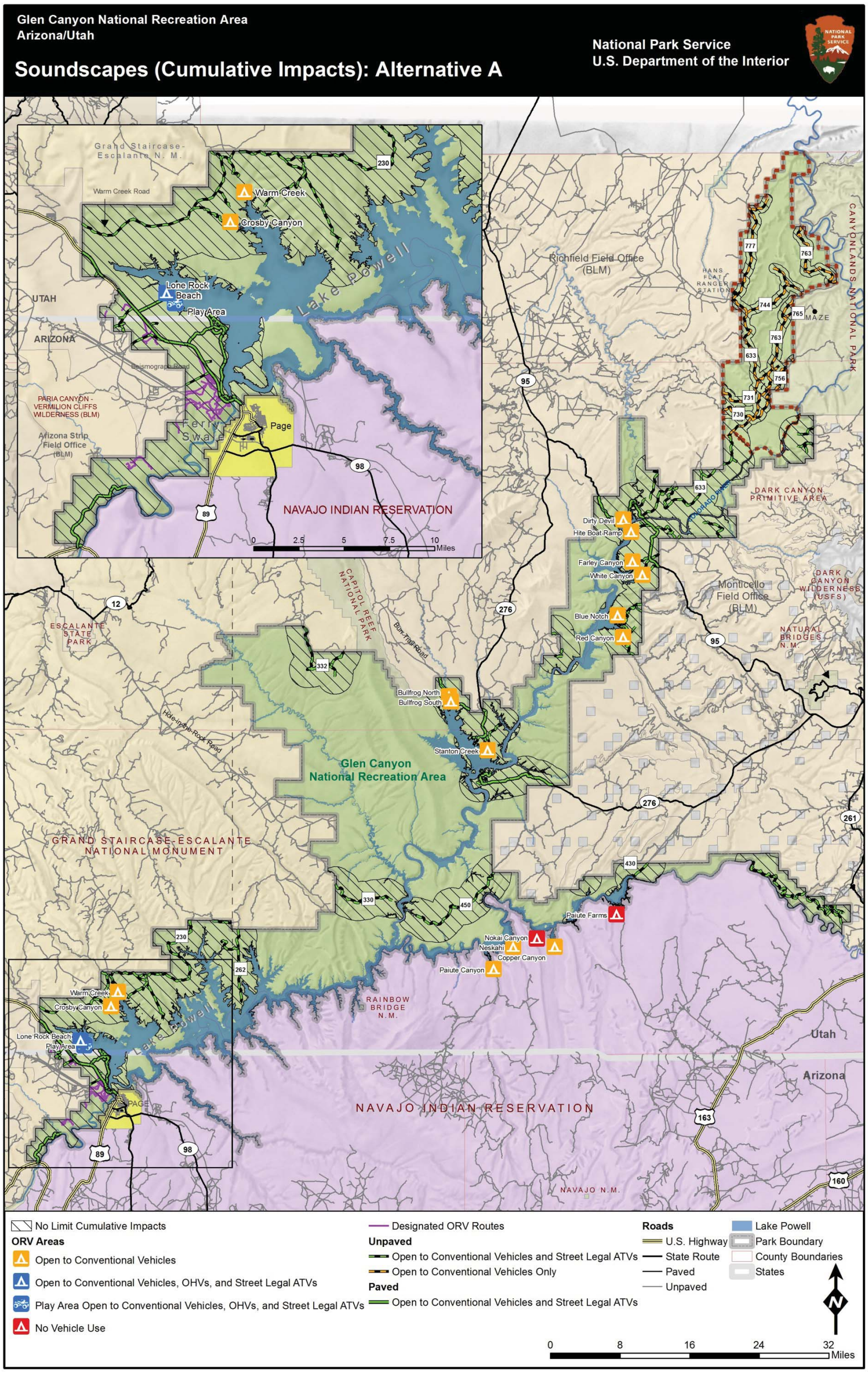


FIGURE 31B: CUMULATIVE IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE A

Alternative B: No Off-road Use

As shown in figure 32a, direct impacts under alternative B total 351,408 acres of land (28.02% of the Glen Canyon land area). These areas could potentially experience a 3 dBA increase in natural ambient level due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially decreased through implementation of the 96 dBA limit on ATVs (80,906 fewer acres within the direct impact noise effect zone or 21.57% of Glen Canyon).

Lone Rock Beach and Play Area

Off-road use would be discontinued at Lone Rock Beach and the Lone Rock Play under alternative B. Therefore, no direct impacts on soundscapes would occur from these areas under alternative B.

However, Lone Rock Road (the paved road that ends at the beginning of Lone Rock Beach) would remain open to conventional motor vehicles and street-legal ATVs. As a result of this road remaining open, all of Lone Rock Beach would remain in the motorized vehicle noise effect zone during vehicle pass-bys (with the 96 dBA limit). However, the number of vehicles using Lone Rock Road could likely be reduced without the beach or play area being open. This would result in a corresponding reduction in the duration of human changes in soundscapes and associated impacts on wildlife listening area and non-motorized human uses. The elimination of off-road uses would eliminate soundscapes impacts associated with higher speed activities at the Lone Rock Beach Play Area.

Implementation of the 96 dBA limit would likely provide a noticeable reduction in overall street-legal ATV sound levels operating on Lone Rock Road by eliminating the loudest vehicles.

Accessible Shorelines

Off-road use would be discontinued at accessible shorelines under alternative B, therefore no direct impacts on soundscapes would occur due to accessible shorelines under alternative B. Portions of the shoreline areas would be within the noise effect zone of street-legal ATVs operating on nearby GMP roads, but the extent of this impact would be reduced through implementation of the 96 dBA limit.

Travel on GMP Roads in Glen Canyon

Adoption of the 96 dBA tailpipe limit would likely provide a noticeable reduction in overall motorized vehicle sound levels by eliminating the loudest street-legal ATVs. With the tailpipe noise limit, impacts would extend 5,460 feet from the road during an ATV pass-by. In addition, a minor reduction in the noise effect zone could occur due to the reduction of the speed limit on unpaved GMP roads from 45 mph to 25 mph. For reasons discussed in the methodology section, this potential benefit was not accounted for in the spreadsheet analysis and tabulation of acreage within the noise effect zone.

Ferry Swale

No ORV routes would be designated in the Ferry Swale area under alternative B, therefore no direct impacts on soundscapes would occur.

Cumulative Impacts

The actions contributing to cumulative impacts under alternative B would be the same as described for alternative A. Approximately 38.36% of Glen Canyon would be in the cumulative noise effect zone under alternative B, with a

limit on street-legal ATV noise. The cumulative impact percentage would not increase without the 96 dBA limit on street-legal ATVs because conventional motor vehicle effects dominate the overall cumulative impact acreage calculation. The southern parts of Crosby Canyon and Warm Creek that would be within the cumulative noise effect zone under alternative A would not be in the cumulative noise effect zone under alternative B. The extent of cumulative impacts would be reduced around Bullfrog North and South although portions of these areas would still be within the noise effect zone of unpaved GMP roads under alternative B. The portions of Paiute Canyon, Neskahi, and Copper Canyon within Glen Canyon would no longer be within the motorized vehicle noise effect zone.

The potentially adverse impacts on soundscapes from aircraft overflights, watercraft, and motorized vehicle use on roads and off-road within Glen Canyon and on adjacent federal lands would result in long-term adverse cumulative impacts when combined with the direct impacts of alternative B. Cumulative impacts would be less than those under alternative A because of the elimination of off-road use by all types of motor vehicles, including conventional motor vehicles, OHVs, and street-legal ATVs, within Glen Canyon and would be further reduced through mitigation (e.g., the 96 dBA limit).

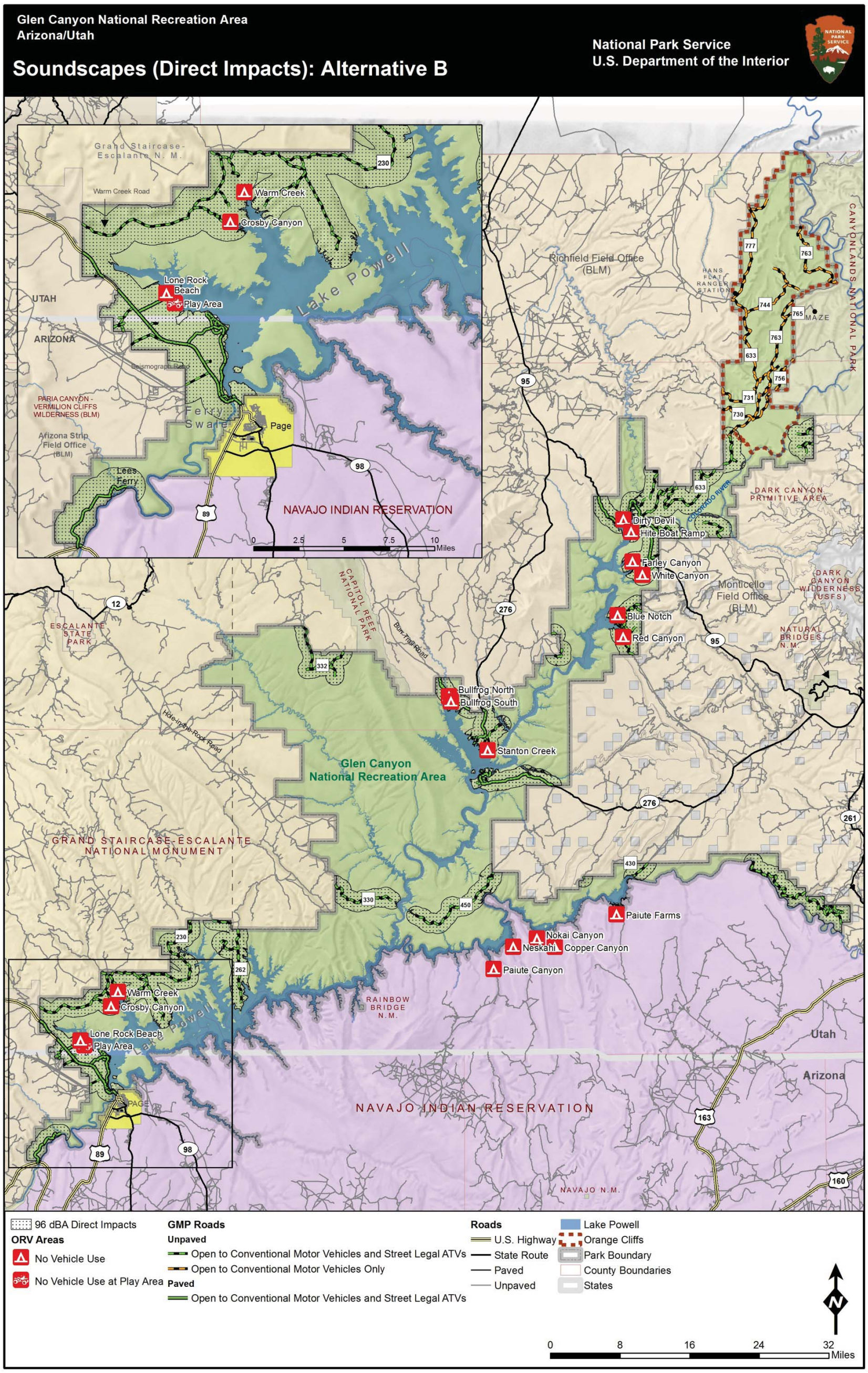


FIGURE 32A: DIRECT IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE B

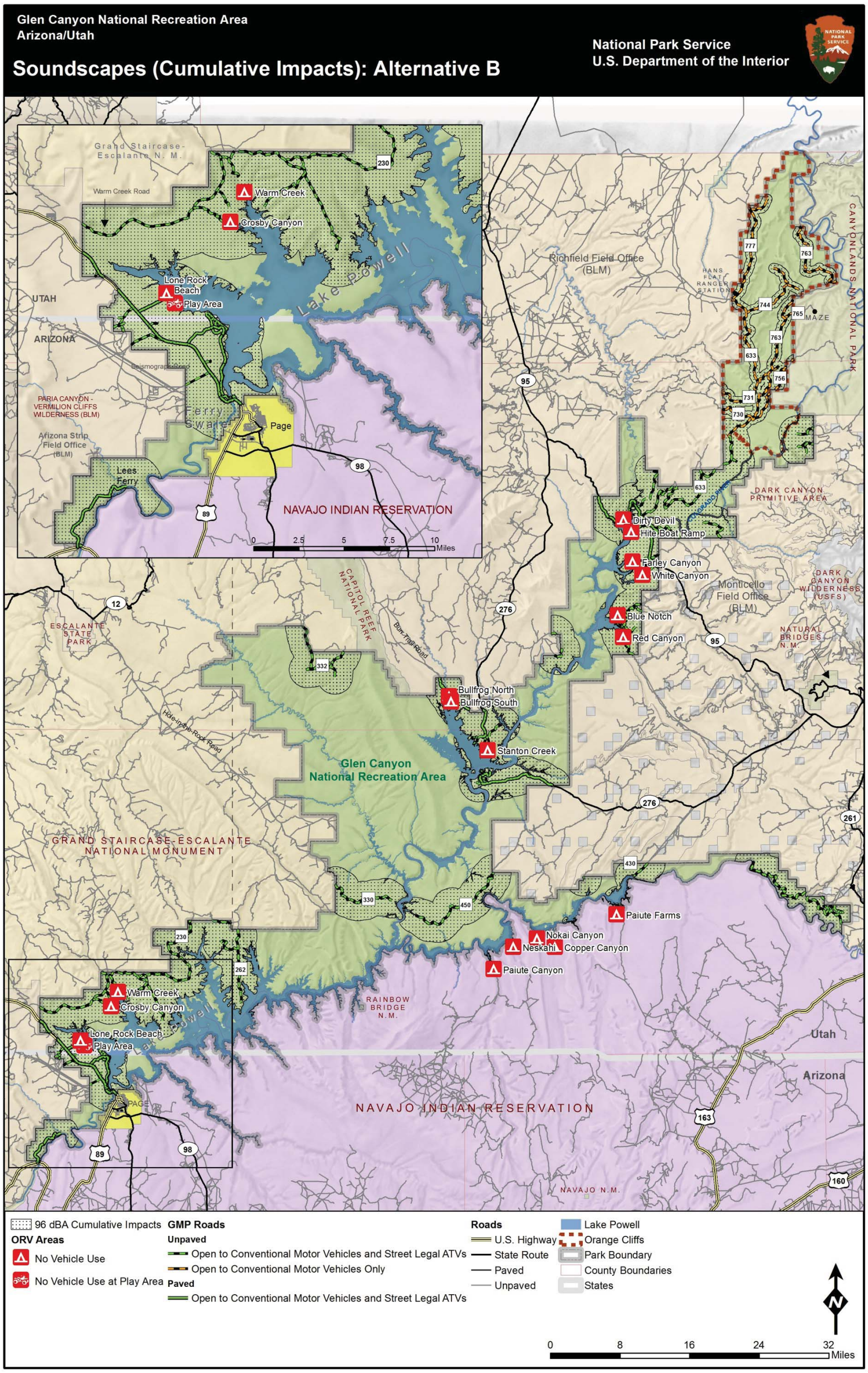


FIGURE 32B: CUMULATIVE IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE B

Alternative C: Increased Motorized Access

As shown in figure 33a, direct impacts under alternative C total 479,270 acres of land (38.21% of the Glen Canyon land area). These areas could potentially experience a 3 dBA increase in natural ambient level due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially increased through implementation of the 96 dBA limit on OHVs and street-legal ATVs (101,715 fewer acres within the direct impact noise effect zone or 30.10% of Glen Canyon land area).

Lone Rock Beach and Play Area

With the 96 dBA limit, the extent of impacts would be reduced to 5,460 feet. All of Lone Rock Beach would be within the noise effect zone of motor vehicle use at the Lone Rock Beach Play Area under alternative C, with the 96 dBA limit (see figure 33a). However, the 96 dBA limit would likely provide a noticeable reduction in overall sound levels in this area by eliminating the loudest vehicles.

Accessible Shorelines

Fifteen accessible shoreline areas would be authorized by permit for use by conventional motor vehicles, OHVs, and street-legal ATVs, subject to water-level closures. Increased impacts on the listening area of wildlife and non-motorized human uses could occur on adjacent land compared to alternative A where shorelines would be used by conventional motor vehicles only. The 96 dBA limit would reduce the extent of these impacts. With the 96 dBA limit, the extent of impacts would be reduced to 5,460 feet. The typical usage pattern at the accessible shorelines is that vehicles drive to the shoreline and park, thus the duration of impacts would be short term and the intensity of impacts would be low.

Travel on GMP Roads in Glen Canyon

In addition to conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on all GMP roads, paved and unpaved, in Glen Canyon under alternative C (including roads within the Orange Cliffs Unit). OHVs and street-legal ATVs would likely be substantially louder than conventional motor vehicles and would be the predominate noise source. Impacts on the listening area of wildlife and non-motorized human uses would occur in adjacent areas of land. Impacts on the listening area of wildlife and non-motorized human uses would occur in adjacent areas of land, as shown in figure 33a. However, the 96 dBA limit would likely provide a noticeable reduction in overall motorized vehicle sound levels by eliminating the loudest OHVs and street-legal ATVs. The extent of impacts would be reduced to 5,460 with the 96 dBA limit. Although no data is available on exact volumes, the GMP roads (especially unpaved roads) have low traffic volumes and would be expected to continue to have low volumes under alternative C. Therefore, the duration of direct impacts on soundscapes would be short-term and the intensity of impacts would be low.

In addition, a minor reduction in the noise effect zone (with the 96 dBA limit) could occur due to the reduction of the speed limit on unpaved GMP roads from 45 mph to 25 mph. For reasons discussed in the methodology section, this potential benefit was not accounted for in the spreadsheet analysis and tabulation of acreage within the noise effect zone.

Ferry Swale

Approximately 15 miles of ORV routes would be designated in the Ferry Swale area under alternative C. The analysis shows that all of the Ferry Swale area would be within the motorized vehicle noise effect zone under alternative C, with the 96 dBA limit (see figure 33a). Most of the noise effect zones of the designated ORV routes overlap with the noise effect zones of GMP roads, however the intensity of impacts would be increased by the

additional OHV and street-legal ATV activity. This would include impacts on the listening area of wildlife and non-motorized human uses. However, the 96 dBA limit would likely provide a noticeable reduction in overall sound levels in this area by eliminating the loudest vehicles. The extent of impacts would be reduced to 5,460 feet from the source with the 96 dBA limit.

Cumulative Impacts

The actions by others contributing to cumulative impacts under alternative C would be the same as described for alternative A. The cumulative impact would be reduced to 515,773 acres or 41.12% of Glen Canyon with the 96 dBA limit on OHVs and street-legal ATVs (see figure 33b).

The potentially adverse impacts on soundscapes from aircraft overflights, watercraft, and motorized vehicle use on roads and off-road within Glen Canyon and on adjacent federal lands would result in long-term adverse cumulative impacts when combined with the beneficial (with 96 dBA limit) impacts of alternative C.

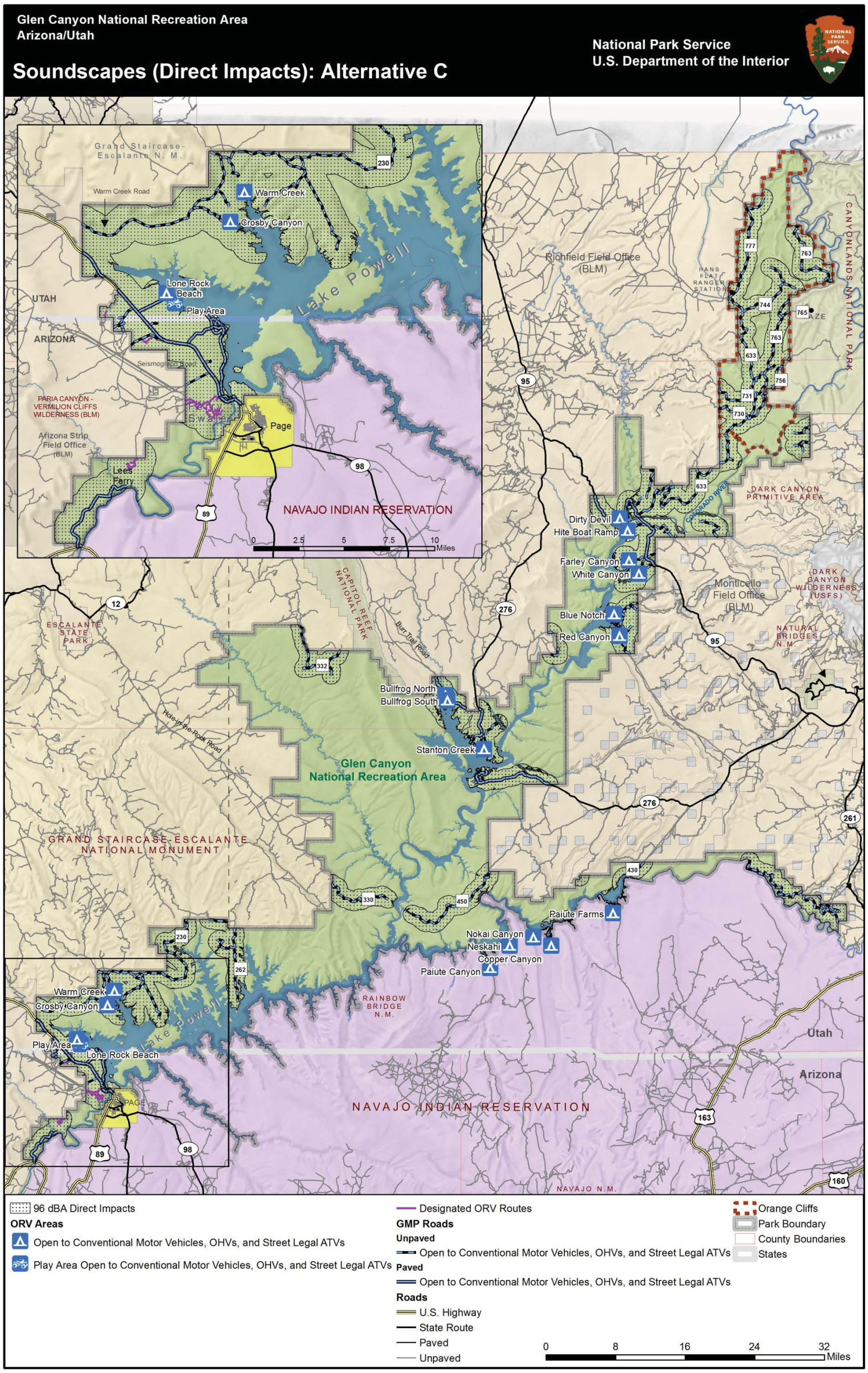


FIGURE 33A: DIRECT IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE C

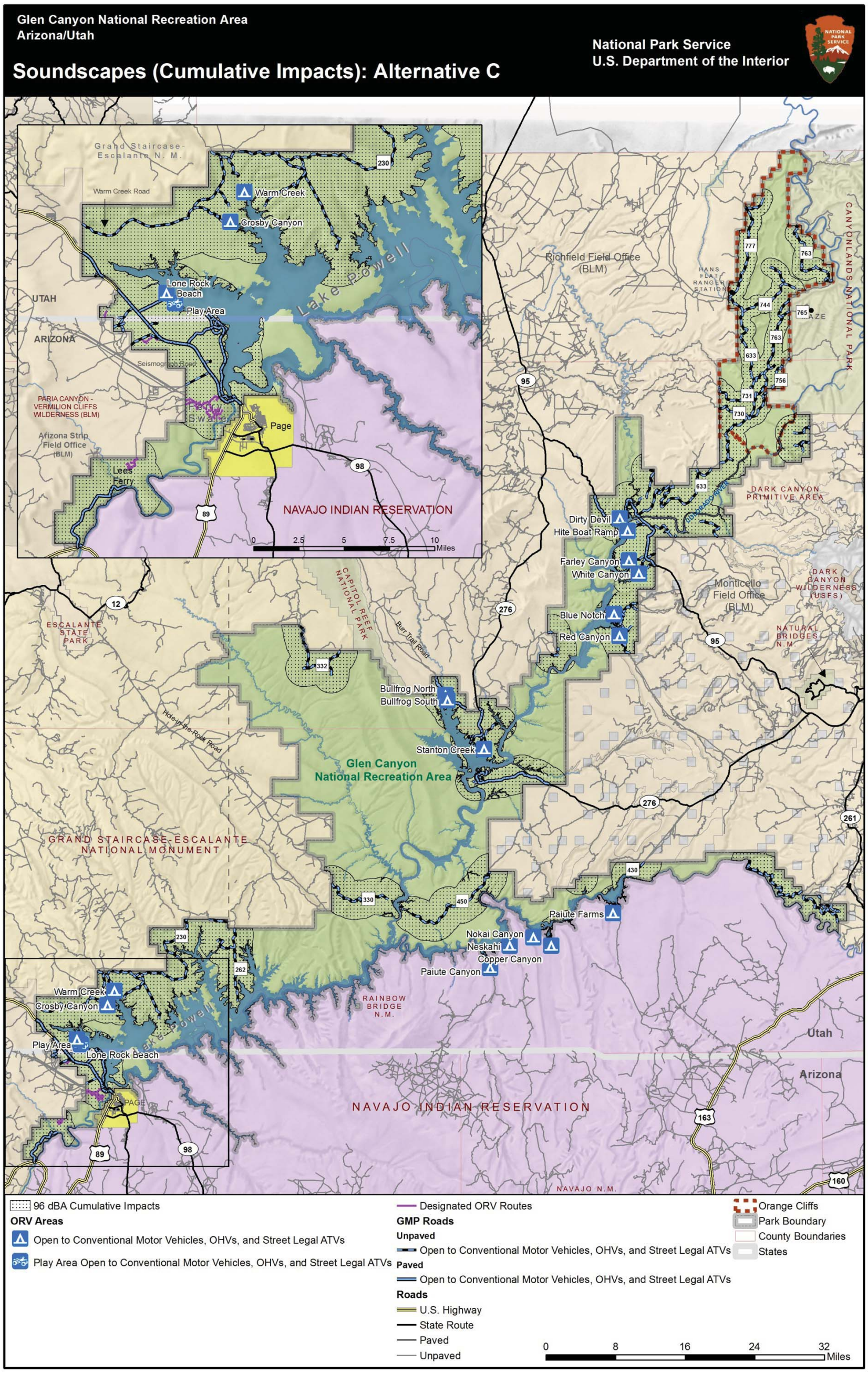


FIGURE 33B: CUMULATIVE IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE C

Alternative D: Decreased Motorized Access

As shown in figure 34a, direct impacts under alternative D total 6,351 acres of land (0.51% of the Glenn Canyon land area). These areas could potentially experience a 3 dBA increase in natural ambient level due to conventional vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would not be affected by the 96 dBA limit because no OHV or street-legal ATV use would be allowed within Glen Canyon (the limit only applies to OHVs and street-legal ATVs)

Lone Rock Beach and Play Area

Lone Rock Beach would be open to conventional motor vehicles only under alternative D, by permit. All motor vehicle use would be discontinued at the Lone Rock Beach Play Area under alternative D. Impacts on natural soundscapes from conventional vehicles operating on Lone Rock Beach could extend up to 2,900 feet from the source (at 15 mph). The scale and labeling of figure 34a do not make this small area of noise effects visible.

Accessible Shorelines

Off-road use would be discontinued at 11 accessible shoreline areas, while four (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp only) would remain open only to conventional motor vehicles. Impacts on natural soundscapes from conventional motor vehicles operating on accessible shorelines could extend up to 2,900 feet from the source (at 15 mph). The scale and labeling of figure 34a do not make this small area of noise effects visible. The typical usage pattern at the accessible shorelines is that vehicles drive to the beach and park, thus the duration of impacts would be short-term and the intensity of impacts would be low.

Travel on GMP Roads in Glen Canyon

Only conventional motor vehicles would be authorized to operate on GMP roads in Glen Canyon under alternative D. Therefore, no direct impacts on soundscapes from OHV or street-legal ATV use would occur (conventional vehicle use on GMP roads is only considered as part of cumulative impacts).

Ferry Swale

No ORV routes would be designated in the Ferry Swale area under alternative D. Therefore, there would be no direct impacts on soundscapes.

Cumulative Impacts

The actions by others contributing to cumulative impacts under alternative D would be the same as described for alternative A. Approximately 481,146 acres of land or 38.36% of Glen Canyon land area would be in the cumulative noise effect zone under alternative D (see figure 34b). The 96 dBA limit on OHV and street-legal ATVs is not applicable under alternative D because no OHVs or street-legal ATVs would be allowed.

The potentially adverse impacts on soundscapes from aircraft overflights, watercraft, and motorized vehicle use on roads and off-road on adjacent federal lands would result in long-term adverse cumulative impacts when combined with the impacts of alternative D.

The closure of 11 accessible shorelines would decrease the area of Glen Canyon subject to motorized vehicle noise effects. In particular, the southern parts of Crosby Canyon and Warm Creek would be within the cumulative noise effect zone under alternative A would not be in the cumulative noise effect zone under alternative D. The extent of cumulative impacts would also be reduced around Bullfrog North and South although portions of these areas

would still be within the noise effect zone of roads under alternative D. The portions of Paiute Canyon, Neskahi, and Copper Canyon within Glen Canyon would no longer be within the cumulative motorized vehicle noise effect zone.

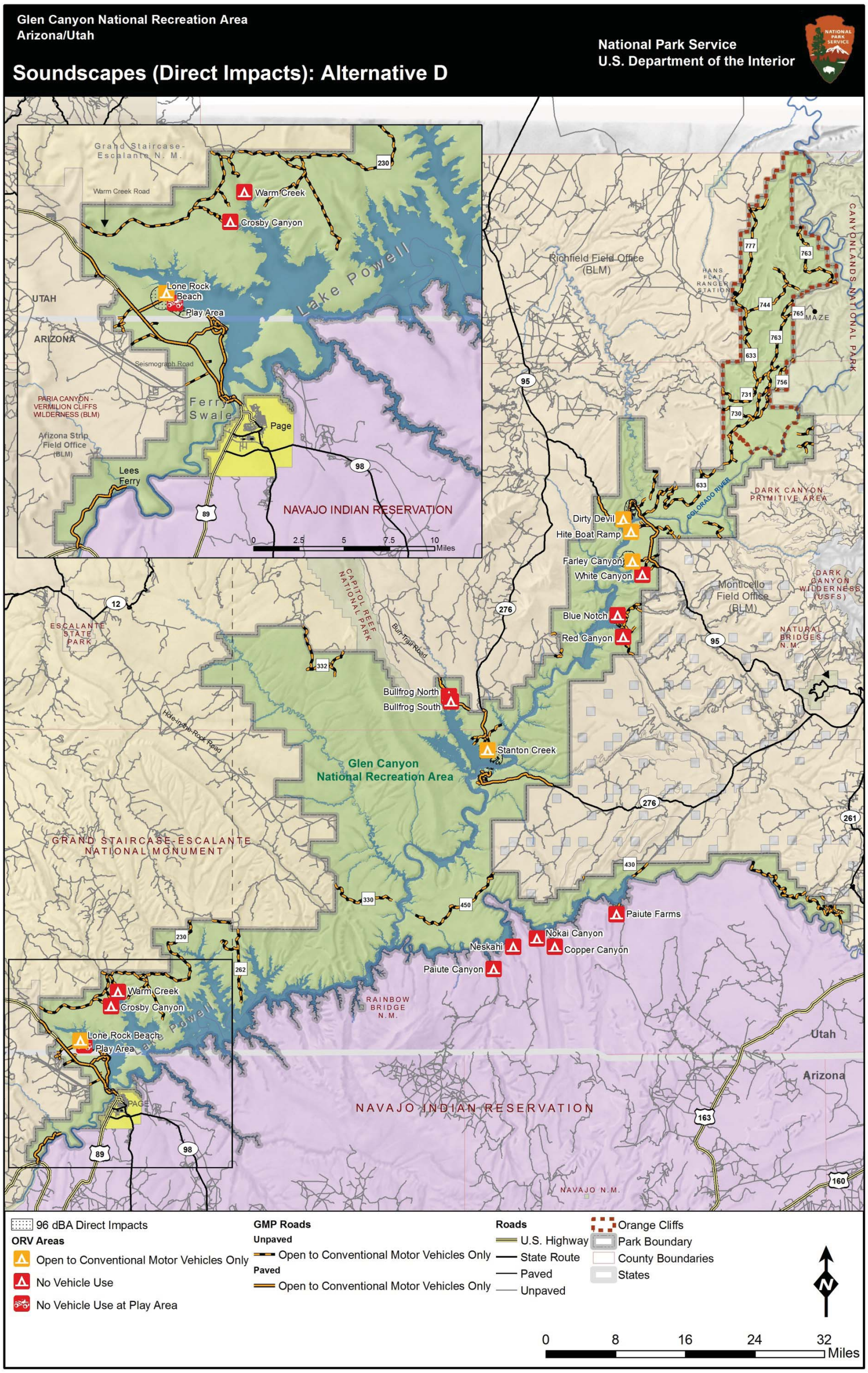


FIGURE 34A: DIRECT IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE D

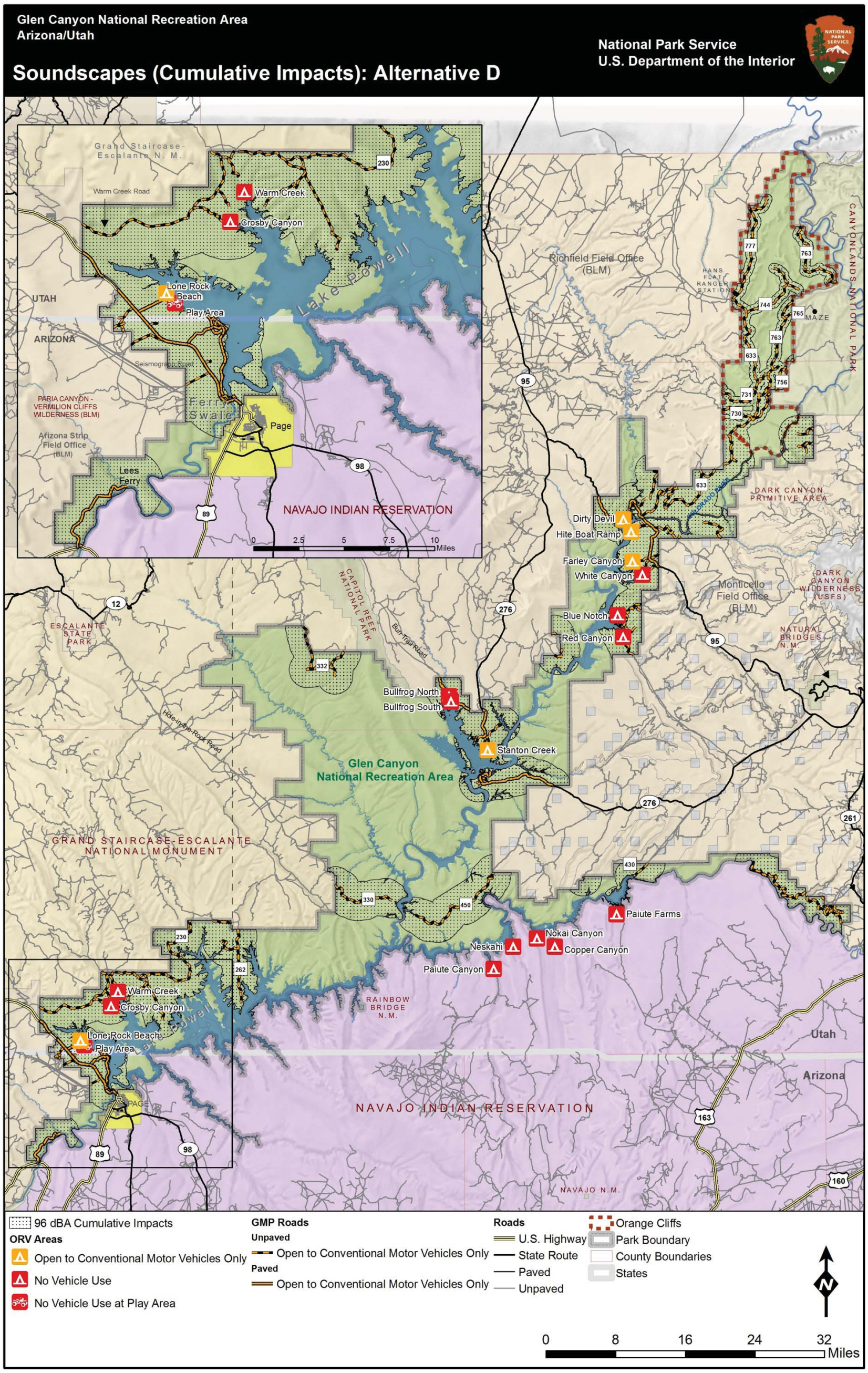


FIGURE 34B: CUMULATIVE IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE D

Alternative E: Mixed Use

As shown in figure 35a, direct impacts under alternative C total 373,135 acres of land (28.75% of the Glen Canyon land area). These areas could potentially experience a 3 dBA increase in natural ambient level due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, there would be no impacts. The degree and geographic extent of impacts on soundscapes would be substantially increased through implementation of the 96-dBA limit on OHVs and street-legal ATVs (82,190 fewer acres within the direct impact noise effect zone or 23.20% of Glen Canyon).

Lone Rock Beach and Play Area

Lone Rock Beach and the Lone Rock Beach Play Area would be open to conventional motor vehicles, OHVs, and street-legal ATVs under alternative E, with the exception of a 20-acre vehicle-free area. All types of motor vehicles would also be allowed in the Lone Rock Beach Play Area. The level of use of these areas is expected to remain high and similar to existing conditions (77,000 vehicle entrances in 2011, see the "Socioeconomics" section in this chapter). Impacts would extend up to 5,460 feet with the 96 dBA limit. All of Lone Rock Beach would be within the noise effect zone of motor vehicle use at the Lone Rock Beach Play Area under alternative E, with the 96-dBA limit (see figure 35a). This would include impacts on the listening area of wildlife and non-motorized human uses. The duration of impacts would be extensive—the play area in particular can result in nearly continuous motorized vehicle use during the day (see chapter 3). The 96 dBA limit would likely provide a noticeable reduction in the intensity of sound levels in this area by eliminating the loudest vehicles.

The vehicle-free area would provide benefits to non-motor vehicle users at a local level, reducing the intensity of human-caused changes in natural soundscapes attributable to motorized vehicles. Noise from OHVs and street-legal ATVs would be reduced in vehicle-free area under alternative E because the distance between OHV and street-legal ATV use in designated areas and the vehicle-free area would increase. However, OHV and street-legal ATV activities in the play area would be still audible.

Accessible Shorelines

Impacts on soundscapes along accessible shorelines would be similar to those described under alternative C. However, off-road use would be discontinued at Warm Creek, and therefore no direct impacts on soundscapes would occur at this accessible shoreline. Warm Creek would still be within the noise effect zone of OHVs and street-legal ATVs operating on nearby GMP roads, but the extent of this impact would be reduced through implementation of the 96 dBA limit.

Travel on GMP Roads in Glen Canyon

Adoption of the 96-dBA limit would likely provide a noticeable reduction in overall motorized vehicle sound levels by eliminating the loudest OHVs and street-legal ATVs. The extent of impacts would be reduced to 5,460 with the 96-dBA limit. Although no data is available on exact volumes, the GMP roads (especially unpaved roads) have low traffic volumes and would be expected to continue to have low volumes under alternative E. Therefore, the duration of direct impacts on soundscapes would be short-term and the intensity of impacts would be low.

In addition, a minor reduction in the noise effect zone (with the 96 dBA limit) could occur due to the reduction of the speed limit on unpaved GMP roads from 45 mph to 25 mph. For reasons discussed in the methodology section, this potential benefit was not accounted for in the spreadsheet analysis and tabulation of acreage within the noise effect zone.

Ferry Swale

Impacts on soundscapes in the Ferry Swale area would be the same as described for alternative C.

Cumulative Impacts

The actions by others contributing to cumulative impacts under alternative E would be the same as described for alternative A. The cumulative impact percentage would be reduced to 38.76% of Glen Canyon with the 96 dBA limit on OHVs and street-legal ATV s (see figure 35b).

The potentially adverse impacts on soundscapes from aircraft overflights, watercraft, and motorized vehicle use on roads and off-road within Glen Canyon and on adjacent federal lands would result in long-term adverse cumulative impacts when combined with the adverse (no mitigation) or beneficial (with mitigation) impacts of alternative E.

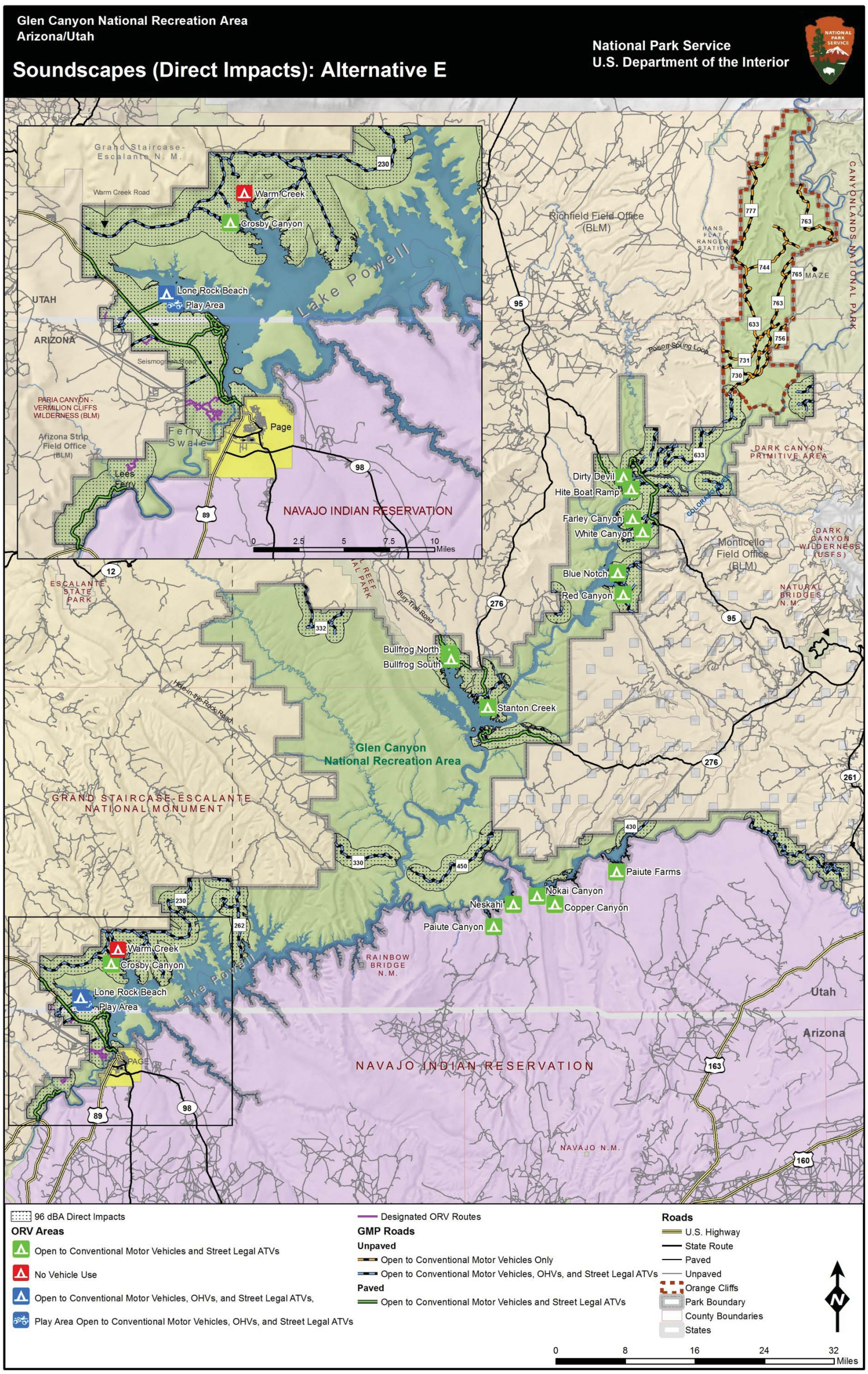


FIGURE 35A: DIRECT IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE E

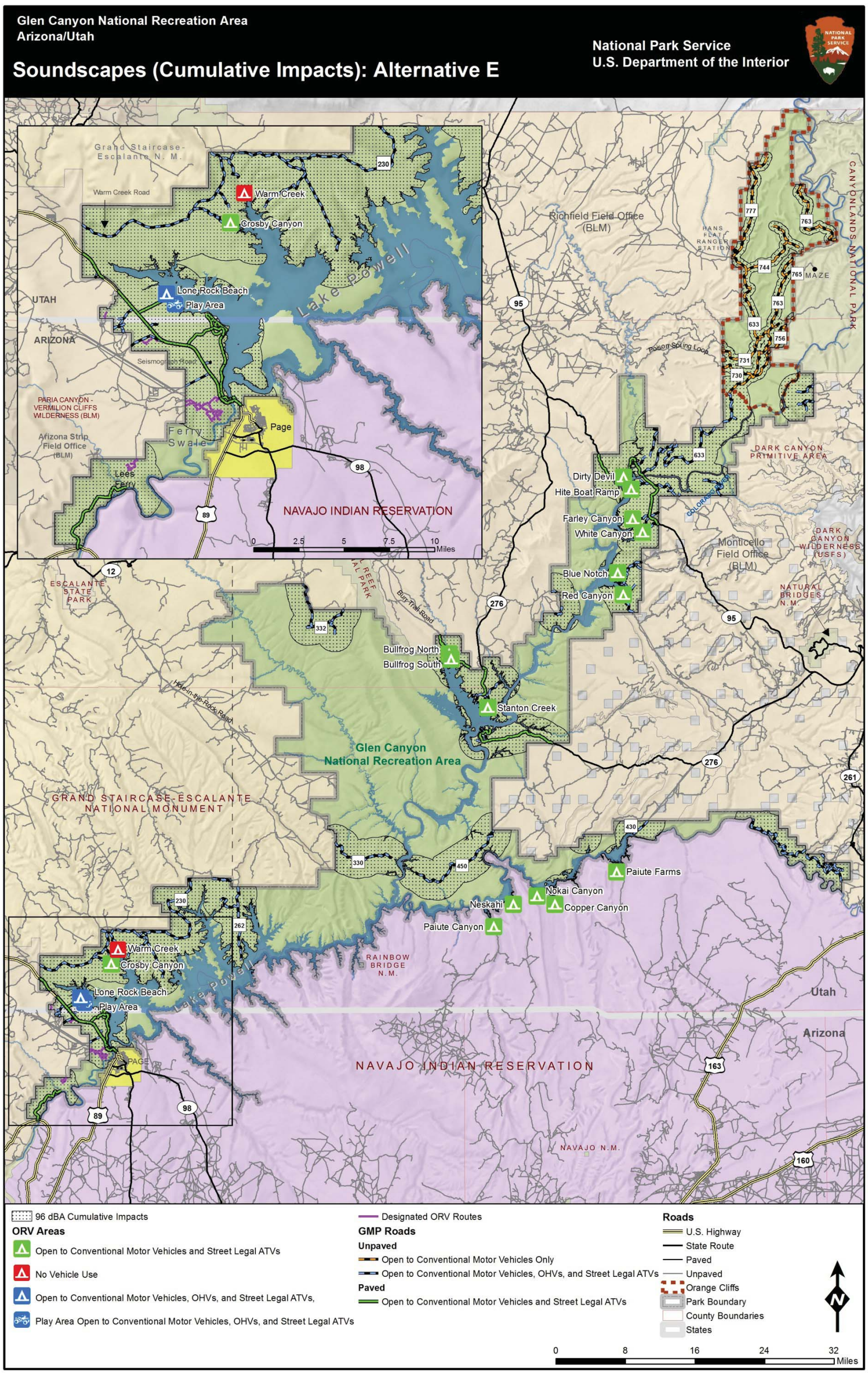


FIGURE 35B: CUMULATIVE IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE E

CONCLUSION

Table 33 provides an overview of the direct and cumulative impact analysis results for each alternative for Glen Canyon as a whole. Figures 31a, 32a, 33a, 34a, and 35a show the direct impact zone of OHV and street-legal ATV use. Figures 31b, 32b, 33b, 34b, and 35b show the cumulative noise effect zone taking into account the direct impacts of each alternative plus the use of conventional motor vehicles on GMP roads. The noise effect zones shown on the maps and summarized in the table represent the area where there would be a 3 dBA or greater increase in sound levels due to motorized vehicles over the natural ambient level of approximately 20 dBA. A 3 dBA increase is important because it results in a 50% reduction in listening area for humans and wildlife (see the methodology section).

TABLE 33: ACREAGE OF GLEN CANYON WITH 50% REDUCTION IN LISTENING AREA DUE TO MOTORIZED VEHICLES, WITH AND WITHOUT 96 DBA LIMIT

Alternative	No Limit on OHV and ATV Noise[a]				96 dBA Limit on OHV and ATV Noise			
	Direct Impacts		Cumulative Soundscape Impact: All Motorized Vehicles[b]		Direct Impacts		Cumulative	
	Acres Affected	Percent of Glen Canyon Affected[b]	Acres Affected	Percent of Glen Canyon Affected	Acres Affected	Percent of Glen Canyon Affected[b]	Acres Affected	Percent of Glen Canyon Affected
A	362,269	28.88%	487,693	38.88%	N/A[c]	N/A	N/A[c]	N/A
B	351,408	28.02%	481,136	38.36%	270,503	21.57%	481,136	38.36%
C	479,270	38.21%	542,381	43.24%	377,555	30.10%	515,773	41.12%
D	6,351	0.51%	481,146	38.36%	N/A[a]	N/A	N/A[c]	N/A
E	373,135	29.75%	492,895	39.30%	290,945	23.20%	486,188	38.76%

a. The shaded areas of the table are not applicable, and are shown for comparison purposes only. No OHV or street-legal ATV use would be allowed under alternative D, therefore the 96-dBA limit is not applicable to this alternative.

b. The direct impacts scenario examines the impact of motorized vehicle use that is the subject of this plan/DEIS, which does not include conventional vehicle use on GMP roads (OHV and street-legal ATV use on such roads is included as part of direct impacts). The cumulative noise analysis includes conventional motor vehicle use on all GMP roads, paved and unpaved, within Glen Canyon. Although conventional vehicle use on GMP roads is not affected by any of the action alternatives, they were included in the analysis to provide a more realistic understanding of the cumulative area of the recreation area that is affected by motorized vehicle noise.

c. The 96 dBA limit would not be established under alternative A, the no-action alternative.

In terms of direct impacts on soundscapes, the prohibition of OHVs and street-legal ATVs on GMP roads under alternative D would result in substantially less impacts on natural soundscapes than alternative A and the other action alternatives (B, C, and E). Less than 1% of the Glenn Canyon land area would be within the direct impact noise effect zone of conventional vehicles under alternative D, compared to 28.88% of Glen Canyon under alternative A. Alternatives B and D would eliminate the high-intensity sound levels attributable to off-road use at the Lone Rock Beach Play Area and would not designate ORV routes in Ferry Swale. The beneficial impacts of alternative D on soundscapes would be most noticeable near the Lone Rock Beach Play Area. However, beneficial impacts would not be as noticeable in remote areas distant from roads and the play area—the quality of soundscapes in these areas would remain high and similar to existing conditions.

Alternative C would have a substantially greater direct impact on soundscapes than alternative A affecting 38.21% of the total land area of the Glen Canyon National Recreation Area. The primary cause of the higher acreage

affected under alternative C is allowing OHVs and street-legal ATVs on GMP roads in the Orange Cliffs Unit (roads in the Orange Cliffs Unit would be open to conventional vehicles only under other alternatives). Incorporation of the 96-dBA tailpipe limit under alternative C would reduce the impacts, but they would still be greater than alternative A and the other action alternatives (377,555 acres or 30.10%). The increase in impacts would be most noticeable in the vicinity of roads in the Orange Cliffs Unit. However, the quality of soundscapes in remote areas distant from where motor vehicles are allowed would remain high and similar to existing conditions.

Under alternative B, the elimination of off-road use at Lone Rock Beach and play area, as well as at accessible shorelines, would result in a slightly lower acreage of the Glen Canyon National Recreation Area potentially impacted compared to alternative A (10,861 acres less or 28.02% of the land area). The extent of direct impacts under alternative B would also be less than under alternatives C and E, but greater than under alternative D. While the reduction in acreage is not large on a recreation area-wide basis because street-legal ATV use would continue on GMP roads (outside Orange Cliffs Unit), the intensity and duration of impacts in the vicinity of the Lone Rock Beach area would be reduced substantially. Incorporating the 96-dBA limit, direct impacts would be reduced to 270,503 acres, or 21.57% of the land area. The beneficial soundscapes impact of eliminating of off-road use at Lone Rock Beach and play area would be very noticeable in adjacent areas. However, beneficial impacts would not be as noticeable in remote areas distant from the play area – the quality of soundscapes in these areas would remain high and similar to existing conditions.

Alternative E would result in slightly greater impacts on soundscapes than alternative A (approximately 10,866 acres more, or 29.75% of the land area). The primary driver in the difference in impacted acreage from alternative A is that street-legal ATVs would be allowed at accessible shorelines and OHVs on unpaved GMP roads under alternative E. Alternative E would result in greater direct impacts on soundscapes than alternatives B and D, but less impacts than alternative C. At the local level, the designation of a vehicle-free area at Lone Rock Beach would reduce the intensity of potential impacts, but off-road use in the adjacent play area would remain noticeable. Mitigation of noise from OHVs and street-legal ATVS (the 96-dBA tailpipe limit) would reduce the impacts of alternative E to less than alternative A (290,945 acres or 23.20%). The increase in impacts due to alternative E would be most noticeable in the vicinity of accessible shorelines. The quality of soundscapes in remote areas would remain high and similar to existing conditions.

All of the alternatives would contribute to adverse cumulative impacts on natural soundscapes in combination with actions by others that include conventional vehicle use on GMP roads, illegal use on adjacent lands, aircraft overflights and watercraft, among others. The difference between direct impacts and cumulative impacts is particularly important for alternative D, where 481,146 acres (38.36%) of land area would be impacted, primarily due to conventional motor vehicle use on GMP roads. Cumulative impacts on soundscapes without the 96 dBA limit would be the greatest under alternative C. Cumulative impacts under alternative E would be less than alternative C, but greater than alternatives A, B, and D.

The context for evaluating the significance of soundscapes impacts is the GMP management zones. For example, motorized vehicle use within the Development Zone (which includes Lone Rock Beach and play area) is consistent with the objectives of that zone. Human activity and associated motorized vehicle noise is generally an expected and accepted element of Development and Recreation and Resource Utilization Zones. Thus, motorized vehicle use in such areas would likely results in less than significant impacts on natural soundscapes. The majority of soundscape impacts from the alternatives occur in the Development and Recreation and Resource Utilization Zones. However, even when motorized vehicle use occurs in the appropriate Development and Recreation and Resource Utilization Zones, impacts on the natural soundscape can extend into the adjacent Natural Zone where such sounds are inconsistent with the management objectives of the zone. Areas where impacts from OHV or street-legal ATV use extend into the Natural Zone and the areas along unpaved GMP roads, including NPS 330, 332 and 450. However, the core of the Natural Zone areas remains a pristine natural soundscape under any of the alternatives. In addition, noise extending into this zone from vehicles authorized under any alternative, will likely

be infrequent, as visitation is not likely to increase greatly and as many roads and shorelines are not regularly visited.

The intensity of soundscape impacts is considered based on the decibel level of the sources involved. The sound level and thus the intensity of impact is greatest closest to the source (e.g., the OHV, street-legal ATV, or conventional motor vehicle) and decreases with increasing distance. Because of the low natural ambient level in much of Glen Canyon National Recreation Area, a pass-by of an OHV or street-legal ATV can be heard over long distances, reducing the listening area for humans and wildlife as explained in the methodology section. The intensity of soundscape impacts is also influenced by the operating characteristics of the vehicles—activities at higher speeds and with more frequent acceleration create a greater load on the vehicle engine and higher noise levels compared to cruise conditions. Thus, the most intense soundscape impacts at Glen Canyon are associated with the Lone Rock Beach Play Area. However, at the scale of the entire park and in consideration of the impacts in relation to the GMP management zones, the impacts are likely not significant.

VISITOR USE AND EXPERIENCE

GUIDING REGULATIONS AND POLICIES

Enjoyment of park resources and values by the people of the United States is fundamental to the purpose of all national parks. NPS is committed to providing appropriate, high-quality opportunities for the public to enjoy the parks. Because not all recreational activities are appropriate for each park, NPS will encourage activities that are appropriate to the purposes for which the park was established, are appropriate to the unique park environment, will promote enjoyment through direct association with park resources, and can be sustained without causing unacceptable impacts on park resources or values (NPS 2006a, Section 8.2).

The recreational use of motorized ORVs is subject to multiple regulations and policies. Most of these regulations are directed toward preventing impacts on park resources and values, as well as on visitor experience.

The Code of Federal Regulations (CFR) states that ORVs may be authorized for use only in national recreation areas, national seashores, national lakeshores, and national preserves (36 CFR 4.10). The majority of national park system units are off-limits to off-road use. For many park units, this prohibition extends to the use of ATVs and similar vehicles designed primarily for off-road driving, even when used on roads.

Overall, the management of visitor use and experience, like all management decisions affecting the resources of a national park, is subject to the Organic Act. It is this foundational law that requires NPS to “provide for the enjoyment” of the national parks while also leaving them “unimpaired for future generations.” Where there is conflict between the public enjoyment of a park area and the conservation of a park value or resource, then “conservation is to be predominant” (NPS 2006a, Section 1.4.3).

This same mandate is reflected in the Glen Canyon GMP (NPS 1979). Although the GMP identifies the primary objective for Glen Canyon as “to manage the recreation area so that it provides maximal recreational enjoyment to the American public and their guests,” the document similarly requires that Glen Canyon be managed “to preserve the scenic, scientific, and historic features contributing to the public enjoyment of the area.”

These purposes—one recreation and enjoyment, the other the preservation of resources and values—are reflected in the objectives of this plan/DEIS:

- Manage authorized vehicle uses to provide safe and healthful opportunities for visitor access and recreation.

- Manage authorized vehicle uses to protect the biological and physical environment, including natural processes and systems.
- Manage authorized vehicle uses to protect cultural resources.
- Establish clear policies to guide authorized vehicle uses.

The 1979 Glen Canyon GMP recognized motorized recreation as an acceptable activity in the Recreation and Resource Utilization Zone and the Development Zone (NPS 1979). The recreational description of these two zones includes scenic touring as an acceptable activity. The recreational use of motorized equipment is prohibited in the Natural Zone.

Methodology and Assumptions

Quantitative information was used to assess the overall impact of ORV management on the supply of available recreation resources. This assessment considers the availability of ORV recreation opportunities, as well as the accessible areas, to assess the level of impacts for each action. The planning team incorporated the comments received during public scoping and the history of motor vehicle use, including off-road use, in Glen Canyon to help make a determination of the level of impact on visitor use and experience. Data used in this analysis, including visitor statistics, historic use patterns, visitor use observations obtained from NPS rangers, and data provided by other land management agencies, is presented in chapter 3. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Context

The geographic context for visitor use and experience considers both Glen Canyon and the larger Glen Canyon planning area, which extends to the surrounding BLM-administered lands. Incorporating the larger geographic planning area in this assessment provides for a more accurate description of the impacts within a larger landscape-planning context. The supply of ORV recreation opportunities is abundant on the federal holdings surrounding Glen Canyon.

Alternative A: No Action

Lone Rock Beach

In 2010, approximately 52,000 vehicles entered Lone Rock Beach and/or Lone Rock Beach Play Area, which represented almost 7% of all vehicle counts in Glen Canyon. Vehicle counts at Lone Rock have increased by a large amount in 2011, with a 35% increase to almost 77,000 vehicles (which does not include December counts), which represents 8% of 2011 vehicle counts (NPS 2012a). These vehicle counts also include those visitors accessing the Lone Rock Beach Play Area. Given that there would be no change in the existing management under alternative A, visitor use patterns would not be expected to change and approximately 250 acres would continue to be available for recreation at this location.

During public scoping, some commenters expressed that ORVs, including conventional motor vehicles, OHVs, and street-legal ATVs, produced too much noise and air emissions and that their visitor experience was negatively impacted by the presence of ORVs in Glen Canyon. For these visitors, the continuation of current management, especially at Lone Rock Beach where conventional motor vehicles, OHVs, and street-legal ATVs are allowed, would result in a continued adverse impact on their visitor experience.

Lone Rock Beach Play Area

Lone Rock Beach Play Area is the only location in Glen Canyon where conventional motor vehicle, OHV, and street-legal ATV use is currently authorized and operation of motor vehicles in an unrestricted manner is permitted. The play area at Lone Rock Beach is a fence-enclosed, 180-acre area that is open to high-intensity motor vehicle use. Under alternative A, this unrestricted use would continue and visitor use would not be impacted. Visitors who expressed a diminished visitor experience from the noise and air emissions of these motor vehicles may continue to experience adverse impacts due to the proximity of the play area to Lone Rock Beach.

Accessible Shorelines

The 13 existing accessible shoreline areas (approximately 5,900 acres) would continue to be authorized for use by conventional motor vehicles only based on the existing conditions and the water levels of Lake Powell. Accessible shorelines available for conventional motor vehicle use would continue to range from a backcountry, wilderness-like experience to more popular areas, such as Stanton Creek and Hite Boat Ramp. The Hite developed area, which includes the Hite Boat Ramp accessible shoreline, as well as primitive and recreational vehicle (RV) camping, a marina, and gas station, is also a popular area. Visitation to this entire developed area, not just the accessible shoreline, accounted for approximately 3% of total visitation to Glen Canyon in 2005 (NPS 2008e). In 2007, 3,953 vehicles were counted at Stanton Creek. Assuming 2.5 visitors per conventional motor vehicle, this equates to approximately 1% of total annual visitation to Glen Canyon. Given that Stanton Creek is one of the most popular accessible shoreline areas (while Bullfrog North and South, also very popular but have been closed in recent years due to low water levels), accessible shoreline use does not represent a major visitor attraction for Glen Canyon. Under the no-action alternative, all recreational opportunities, such as camping and fishing, would continue to occur at these locations with no measurable impact on visitor use numbers or patterns.

Paiute Farms and Nokai Canyon are currently being accessed by the public, primarily by residents of local communities, but are not officially open under the 1988 Accessible Shorelines EA/DCP or the 2006 DCP/EA. Both accessible shorelines have limited facilities and areas for camping. The no-action alternative would discontinue use of these two areas and management actions taken to prevent access. Eliminating all motor vehicle access to these two shoreline areas except by boat or walking would noticeably alter visitor use patterns of local residents that use these areas and their accessibility to the shorelines.

Travel on GMP Roads in Glen Canyon

Under alternative A, conventional motor vehicles and street-legal ATVs would continue to be authorized to operate on all GMP roads in Glen Canyon, except only conventional motor vehicles would be allowed on GMP roads in the Orange Cliffs Unit. Approximately 75 miles of paved roads and 265 miles of unpaved GMP roads would be available to conventional vehicles and street-legal ATVs. An additional 100 miles of unpaved roads would be available to conventional vehicles in the Orange Cliffs Unit. All street-legal ATVs traveling on authorized GMP roads would be required to meet all state traffic and vehicle laws, including registration, titling, odometer statement, vehicle identification number, license plates, registration fees, and county motor vehicle emissions inspection and maintenance programs. Because there would be no change in use or accessibility, there would be no measurable impact on visitors using Glen Canyon roads. Visitors seeking a quiet, backcountry experience may be adversely impacted by the noise street-legal ATVs produce in the more remote areas of Glen Canyon.

Ferry Swale

Ferry Swale is increasing in off-road use popularity, especially with residents from Page, Arizona, and allows direct access from Glen Canyon to BLM land to the west of Glen Canyon, providing a beneficial experience for local residents. According to a 2007 visitor use survey (University of Idaho 2008), Lees Ferry in Ferry Swale attracts approximately one-third of all Glen Canyon visitors. Lees Ferry provides day-hiking and camping opportunities in

addition to a boat launch. The hiking trails along the south end of Glen Canyon provide a quiet, backcountry experience for visitors; however, illegal off-road use is increasing in this area of Glen Canyon, intruding on the visual characteristics of the Ferry Swale area. Under alternative A, approximately 53 miles of ORV routes would be designated for use by conventional motor vehicles, OHVs, and street-legal ATVs, which would create an authorized off-road use from a previously illegal use. The continued presence of ORVs, along with the noise they produce, disrupts the backcountry experience by introducing the unnatural elements of engine noise and motorized vehicle into the otherwise scenic and natural landscape, adversely impacting the visitor experience. Under alternative A, visitors seeking a quiet, backcountry experience may continue to experience an adverse impact from the presence of ORVs in this location. OHVs and street-legal ATVs would be the main cause of this adverse impact, because the noise generated by OHVs and street-legal ATVs are generally louder and more disruptive than noise from conventional motor vehicles. With the introduction of designated ORV routes, however, visitors seeking a quiet, backcountry experience would be able to determine where authorized off-road use is located and avoid those locations to the extent possible, reducing the potential adverse impacts from noise.

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect visitors and the recreational opportunities. In recent years, the rising and falling water levels as a result of natural fluctuations and dam operations have exposed more or less of the accessible shoreline areas, impacting the areas available for recreation. Following these events, several popular accessible shoreline areas have been closed due to accessibility issues, resulting in an adverse impact on visitor use and experience.

Beneficial impacts on visitor experience have occurred, and would continue to occur into the future, from the implementation of the following plans or actions:

- 1979 Glen Canyon (GMP), which considers visitor needs in managing Glen Canyon resources.
- 1981 Lone Rock Beach EA/DCP, 1988 Accessible Shorelines EA/DCP, 1986 Paiute Farms/San Juan Marina DCP/EA, 2008 Uplake DCP/EA which provide guidance for development and use in various locations across Glen Canyon.
- Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan which determines how the backcountry areas of Glen Canyon should be managed.
- Development of the Interim Management Plan for Lone Rock Beach Play Area, which determined the existing use of the play area by ORVs.
- Adverse impacts may also result from these management plans that restrict visitor use, including where OHVs and street-legal ATVs can be operated and which accessible shoreline areas are open to visitor use. For those visitors seeking a backcountry experience, when recreating in areas available to off-road use under these management plans, those visitors may experience adverse impacts from increased noise. In the interest of protecting resources, some of these management plans may restrict some visitor opportunities in certain locations, which may result in slight adverse impacts.

Additional actions include the development of BLM Arizona Strip Office Travel Management Plan and development and operation of the Amangiri Resort, which also results in beneficial impacts on visitor use and experience by providing an expanded choice of lodging locations in the vicinity of Glen Canyon. Unauthorized off-road use on adjacent BLM lands could continue, adversely impacting those visitors in Glen Canyon's adjacent backcountry locations due to the vehicle noise in a wilderness-like setting.

Current and future BLM projects include the update and implementation of resource management plans and travel management plans for the Monticello and Hanksville field offices, which provide beneficial impacts on visitors, similar to the existing management plans. Current and future projects within Glen Canyon include the development

and implementation of group use permits on Hole-in-the-Rock Road, which will provide beneficial impacts on visitor use at this location.

Actions, like the development and implementation of group use permits on Hole-in-the-Rock Road and Fee Station Improvements at Lone Rock Beach and improved interpretation along the Colorado River would likely provide long-term beneficial impacts on visitor use and experience because of the improved visitor amenities, programs, and use areas. The GMP and Experimental and Management Plan for Glen Canyon Dam (Bureau of Reclamation 2008) would most likely provide long-term beneficial impacts because these plans and activities would ensure that visitor opportunities continue within Glen Canyon.

The potentially adverse impacts from rising and falling water levels, in combination with the continuation of adverse impacts on those users disturbed by ORV activity under alternative A, would result in long-term adverse cumulative impacts on visitors in ORV areas of Glen Canyon. However, for ORV users, the beneficial impacts of Glen Canyon plans would continue to allow access throughout Glen Canyon and alternative A would not contribute adverse or beneficial impacts.

Alternative B: No Off-road Use

Lone Rock Beach

Under alternative B, Lone Rock Beach would be closed, and the area restored to natural conditions. Visitors would continue to be able to camp at Lone Rock Beach and would be able to park along Lone Rock Beach Road and walk to the shoreline, approximately 1/4 mile to 1 mile, depending on the lake elevation and desired location. Parking at this site is limited, however, and visitors would be expected to quickly fill the designated spaces. The restriction of off-road access to Lone Rock Beach would considerably alter use patterns and visitor accessibility to the shoreline. Those unable to walk the length of beach to the water would no longer be able to visit this location. Visitors seeking beach solitude, however, may experience beneficial impacts from the removal of off-road use at this location. Visitor use patterns at this location would be considerably altered, impacting all visitors that currently access this location. In 2010, approximately 6% of all visitors accessed the Lone Rock Beach area and these visitors would still be able to access the area without a boat, minimizing the potential impact on visitor use. Depending on parking availability, visitors would experience a moderate inconvenience of the beach being located farther from their vehicle and would have to carry all camping and fishing equipment to the beach from the parking area. This impact would be greater for elderly or disabled visitors, who may be unable to walk longer distances in the sand or carry all their equipment. The limited number of designated parking spaces may require some visitors to park along the road and walk a greater distance, and may create traffic congestion during the peak visitor season. Overall, there would be adverse impacts for visitors who cannot find parking, cannot walk longer distances, and those who cannot or do not wish to carry gear. The adverse impact would not be significant, however, because while visitors may be unable to continue their current use, they would still be able to access the site.

Lone Rock Beach Play Area

Similar to Lone Rock Beach, under alternative B the Lone Rock Beach Play Area would be closed and the area restored to natural conditions. Users wishing to operate conventional motor vehicles, OHVs, or street-legal ATVs in an unrestricted manner would no longer be able to do so in Glen Canyon, resulting in a substantial change to visitor patterns and use for this location. With the closure of the play area, users would no longer be authorized to operate their motor vehicles in an unrestricted manner as the area is currently used in this unique way at Glen Canyon, resulting in a substantial adverse impact on those visitors seeking this type of experience in Glen Canyon. There are no other areas in the region of Glen Canyon, on adjacent BLM land or lands owned by other local, state, or federal agencies where this type of use could occur. Off-road use would continue to be allowed on neighboring BLM land. While full off-road use estimates are not available, there is 3,700 miles of designated ORV routes in the Richfield Office area (Wayne County) and 553 miles of designated routes that allow all ORV use at Grand Staircase

– Escalante National Monument (Downey 2012). There would be no easily accessible ORV area available in Page, Arizona, however, because all nearby off-road opportunities outside of Glen Canyon would be in Utah. Visitors at neighboring Lone Rock Beach, where off-road use would also be prohibited, may experience a beneficial impact on their visitor experience from the reduction in noise from ORVs at this location.

Accessible Shorelines

Under alternative B, all motor vehicle use would be discontinued at 15 accessible shorelines—the 13 existing areas plus Paiute Farms and Nokai Canyon. Access to Lake Powell through off-road use would be restricted. All visitors seeking access to these 15 shoreline areas would need to use a boat or walk to reach them. Eliminating all access to these areas except by boat or walking would considerably alter visitor use patterns and accessibility to the shoreline. Camping would be permitted along any of the shorelines; however, the only access available would be by boat or walking. Hite Boat Ramp would be one of the only shoreline camping areas that could be accessed without walking a considerable distance. Visitors experiencing Glen Canyon by boat would not be adversely impacted.

Due to the remote nature of some of the accessible shoreline areas, it is unknown exactly how many visitors would be displaced under alternative B. Visitation at Stanton Creek, the most popular accessible shoreline, ranged from approximately 4,000 vehicles (2007) to 5,700 vehicles (2002), which may also be reflective of the changes in lake elevation. In 2002, nearly 10,000 vehicles were counted at Bullfrog North and South; however, the accessible shoreline has since been closed in recent years due to low water levels. At Hite developed area, visitors at the primitive and RV camping sites would continue to be able to access the Hite Boat Ramp accessible shoreline by walking. Approximately 59,000 visitors visited the entire Hite developed area in 2005, including the Hite Boat Ramp accessible shoreline (NPS 2008e). Visitors would continue to be able to launch boats at this location.

Overall, these visitation numbers indicate that between 2 and 4 % of all visitors to Glen Canyon would be impacted by the discontinuation of off-road use at the accessible shoreline areas and that these discontinuations would not noticeably impact the visitor use of the entire Glen Canyon. However, those without a boat who are seeking access to Lake Powell would be limited in their options. These visitors would only be able to see the lake from the marina areas, which can be crowded, or from the more remote Hite developed area. Because off-road access to the accessible shoreline areas would be discontinued, primitive camping opportunities at the managed shoreline areas would be eliminated for visitors without a boat outside of the Hite developed area.

Visitors seeking a remote, backcountry shoreline experience by vehicle would be unable to have that recreational opportunity at Glen Canyon and may therefore choose to no longer visit Glen Canyon; adverse impacts on visitor experience would be the greatest for this user group.

Travel on GMP Roads in Glen Canyon

Impacts on visitor use and experience under alternative B would be the same as those described for alternative A, with no change to existing management and use. There would be no measurable change on visitors using conventional motor vehicles or street-legal ATVs on GMP roads. Visitors seeking a quiet, backcountry experience may be adversely impacted by the noise street-legal ATVs produce in the more remote areas of Glen Canyon.

Ferry Swale

Off-road use would not be authorized in Ferry Swale, resulting in a reduction of historical connections to BLM lands and restricted off-road access between the two federally managed properties. Without off-road use, the hiking trails along the south end of Glen Canyon would provide a quiet, backcountry experience for visitors seeking such an experience.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to affect visitor use and experience would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the noticeable adverse impacts on ORV users under alternative B, could likely result in noticeable long-term adverse cumulative impacts on ORV users because this use would no longer be available within Glen Canyon. However, the beneficial impacts of restricting off-road use, including closure of accessible shoreline areas, Lone Rock Beach, and Lone Rock Beach Play Area to off-road use under alternative B, would provide long-term cumulative benefits for visitors who desire an experience free of motorized vehicle presence, disturbance, lights, or noise.

Alternative C: Increased Motorized Access

Lone Rock Beach

Impacts on visitor use and experience for ORV users at Lone Rock Beach would be the same as described for alternative A, with the additional requirement that all users obtain ORV permits. The permit requirement would not be expected to adversely impact visitor use at Lone Rock Beach, but may cause a small adverse impact on visitor experience due to the additional cost associated with visiting Glen Canyon and the time required to obtain the permit. Additionally, there would continue to be the potential for adverse impacts on visitor experience for some visitors disturbed by the noise of ORVs.

Lone Rock Beach Play Area

Impacts on visitor use and experience for ORV users at Lone Rock Beach Play Area would be the same as described for alternative A. There would be no change to existing management, with the exception of the added ORV permit and safety requirement that all conventional motor vehicles, OHVs, and street-legal ATVs must attach a safety flag for increased visibility. This additional safety requirement would have a beneficial impact on the safety of all visitors in the play area due to the increased visibility and safety of all visitors.

Accessible Shorelines

Impacts on visitor use and experience along accessible shorelines under alternative C would be similar to those described for alternative A, with the continuation of existing management of the 13 accessible shorelines, but two additional accessible shorelines would be authorized for off-road use. These two shorelines are currently accessed by visitors but are not managed under the 1988, 2006, or 2008 Uplake DCP/EAs. The addition of Paiute Farms and Nokai Canyon would increase the number of accessible shorelines to 15 (approximately 7,300 acres of accessible shoreline) for conventional motor vehicle use. The expansion of the number of accessible shoreline areas would benefit conventional motor vehicle users in Glen Canyon and would increase the area available for conventional motor vehicle users to drive directly to the shoreline. Under alternative C, OHVs and street-legal ATVs would also be authorized for use at the accessible shoreline area, which is currently restricted to these types of vehicles, increasing the area available for OHVs and street-legal ATV opportunities and providing a beneficial impact for these users.

With the expansion and authorization of OHV and street-legal ATV use at accessible shorelines, some visitors to Glen Canyon may perceive adverse impacts on their visitor experience due to the increase in noise and air emissions in new areas of Glen Canyon. Visitors seeking a quieter experience, especially along the less frequently used accessible shorelines, may experience negative impacts from increased OHV and street-legal ATV use in those locations. This impact would be more prominent in the less frequently used and more remote shoreline areas such as Red Canyon and Copper Canyon.

Under alternative C, permits would be required for all conventional motor vehicle, OHV, and street-legal ATV users to enter the accessible shoreline areas. Visitors would be able to obtain permits at designated issuing stations or by mail, and would need to pay a fee for each permit. The permit requirement could adversely impact conventional motor vehicle, OHV, and street-legal ATV operators, due to the additional cost associated with visiting Glen Canyon and the time required to obtain the permit.

Travel on GMP Roads in Glen Canyon

Impacts on visitor use and experience on Glen Canyon roads under alternative C would be similar to those described for alternative A. Conventional motor vehicles would continue to be authorized to operate on all GMP roads. Unlike alternative A, OHVs and street-legal ATVs would also be authorized to operate on all GMP roads, including roads in the Orange Cliffs Unit. There would be a beneficial impact on visitors using OHVs and street-legal ATVs on GMP roads because the amount of roadways available for OHV and street-legal ATV use Glen Canyon-wide would increase by 100 miles to a total of 365 miles of unpaved road available. OHVs would also be authorized to use an additional 75 miles of paved GMP roads not currently authorized for use by these types of vehicles. Visitors seeking a quiet, backcountry experience may be adversely impacted by the noise OHVs and street-legal ATVs produce in the more remote areas of Glen Canyon. This adverse impact would be most noticeable in the Orange Cliffs Unit, where OHV and street-legal ATV use is currently restricted.

Ferry Swale

Beneficial impacts on visitor use and experience for conventional motor vehicle, OHV, and street-legal ATV users within Ferry Swale under alternative C would increase. The designation of ORV routes within the Ferry Swale area would provide the beneficial impact of additional authorized ORV areas. Given that Ferry Swale is increasing in popularity for off-road use, especially for residents from Page, Arizona, the designated ORV routes would allow authorized direct access from Glen Canyon to BLM land to the west, providing a beneficial experience for local residents.

Currently, there is an estimated 70 miles of illegal user-created trails within the Ferry Swale management area. Under alternative C, NPS would formally designate 15 miles of these user-created trails into ORV routes. Although the miles of designated ORV routes is much less than the miles of user-created trails, the newly designated ORV routes would help meet the demands for off-road use in Ferry Swale. However, under alternative C, visitors seeking a backcountry experience and using the hiking trails along the south end of Glen Canyon near Lees Ferry would continue to experience an adverse impact from the presence of ORVs in this location.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect visitor use and experience would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the localized, potentially noticeable adverse impacts on users seeking a remote experience under alternative C, would result in long-term adverse cumulative impacts on those visitors. However, ORV users Glen Canyon-wide would experience long-term beneficial cumulative impacts from the expansion of motor vehicle access, including authorized use off-road use by conventional motor vehicles at two new accessible shoreline areas, the use of OHVs and street-legal ATVs at 15 accessible shorelines and on GMP roads, including the Orange Cliffs Unit, and authorized off-road use on designated ORV routes in Ferry Swale under alternative C. Overall, the impacts on visitor use and experience from implementation of alternative C combined with impacts from cumulative projects would be noticeable.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Under alternative D, Lone Rock Beach would remain open to conventional motor vehicles only; OHVs and street-legal ATVs would not be allowed. Conventional motor vehicle use would continue to be managed as described for alternative A, with the additional requirement that all users obtain ORV permits. Similar to alternative C, the permit requirement would not be expected to adversely impact visitor use at Lone Rock Beach, but may cause a small adverse impact on visitor experience due to the additional cost associated with visiting Glen Canyon and the time required to obtain the permit. Visitors would continue to be able to access Lone Rock Beach by conventional motor vehicles and overnight camping would still be authorized. Visitors wishing to enjoy a quieter beach experience may have an improved visitor experience due to the reduction in noise and air quality impacts from the removal of OHV and street-legal ATV use from the area. Those visitors wishing to access Lone Rock Beach by OHVs and street-legal ATVs would no longer be able to do so and could experience a considerable change in their use.

Lone Rock Beach Play Area

Impacts on use and experience for conventional motor vehicle, OHV, and street-legal ATV users at Lone Rock Beach Play Area would be the same as described for alternative B. The Lone Rock Beach Play Area would be permanently closed and there would be no opportunities for unrestricted motor vehicle use in Glen Canyon, which would result in severe adverse effects on this user group.

Accessible Shorelines

Under alternative D, 11 existing accessible shoreline areas, including Paiute Farms and Nokai Canyon, would not be authorized for off-road use. Without a boat, visitors would be unable to access these areas of Glen Canyon. Four accessible shoreline areas (approximately 1,100) acres would be authorized for use by conventional motor vehicles by permit only: Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp. Stanton Creek is one of the main accessible shoreline areas in Glen Canyon, increasing in popularity since the closure of the Bullfrog North and South site in 2002. Hite Boat Ramp, as part of the Hite developed area, is also popular, but visitation has dropped as lake levels have dropped (DCP 2008e). Farley Canyon is a popular fishing and camping location that receives a moderate amount of visitor use. The Dirty Devil shoreline area was previously popular, although it no longer provides access to Lake Powell due to the falling lake elevation and visitation has decreased in recent years. Visitors still camp at this location; however, it is does not attract as many visitors as in the past and it does not allow for fishing.

While four accessible shoreline areas would remain available for use by conventional motor vehicles, depending on the level of use, visitors may experience a negative impact from increased crowding in the four authorized areas. However, generally, visitor experience at these shoreline areas would not be noticeably impacted and overall visitor use patterns would not likely change because two of the four accessible shorelines currently experience high visitation comparable to other accessible shorelines. Conversely, visitors seeking the more remote experience of using a less-visited accessible shoreline with access to Lake Powell may no longer be able to do so at Glen Canyon without a boat. There would be a potential for beneficial impacts on boaters accessing the shoreline areas closed to off-road use, due to the reduced visitation and noise at these locations. Similar to alternative C, visitors may experience an adverse impact from the additional cost of purchasing a permit to enter the accessible shorelines.

Travel on GMP Roads in Glen Canyon

Under alternative D, only conventional motor vehicles would be authorized to operate on all GMP roads; OHVs or street-legal ATVs would be prohibited on all roads within Glen Canyon. Visitors wishing to tour Glen Canyon by

OHVs or street-legal ATVs would be unable to do so. Visitor use patterns would change substantially and access by OHVs or street-legal ATVs of any area of Glen Canyon would not be authorized.

Ferry Swale

Under alternative D, all off-road use would not be authorized at Ferry Swale and impacts on visitor use and experience would be the same as described under alternative B. No motor vehicle users would be able to access BLM land by off-road methods, passing through the Ferry Swale area of Glen Canyon, limiting access points to BLM areas. There would be beneficial impacts for visitors not using motor vehicles in the Ferry Swale area due to the reduction of noise from the prohibition of off-road use in this area.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to affect visitor use and experience would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the potential severe adverse impacts on OHV and street-legal ATV users under alternative D, could result in long-term severe adverse cumulative impacts on OHV and street-legal ATV users. Conventional motor vehicle users would experience long-term adverse cumulative impacts, but these impacts would not be noticeable. However, the beneficial impacts restrictions on motorized access, including closure of some accessible shoreline areas, Lone Rock Beach, and Lone Rock Beach Play Area to off-road use as well as the elimination of OHV and street-legal ATV use under alternative D would provide long-term cumulative benefits for visitors who desire an experience free of motorized vehicle presence, disturbance, lights, or noise.

Alternative E: Mixed Use

Lone Rock Beach

Impacts on the visitor use and experience of motor vehicle users in Lone Rock Beach under alternative E would be the same as described for alternative C. Under alternative E, however, approximately 20 acres of the beach would be designated as a vehicle-free zone. This designation would provide an added beneficial experience for those visitors seeking a quieter beach experience away from motor vehicles.

Lone Rock Beach Play Area

Impacts on the visitor use and experience of motor vehicle users in the Lone Rock Beach Play Area under alternative E would be the same as described for alternative C.

Accessible Shorelines

Similar to alternative C, Paiute Farms and Nokai Canyon would be formally managed as accessible shoreline areas under alternative E. Off-road use at Warm Creek would be discontinued. Warm Creek provides a more primitive experience for visitors; however, it has been inaccessible since 2002 due to decreased lake elevations and received minimal visitor use when it was open. Warm Creek provides access to Warm Creek Bay; however, under alternative E visitors would still be able to access Warm Creek Bay by Crosby Canyon when lake elevations allow (currently, Crosby Canyon is inaccessible).

Conventional motor vehicle users would benefit from the formal management of off-road use at Paiute Farms and Nokai Canyon as accessible shorelines and would be authorized to access 14 accessible shoreline areas, providing approximately 6,000 acres of available area. Street-legal ATV users would also be authorized to use all accessible shoreline areas authorized for off-road use. This would also expand the areas available for street-legal ATV use

throughout Glen Canyon to approximately 6,000 acres, providing a beneficial impact for the visitor use and experience of street-legal ATV users.

Similar to alternative C, visitors to the accessible shoreline areas who are seeking a quiet experience may be adversely impacted by increased noise and air emissions from the addition of street-legal ATV use at these locations. This impact would be more noticeable in the more remote, less frequently visited accessible shoreline areas. Depending on each visitor's perception, this impact could be a small annoyance or great enough to discourage future visitation to the shoreline areas. Overall visitor use patterns would not be expected to change under this alternative, however, because street-legal ATV users make up a small percentage of Glen Canyon visitors and there are few registered street-legal ATVs in the surrounding counties.

Travel on GMP Roads in Glen Canyon

Under alternative E, conventional motor vehicles would continue to be authorized on all GMP roads (75 miles paved and 365 miles unpaved). OHVs and street-legal ATVs would be authorized to operate on 265 miles of unpaved GMP roads; in addition, street-legal ATVs would be authorized to operate on 75 miles of paved GMP roads. OHVs and street-legal ATVs would continue to be unauthorized to operate in the Orange Cliffs Unit. Similar to alternative C, allowing OHVs and street-legal ATVs to operate on unpaved GMP roads may increase the amount of OHV and street-legal ATV use on roads. Likely, the impact on visitor use and experience from this increase in use would be small because OHV and street-legal ATV use is a small subset of ORV users within Glen Canyon. OHVs users would experience a beneficial impact from the addition of unpaved GMP road segments they are allowed to operate in within Glen Canyon. Similarly, street-legal ATV users would experience a beneficial impact from being authorized to use both paved and unpaved GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit. Visitors seeking a quiet, backcountry experience may be adversely impacted by the noise OHVs and street-legal ATVs produce in the more remote areas of Glen Canyon. Visitors to the Orange Cliffs Unit would likely not experience this adverse impact due the continuation of no authorized use of OHVs or street-legal ATVs in this location.

Ferry Swale

Impacts on visitor use and experience for all motor vehicle users in Ferry Swale under alternative E would be the same as described for alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to affect visitor use and experience would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the localized, notable adverse impacts on users seeking a remote experience under alternative E, would result in long-term adverse cumulative impacts on those visitors. However, motor vehicle users Glen Canyon-wide would experience long-term beneficial cumulative impacts from the expansion of varied motorized access, including two newly off-road authorized accessible shoreline areas, the use of street-legal ATVs at accessible shorelines, and the use of OHVs on unpaved GMP roads under alternative E. Overall, the impacts on visitor use and experience from implementation of alternative E combined with impacts from cumulative projects would noticeable and beneficial.

Conclusion

Table 34 provides additional detail regarding the numbers of acres with authorized off-road use under each alternative. Table 35 shows numbers of miles of GMP roads with authorized off-road use, and table 36 shows miles of designated ORV routes at Ferry Swale.

Table 34: Number of Locations and Acres of Authorized Off-Road Use, including Accessible Shorelines, Lone Rock Beach, and Lone Rock Beach Play Area

Vehicle Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Conventional Motor vehicles	15 (6,300 acres)	0 (0 acres)	17 (7,700 acres)	5 (1,350 acres)	16 (6,430 acres)
OHVs	2 (430 acres)	0 (0 acres)	17 (7,700 acres)	0	2 (430 acres)
Street-legal ATVs	2 (430 acres)	0 (0 acres)	17 (7,700 acres)	0	16 (6,430 acres)

Table 35: Miles of Paved and Unpaved GMP Roads with Authorized Off-Road Use

Vehicle Type	GMP Road Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Conventional Motor Vehicles	Paved GMP	75 miles	75 miles	75 miles	75 miles	75 miles
	Unpaved GMP	365 miles	365 miles	365 miles	365 miles	365 miles
OHVs	Paved GMP	0 miles	0 miles	75 miles	0 miles	0 miles
	Unpaved GMP	0 miles	0 miles	365 miles	0 miles	265 miles
Street-legal ATVs	Paved GMP	75 miles	75 miles	75 miles	0 miles	75 miles
	Unpaved GMP	265 miles	265 miles	365 miles	0 miles	265 miles

Note: All mileage is approximate and based on best available GIS data.

Table 36: Miles of Designated ORV Routes in Ferry Swale

Miles of ORV Routes	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Conventional Motor Vehicles, OHVs and Street-Legal ATVs	53 miles	0 miles	15 miles	0 miles	15 miles

Alternative C would result in the widest variety of authorized visitor uses compared to alternatives A, B, and D, because alternative C would provide expanded OHV and street-legal ATV opportunities at accessible shoreline areas and on GMP roads, and the authorization of off-road use at two additional accessible shoreline areas. Both alternatives C and E would be fairly comparable in terms of visitor experience; both alternatives would allow OHV and street-legal ATV a use within Glen Canyon, though alternative E would be comparable to a slightly lesser degree. Alternative C authorizes conventional motor vehicles, OHVs, and street-legal ATVs the use of 15 accessible shorelines and all GMP roads. Alternative E authorizes conventional vehicle and street-legal ATV use of 14 accessible shorelines and all GMP roads with the exception of the Orange Cliff Unit (however, OHVs would be authorized on unpaved GMP roads only, with the exception of the Orange Cliffs Unit), and alternative E creates a vehicle-free area at Lone Rock Beach. Visitors who do not enjoy the noise and air pollution produced by motor vehicles may prefer alternative E, which provides a vehicle-free experience at Lone Rock Beach. Alternative E could be expected to have slightly higher levels of visitation at Lone Rock Beach compared to alternatives A, B, C, and D, by providing vehicle-free area, which may attract visitors seeking this type of experience.

Under alternatives C and E, the continued access of conventional motor vehicles, OHVs, and street-legal ATVs to Lone Rock Beach and Lone Rock Beach Play Area; additional access for street-legal ATVs at the accessible shoreline areas; increased number of accessible shorelines; and designation of ORV routes in Ferry Swale would increase visitation by those wishing to enjoy off-road activities within Glen Canyon. Currently, OHV and street-legal ATV riding is not a prominent or primary activity at the recreation area (University of Idaho 2008); however, authorizing street-legal ATV use at 14 (alternative E) or 15 (alternative C) shoreline areas and authorizing OHVs on GMP roads under alternative C and unpaved GMP roads under alternative E could result in additional visitation in the recreation area. It is also possible that OHV and street-legal ATV users who would have visited Lone Rock Beach and the play area might instead choose to visit one of the newly accessible areas or drive on the GMP roads under alternatives C or E, shifting where the visitation would occur but not result in additional visitation.

Visitors seeking a quiet, backcountry experience may no longer be able to do so under alternatives C and E, due to the expansion of OHV and street-legal ATV use on accessible shorelines (though OHVs would not be authorized for use at accessible shorelines under alternative E) and the designation of ORV routes in Ferry Swale. The number of visitors seeking a quiet, backcountry experience may increase under alternatives B and D, where conventional vehicle, OHV, and street-legal ATV use would be discontinued at all accessible shorelines (alternative B) or OHV and street-legal ATV use would be eliminated from all of Glen Canyon (alternative D). This would be most noticeable on the accessible shorelines. No motor vehicle use, including use of conventional motor vehicles, would be authorized on any accessible shorelines under alternative B, but would be authorized on four accessible shorelines and Lone Rock Beach under alternative D. However, under alternative B and D, several of the accessible shorelines are remote and not easily accessible without a boat, potentially eliminating these shoreline areas with no off-road use from use by visitors relying on motor vehicles for access.

The management of ORVs under any of the alternatives would not likely significantly impact overall visitor use and experience at Glen Canyon. The continuation of the current visitor use patterns and experience under alternative A is not likely to result in significant impacts on the recreational opportunities or experiences associated with off-road use of conventional motor vehicles and street-legal ATVs in Glen Canyon. The 2007 Glen Canyon Visitor Study stated that most visitor groups, approximately 85%, rated the overall quality of services, facilities, and recreational opportunities at Glen Canyon as “very good” or “good” (University of Idaho 2008). Any visitors currently adversely impacted by the operation of ORVs in the recreation area, which may include the 3% of visitors who rated the quality of their visit as “very poor” or “poor,” would continue to experience negative impacts. These adverse impacts would be the greatest under alternatives A, C, and E, which would increase areas available for conventional motor vehicles, OHVs, and street-legal ATVs, most notably in the Ferry Swale and Orange Cliffs Unit. However, visitor studies indicate that overall, visitors are happy with the visitor experience at Glen Canyon (NPS 2007f). Additionally, the majority of Ferry Swale is designated as a Recreation and Resource Utilization Zone under the existing GMP; therefore, the multiple uses in this location would be consistent with current management and would reduce the potential for visitor conflicts, ensuring no likely significant impacts.

Use of GMP roads by conventional vehicles recreation area-wide would not change under any alternatives and would not impact visitor use or experience. Under alternative D, the use of street-legal ATVs and OHVs would be completely eliminated within Glen Canyon, including on GMP roads. This elimination would not likely be significant, however, because OHVs and street-legal ATV use represents a small fraction of the 2-4% of all Glen Canyon visitors that use ORVs. Use of GMP roads under all alternatives would be consistent with the existing management zones where the roads are located, which mainly include Recreation and Resource Utilization and Development Zones.

Alternative B would be the most restrictive for off-road use in Glen Canyon. Visitor use patterns and visitor experience for conventional vehicle and ATV users would be substantially impacted under alternative B because all off-road use would be eliminated from Lone Rock Beach, Lone Rock Beach Play Area, all accessible shoreline areas, and Ferry Swale. With the elimination of off-road use in the recreation area, alternative B would provide the most beneficial impact on visitors seeking a quiet recreation area experience with more solitude and backcountry

areas without the interruption of off-road use. However, impacts on visitor use and experience for conventional motor vehicle users currently using accessible shoreline areas; conventional motor vehicle, OHV, and street-legal ATV users at Lone Rock Beach and Lone Rock Beach Play Area would likely be locally significant because these areas would be closed, reducing the ORV areas available within Glen Canyon National Recreation Area. Visitors who prefer unrestricted off-road use would likely experience significant impacts with the closure of the Lone Rock Beach Play Area. This could result in a locally significant impact on their visitor experience because this unique use would no longer be available within the national recreation area and this user group may find this management action highly controversial. Additionally, eliminating off-road use at Lone Rock Beach and Lone Rock Beach Play Area would be inconsistent with the GMP, which manages the area as a Development Zone. Under the GMP, the Development Zone is designated to allow a wide range of recreational use. Although the specific percentage of visitors who would be impacted by these closures is unknown, the majority of visitors to Glen Canyon experience the recreation area by boat and less than 4% of visitors would be expected to be impacted by this alternative. The Development Zone equates to only 2% of the total acres available for recreation at Glen Canyon. Therefore, these adverse impacts would be limited to a specific user group and would be experienced in localized areas of the recreation area. Given that alternative B would not likely result in significant impacts, all other alternatives would not likely be significant because they would continue to allow some amount of off-road use within Glen Canyon.

CULTURAL RESOURCES

GUIDING REGULATIONS AND POLICIES

Federal actions that have the potential to affect cultural resources are subject to a variety of laws. The National Historic Preservation Act of 1966 (NHPA) (as amended) is the principal legislative authority for managing cultural resources associated with NPS projects. Generally, Section 106 of the act requires all federal agencies to consider the effects of their actions on cultural resources listed on or determined eligible for listing in the National Register. Such resources are termed historic properties. Agreement on how to mitigate effects on historic properties is reached through consultation with the State Historic Preservation Officer (SHPO); the Tribal Historic Preservation Officer (THPO), if applicable; and the Advisory Council on Historic Preservation, as necessary. In addition, federal agencies must minimize harm to historic properties that would be adversely affected by a federal undertaking. Section 110 of the act requires federal agencies to establish preservation programs for the identification, evaluation, and nomination of historic properties to the National Register.

The NHPA established the National Register, the official list of the nation's historic places worthy of preservation. Administered by NPS, the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's cultural resources. The criteria applied to evaluate properties are contained in 36 CFR 60.4.

Cultural resources that are evaluated as significant to the nation's heritage are eligible for listing in the National Register. These resources must be taken into consideration during the planning of federal projects. When historically significant resources are found within the area of potential effect of an undertaking, the responsible agency official initiates an assessment of adverse effects (36 CFR 800.5). The assessment of adverse effects is a consultative process that includes SHPO associated American Indian tribes (and their THPO, if applicable) and/or traditionally associated groups other than American Indian tribes, and SHPO. At Glen Canyon, "Traditionally Associated Peoples" includes The Church of Jesus Christ of Latter-day Saints and descendants of contemporary ranching communities that attach cultural significance to the eligible resource. The consultation process can lead to avoidance or to minimization and mitigation of effects that are deemed adverse. By doing so, the NHPA and its implementing regulations offer some protection to significant historic properties.

Many of the identified archeological resources and ethnographic resources in the study areas have not been evaluated for the National Register. Until such time as these resources are formally evaluated, they should be treated as significant or National Register eligible by Glen Canyon. Ethnographic resources may be eligible for the

National Register if they are important to "the beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice" (Parker and King 1998). National Register-eligible ethnographic resources are known as traditional cultural properties (TCPs).

Other important laws or Executive Orders designed to protect cultural resources include, but are not limited to:

- American Indian Religious Freedom Act—to protect and preserve for American Indians access to sites, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites
- Archeological Resources Protection Act—to secure, for the present and future benefit of the American people, the protection of archeological resources and sites that are on public lands and Indian lands
- Native American Graves Protection and Repatriation Act
- Executive Order 11593 (Protection and Enhancement of the Cultural Environment)—to provide leadership in preserving, restoring, and maintaining the historic and cultural environment of the United States
- Executive Order 13007 (Indian Sacred Sites)—to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites

Through the legislation and Executive Orders listed above, NPS is charged with the protection and management of cultural resources in its custody. This is further implemented through Director's Order 28: Cultural Resource Management (NPS 1998c), NPS *Management Policies 2006* (NPS 2006a), and the 2008 "Programmatic Agreement among NPS (U.S. Department of the Interior), the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers for Compliance with Section 106 of the National Historic Preservation Act" (NPS 2008f). These documents charge NPS managers with avoiding, or minimizing to the greatest degree practicable, adverse impacts on resources and values. Although NPS has the discretion to allow certain impacts in park units, that discretion is limited by the statutory requirement that resources and values remain unimpaired, unless a specific law directly provides otherwise.

Methodology and Assumptions

The methodology for assessing impacts on archeological sites and ethnographic resources included a review of published literature, archeological site information from the Glen Canyon archeological site data base, discussions with the Glen Canyon staff archeologist, and the resource-specific knowledge of planning team members. In addition, it should be noted the accessible shoreline areas were sampled for the presence of archeological sites according to a previously published research design (Caldwell 2011; Vance and Downum 2012; Vance and Downum 2013). Those parts of the accessible shoreline study areas that fall outside the sampling design remain un-surveyed. The purpose of the sampling strategy was to generate data on types of historic properties present so that a level of survey effort could be established for these areas.

For the purposes of the impacts analysis, Lone Rock Beach, Lone Rock Beach Play Area, accessible shorelines, GMP roads, and proposed designated ORV routes in Ferry Swale were portioned into study areas. Additionally, Lone Rock Beach, Lone Rock Beach Play Area, and accessible shorelines included a buffer area of 0.5 mile. This is based on the nature and intensity of the impacts that may potentially occur in these areas. The study area represents the area where the highest level of use and greatest potential for impacts on archeological sites and ethnographic resources are anticipated. Direct impacts on these resources are anticipated in the study areas of each geographic area in the analysis. Indirect impacts are anticipated in the buffer areas which surround the study areas. For the accessible shorelines, the study area is the shoreline itself while the buffer extends for 0.5 mile outside the demarcated shoreline area. For the GMP roads, direct impacts occur within the footprint of the travel lanes

extending up to 33 feet (10 meters) from the road centerline. Indirect impacts may occur within the area outside of the travel lanes for a distance of between 33 and approximately 200 feet (60 meters) on either side of the centerline. Designated ORV routes in Ferry Swale are not roads and as a result their footprint is smaller than that of the GMP roads. Consequently, the zone of direct impacts measures approximately 24 feet in width (12 feet either side of the centerline). The zone of indirect impacts extends from between 12 and 200 feet on either side of the ORV route centerline. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Context

The geographic study area for archeological resources is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

Archeology

In the American southwest, archeological resources, some of which are ethnographic resources, are often found in surface contexts and are vulnerable to effects from off-road use (Schiffman 2005; Spangler 2006; Sampson 2009). Impacts from off-road use have been particularly severe on public lands (Ouren et al. 2007). Scientific literature has been generated to assist land managers tasked with maintaining the health of ecosystems and the integrity of archeological sites, cultural landscapes, and ethnographic resources (Ouren et al. 2007; Sowl and Poetter 2004). These scientific studies often include discussions of off-road use effects, off-road use effects mitigation, site-restoration techniques, and research needs (Ouren et al. 2007).

ORVs are known to impact many of the natural and cultural resources of this region. Prominent among them are soils, water quality, air quality, vegetative communities, wildlife, watersheds, archeological, and ethnographic resources. Soils are widely recognized in the scientific community as an important component of desert ecosystems (Dregne 1983; Lovich and Bainbridge 1999). ORV impacts on soils are particularly relevant to archeological resources that can include ethnographic resources because soils constitute the physical matrix in which artifacts, cultural features, and other cultural deposits reside.

Consequently a basic understanding of how off-road use impacts the physical characteristics of soils is germane to our discussion of effects on archeological and ethnographic resources. ORV disturbance of desert soils alters their physical characteristics resulting in compaction, reduced surface water infiltration, higher rates of surface water run-off and erosion, and destabilization of land forms resulting in accelerated rates of wind erosion (Webb 1982; Iverson et al. 1981; Tuttle and Griggs 1987; Gillette and Adams 1983; Belnap 2002). Soils compaction has been linked to increased run-off resulting in the formation of rills and gullies particularly on elevated terrain and hill side-slopes. Surface runoff mobilizes the sediments containing the archeological deposits destroying their contexts in the process.

Natural biotic communities are also susceptible to impacts from ORVs (Lathrop and Rowlands 1983). Damage to annual and perennial plants weakens the root systems that stabilize land surfaces. Once these communities are disturbed, soils become more susceptible to wind erosion. Wind erosion deflates archeological sites potentially combining different artifact assemblages from different time periods that become very difficult to interpret in terms of function, period of use, and ethnic affiliation (Grayson 2011).

Sampson (2009) and Sowl and Poetter (2004) summarize the scope of the threat to archeological sites and by extension ethnographic resources created by un-regulated off-road use on public lands in the West. Both direct and indirect impacts due to motor vehicles used off-road are described. The range of impacts includes:

- Breaking and displacement of surface artifacts degrading the ability of the site to yield important scientific information through artifact analysis and spatial interpretation;
- Damage to surface features, and cultural deposits caused by vehicle passage;
- Compaction and shearing of subsurface soils containing features and cultural deposits degrading their integrity and potential to contain preserved artifacts and eco-facts and;
- Indirect impacts are also documented in the literature where they are attributed to increased pedestrian access by ORVs to archeological sites and sensitive ethnographic resources. This category of impacts includes:
  - Looting of archeological sites by professional pot-hunters, as well as casual collecting by visitors to the recreation area,
  - Purposeful vandalism of petroglyph and pictograph sites often by "tagging" of these resources with spray paint;
  - Deflation of sediments containing archeological deposits caused by the passage of vehicles and foot-traffic and;
  - Inadvertent vandalism of archeological and ethnographic sites by camping activities such as trash disposal, hearth construction, and pit digging.

Lithic and ceramic surface scatters are by far the most commonly occurring site type in those portions of Glen Canyon covered by this plan/DEIS. All 182 sites currently identified in the accessible shoreline areas, along unpaved GMP roads and its buffers constitute surface sites of some kind. This total includes 47 sites determined or recommended eligible for the National Register including the Hole-in-the-Rock Trial and Hole-in-the-Rock. It is likely that additional archeological and ethnographic resources will be exposed below the 3,700-foot contour as Lake Powell recedes from the existing shoreline. Though the number of these sites is unknown, there are likely significantly fewer than the 518 identified in pre-inundation data (Bureau of Reclamation 2007).These sites will be vulnerable to the same impacts as those now exposed on the valley floor.

In summary, as more areas become accessible to the public for recreational use, both direct and indirect impacts on numbers of archeological sites, and by extension ethnographic resources, will potentially increase (Sampson 2009; Sowel and Poetter 2004). A correlation appears to exist between road proximity and vandalism of archeological sites some of which are ethnographic resources. The problem of vandalism and purposeful looting becomes more salient for land managers when ORV access opens up hard to monitor remote back country areas. Both direct and indirect impacts on archeological sites are likely to increase at Glen Canyon as the flood pool falls below the 3,700 foot contour exposing formally inundated archeological sites. Reservoir operations policy directly impacts the integrity of archeological sites, and by extension ethnographic resources by causing shoreline erosion and exposure by elevation fluctuations. Indirect impacts on vulnerable cultural remains include recreational activities and human intrusion from camping, boating, hiking, and ORV use. Although subject to direct and indirect impacts from many sources, many archeological sites, and by extension ethnographic resources, retain their integrity in shoreline environments.

The direct and indirect adverse impacts that may occur as a result of increased public and recreational use would be mitigated to some extent by implementation of NPS resource management practices and law enforcement policies. NPS would prosecute looters and vandals under the Archeological Resource Protection Act. In addition, under NPS stewardship policies for cultural resources, some sites in the Archeological Sites Management Information System inventory are periodically evaluated under the Archeological Sites Management Information System Site Condition Assessment program. Remedial actions are developed for sites are found to be threatened by natural or man-made causes.

Alternative A: No Action

Lone Rock Beach

No archeological sites or ethnographic resources have been identified in the Lone Rock Beach study area. Therefore, alternative A would not have direct impacts, beneficial or adverse, on archeological resources in Lone Rock Beach.

The Lone Rock Beach study area is surrounded by a 0.5-mile buffer. Three sites in the buffer have not been evaluated (see table 18). Long-term adverse indirect impacts on these sites may result from continued operation of conventional motor vehicles, OHVs, and street-legal ATVs in the area. Indirect impacts could include the increased risk of vandalism and looting, as well as long term soil loss or degradation by erosion, which could damage archeological resources. Potential illegal use of conventional motor vehicles, OHVs, and street-legal ATVs outside of authorized off-road areas may generate indirect adverse impacts on the three sites in the buffer area. NPS law enforcement and resource management policies would mitigate such adverse impacts.

Lone Rock Beach Play Area

A total of three archeological sites, and by extension ethnographic resources, are located in the Lone Rock Beach Play Area study area (see table 18). A phased data recovery was completed at these sites to mitigate adverse impacts resulting in a finding of not eligible for the National Register (Liestman 1986). Because the adverse impacts on these three sites have been previously mitigated continued unrestricted off-road use at Lone Rock Beach Play Area would have no direct adverse impacts on these three sites.

The Lone Rock Beach Play Area study area is surrounded by a 0.5-mile buffer. One site in the Lone Rock Beach Play Area buffer has not been evaluated for the National Register. Long-term indirect adverse impacts may continue to occur under this alternative. Indirect adverse impacts could include the increased risk of vandalism and looting, as well as long-term soil loss/degradation by erosion, which could damage archeological resources. Potential illegal use of conventional motor vehicles, OHVs, and street-legal ATVs outside of authorized off-road areas may have both direct and indirect adverse impacts on the unevaluated site in the Lone Rock Beach Play Area buffer area. NPS law enforcement and resource management policies would mitigate such adverse impacts.

Accessible Shorelines

Under alternative A, 13 accessible shorelines would remain open to conventional motor vehicle use only (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp). Three sites are eligible for the National Register; two of these unevaluated sites are located within the accessible shorelines study area (see table 18). Some of these sites are regarded as ethnographic resource of value to the descendent communities. Under alternative A, continued use of conventional motor vehicles may result long-term direct adverse impacts on these five sites.

The accessible shoreline study areas are surrounded by 0.5-mile buffers. The buffers contain 19 archeological sites that are eligible for the National Register and 25 sites that have not been evaluated. Long-term indirect adverse impacts on these sites may result from continued operation of motor vehicles in the area. Potential illegal use of conventional motor vehicles outside of authorized off-road areas may have both direct and indirect adverse impacts on the National Register-eligible and unevaluated sites in the accessible shoreline areas.

Under alternative A, only conventional motor vehicles would be permitted to depart roads and drive directly to the shoreline to park in designated areas, resulting in the continued disturbance of archeological sites in this area. Both direct and indirect impacts should be anticipated under these circumstances. Direct impacts would include artifact

breakage and displacement from original context, damage to surface cultural features and soil compaction. Indirect impacts would be increased risk of vandalism and looting, as well as long-term soil loss/degradation by erosion. Adverse impacts on National Register-eligible or unevaluated sites would require mitigation. NPS law enforcement or Archeological Resources Protection Act violations and resource management policies (Archeological Sites Management Information System Condition Assessments) would provide for mitigation of such adverse impacts.

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively designate closures of these shoreline areas. Currently Warm Creek, Crosby Canyon, and Bullfrog North and South are temporarily closed due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. The Paiute Farms and Nokai Canyon accessible shorelines are not officially open, although they are currently being accessed. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access. Archeological sites in these areas could continue to be damaged by pressure from vehicles, which would expose the sites to the forces of erosion. NPS maintains the administrative ability to enforce existing regulations and prevent unauthorized off-road use. The Park Service would implement a phased approach to the continued use of those accessible shorelines at which archeological surveys are not complete. For those shorelines areas not surveyed, and where none are planned, those areas would be closed until the resources can be identified and evaluated.

Travel on GMP Roads in Glen Canyon

Under alternative A, conventional motor vehicles and street-legal ATVs would be authorized to operate on all GMP roads in Glen Canyon, except street-legal ATVs would not be allowed at the Orange Cliffs Unit. ATVs that do not meet the street-legal requirements under Utah and Arizona code and all OHVs are prohibited from operating on any road in Glen Canyon. Under this alternative, these current management practices would continue. A total of 39 National Register-eligible archeological sites, and by extension ethnographic resources, are present in 440 miles of GMP roads. An additional 23 sites have not been evaluated for the National Register (see table 18).

It is assumed that direct impacts on National Register-eligible and unevaluated archeological sites in the footprint of the roadways have already occurred. Because the integrity of the archeological deposits in the direct impact zone has been compromised, continued motor vehicle use of the GMP roads would have no direct adverse impact. Potential long-term indirect adverse impacts could occur in the buffer zone. Potential illegal off-road use of conventional motor vehicles and street-legal ATVs off of the GMP roads may have both direct and indirect adverse impacts on the National Register-eligible and unevaluated sites. NPS law enforcement and resource management policies would mitigate such adverse impacts.

The Hole-in-the-Rock Trail and Hole-in-the-Rock are National Register-listed properties accessible to the public by an unpaved GMP road. The landscape that encompasses these individually listed properties is regarded as potentially eligible for the National Register as a traditional cultural property (TCP) significant to The Church of Jesus Christ of Latter-day Saints. For the purposes of this plan/DEIS, the cultural landscape includes the Hole-in-the-Rock Trail and the unpaved GMP road, as vehicles cannot be driven down the Hole. Under alternative A, use of this unpaved GMP road would continue to be allowed for conventional motor vehicles and street-legal ATVs and therefore would not result in damage to the listed Hole-in-the-Rock Trail and to the potentially eligible TCP of the Hole-in-the-Rock landscape. The potential for adverse effects from potential illegal off-road use could continue under this alternative but would be mitigated by NPS law enforcement and resource management policies.

Ferry Swale

Under alternative A, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized for use on approximately 53 miles of designated ORV routes. A total of six National Register-eligible archeological sites, and by extension ethnographic resources, are within the study areas of these linear corridors (see table 18). An additional three sites have not been evaluated for the National Register.

Direct and indirect impacts on eligible and unevaluated archeological sites within the designated ORV routes would be similar to those for the GMP roads. It is assumed that direct impacts on National Register and unevaluated archeological sites in the footprint of the designated ORV routes have already occurred. Because the integrity of the archeological deposits in the direct impact zone has been compromised, continued motor vehicle use of the designated ORV routes would have no adverse impact. Long-term indirect impacts may occur in the buffer area. The potential indirect impacts include looting of archeological sites, purposeful vandalism of petroglyph and pictograph sites, deflation of sediments containing archeological deposits, and inadvertent vandalism of archeological and ethnographic sites. Potential illegal use of conventional motor vehicles, OHVs, and street-legal ATVs outside of the designated ORV routes may have both direct and indirect adverse impacts on the National Register-eligible and unevaluated sites in Ferry Swale. NPS law enforcement and resource management policies would mitigate such adverse impacts.

Short-term beneficial impacts on archeological sites, some of which are ethnographic resources, include designating ORV routes under NPS rules for the authorized operation of motorized vehicles within Glen Canyon. In addition, a long-term benefit to these resources would occur from the reduction and or elimination of ORV traffic in the dispersed areas of Ferry Swale. Under these conditions, natural vegetation in the area would be restored stabilizing local soils and by doing so reducing the potential for erosion. This would have a beneficial impact on archeological sites by preserving their physical integrity.

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to impact National Register-eligible and unevaluated sites. These cumulatively considerable actions are described in greater detail in chapter 1. Both adverse and beneficial impacts have occurred as a result of these. Adverse impacts have accrued to archeological resources, and by extension ethnographic resources, from authorized and unauthorized off-road use which has resulted in degradation of the resource base. Beneficial impacts on archeological sites have occurred, and would continue to occur into the future from the implementation of the following plans or actions:

- Resources Management Plan, Cultural Component, Glen Canyon National Recreation Area; which establishes cultural resource management zones;
- Glen Canyon National Recreation Area, Archeological Resources Protection Plan; which establishes protocols for protection of archeological sites;
- Ruins Protection Plan, Glen Canyon National Recreation Area, which establishes protocols for the preservation of this class of archeological resources.

Beneficial cumulative impacts may also result from the above-mentioned management plans where restrictions to off-road use are put in place. Overall, these actions contribute to cumulatively significant long-term adverse and beneficial impacts on National Register-eligible archeological sites, the National Register-listed Hole-in-the-Rock Trail, and the associated potentially eligible TCP landscape of Hole-in-the-Rock landscape.

Alternative B: No Off-road Use

Lone Rock Beach

Under alternative B, Lone Rock Beach would be closed permanently to off-road use and restored to natural conditions. No archeological sites or ethnographic resources have been identified in the Lone Rock Beach study area. The Lone Rock Beach buffer area contains three archeological sites that have not been evaluated (see table 18). However, alternative B would not have any indirect impacts on these three unevaluated archeology sites, as off-road use would be prohibited. Restoration of natural vegetation in the area would stabilize local soils and by doing

so reduce the potential for erosion. This would have a beneficial long-term impact on these resources by preserving their physical integrity.

Lone Rock Beach Play Area

Under alternative B, Lone Rock Beach Play Area would be closed permanently to off-road use and restored to natural conditions. A total of three archeological sites are located in the Lone Rock Beach Play Area study area (see table 18). Data recovery was completed at these sites to mitigate adverse impacts resulting in a finding of not eligible for the National Register (Liestman 1986). Because the adverse impacts on these three sites have been previously mitigated, closing the Lone Rock Beach Play Area would have no direct impact on these three sites. There is one site in the Lone Rock Beach Play Area buffer that has not been evaluated for the National Register. Restoration of natural vegetation in the area would stabilize local soils and by doing so reduce the potential for erosion. This would have a beneficial long-term impact on these resources by preserving their physical integrity.

Accessible Shorelines

Alternative B would eliminate adverse direct and indirect impacts on the 66 archeological sites, and by extension ethnographic resources, that have either not been evaluated or have been determined eligible for the National Register at accessible shorelines in Glen Canyon (see table 18). In addition, restoration of natural vegetation in these areas would stabilize local soils and by doing so reduce the potential for erosion. This would have a long-term beneficial impact on archeological sites, and by extension ethnographic resources, eligible for the National Register, as well as those sites that have not been evaluated by preserving their physical integrity.

Travel on GMP Roads in Glen Canyon

Under alternative B, impacts on 39 archeological sites, some of which are ethnographic resources determined eligible for the National Register, and 23 sites unevaluated would be the same as those under alternative A. The same may be said for the National Register-listed Hole-in-the-Rock Trail and the potentially eligible TCP of the Hole-in-the-Rock landscape. If Glen Canyon staff become aware of an eligible cultural resource on the roadway itself, the park would mitigate the effects on that resource. The mitigation techniques are described under alternative C, Lone Rock Beach.

Ferry Swale

Under alternative B, no ORV routes would be designated. There would be no long- or short-term adverse direct or indirect impacts on the six National Register-eligible and three unevaluated sites recorded in the Ferry Swale study area. Cessation of off-road motor vehicle use would result in restoration of natural vegetation in this area. The potential for additional erosion from motor vehicle use would be eliminated, thereby stabilizing the sites. This would have a long-term beneficial impact on archeological sites, and by extension ethnographic resources, eligible for the National Register, as well as those sites that have not been evaluated by preserving their physical integrity.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to impact archeological sites, and by extension ethnographic resources, the Hole-in-the-Rock Trail, and the potentially eligible TCP of the Hole-in the-Rock landscape under the no-action alternative would occur, however the impacts would be the less than those described under alternative A due to the elimination of off-road use in Glen Canyon. The impacts of these actions, in combination with the significant adverse impacts on National Register-eligible archeological sites under alternative B, would result in less severe long-term adverse cumulative impacts on these resources. However, the beneficial impacts on this class of historic properties accruing from greater protection of these resources provided under alternative B would provide long-term beneficial cumulative

impacts. The net result of the analysis indicates that the impacts on National Register-eligible and unevaluated sites under this alternative would be beneficial.

Alternative C: Increased Motorized Access

Lone Rock Beach

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would continue to operate at Lone Rock Beach. However, off-road use of these motor vehicles would require an ORV permit. No archeological sites or ethnographic resources have been identified in the Lone Rock Beach study area. Therefore, alternative C would not have direct impacts on these resources in Lone Rock Beach.

There are three unevaluated sites in the buffer (see table 18). Long-term adverse indirect impacts on these sites may result from continued operation of motor vehicles in the area. Indirect impacts would be increased risk of vandalism and looting, as well as long-term soil loss/degradation by erosion, which may damage the archeological sites. Adverse impacts on National Register-eligible and unevaluated archeological sites, and by extension ethnographic resources, would be mitigated or eliminated by the following measures:

- Public education through media and resource interpretation by Glen Canyon personnel
- Increased law enforcement monitoring of culturally sensitive areas as provided for under the Accessible Shorelines 1988 Programmatic Agreement
- Reduction of use during time of the year when eligible or unevaluated archeological resources, and by extension ethnographic resources, are vulnerable due to surface conditions
- Use of Archeological Resources Protection Act signage and restrictive barriers where feasible
- Application of passive surveillance systems like video cameras and motion detectors
- Repairs and rehabilitation or other preservation treatments for damaged or threatened archeological deposits, foundations, and/or ruins
- Road relocation or redesign to avoid culturally sensitive archeological and ethnographic resources
- Re-vegetation and drainage control to stabilize threatened or damaged archeological deposits
- Data recovery of Criterion D National Register-eligible archeological sites in extreme cases when other protective measures have failed.

Although Lone Rock Beach has been surveyed, the potential exists for un-recorded sites to be impacted by motor vehicles operating off road in these areas. The potential for adverse impacts on un-recorded archeological sites, and by extension ethnographic resources, may be mitigated by monitoring of ORV impacts as stipulated in the Environmental Assessment and Management/Development Concept Plans for Lake Powell's Accessible Shorelines (NPS 1988).

Lone Rock Beach Play Area

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would continue to operate at Lone Rock Beach Play Area. However, off-road use of these motor vehicles would require an ORV permit and a safety flag.

A total of three archeological sites are located in the Lone Rock Beach Play Area. Data recovery was completed at these sites to mitigate adverse impacts resulting in a finding of not eligible for the National Register (Liestman

1986). Because the adverse impacts on these three sites have been mitigated, continued unrestricted off-road use at Lone Rock Beach Play Area would have no direct adverse impacts on these three sites.

There is one site in the Lone Rock Beach Play Area buffer that has not been evaluated for the National Register. Long-term adverse indirect impacts may continue under this alternative. Indirect impacts would be increased risk of vandalism and looting, as well as long-term soil loss/degradation by erosion that may damage the archeological site. Mitigation measures would be implemented at Lone Rock Beach Play Area, similar to the mitigation measures for Lone Rock Beach.

Accessible Shorelines

Under alternative C, a total of 15 ORV-accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles, OHVs, and street-legal ATVs by permit, subject to water-level closures.

A total of six sites eligible for the National Register and four evaluated sites are located within the accessible shorelines study area (see table 18). Some of these sites are regarded as ethnographic resource of value to the descendent communities. Under alternative C, increased off-road motor vehicle use may result long-term direct adverse impacts on these 10 sites. The buffers contain 19 archeological sites that are eligible for the National Register and 37 unevaluated sites. Long-term adverse indirect impacts on these sites may result from continued operation of motor vehicles in the area.

Continued off-road use by conventional motor vehicles combined with the additional use by OHVs and street-legal ATVs would lead to degradation of surface artifacts as well as subsurface cultural features and deposits. These impacts would likely occur as a result of the crushing and shearing of the archeological matrix, resulting in soil compaction and accelerated erosion.

Under this alternative, accessible shorelines would be marked and defined in a manner consistent with the control of off-road use for the protection of Glen Canyon resources, including soil and geological features. All motor vehicle users would be permitted to drive off-road only from the end of roads directly to the shoreline areas; soils along this path between roads and designated parking areas would continue to be impacted. Although a permitting system would result in better management of motorized access, the potential for future increased off-road use at accessible shorelines would result in the potential for more widespread and higher-intensity adverse impacts on archeological sites, some of which are also ethnographic resources. Mitigation measures would be implemented at accessible shorelines, similar to that for Lone Rock Beach and the play area. The mitigation techniques are described under alternative C, Lone Rock Beach.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to operate on all GMP roads, including the Orange Cliffs Unit. There could be a net increase in traffic under this alternative resulting in more long term direct and indirect effects on archeological resources, and by extension ethnographic resources, the Hole-in-the-Rock Trail, and the potentially eligible TCP of the Hole-in the-Rock landscape. Impacts on 39 National Register-eligible sites and 23 sites that have not been evaluated could increase in intensity under alternative C. Similar to alternatives A and B, it is assumed that short- and long-term direct adverse impacts on National Register sites and unevaluated archeological sites in the GMP roads have already occurred. Because the integrity of the archeological deposits in the direct impact zone has been compromised continued motor vehicle use of the GMP roads would have no short- or long-term adverse impact. The potential long-term indirect adverse impacts include looting of archeological sites, purposeful vandalism of petroglyph and pictograph sites, deflation of sediments containing archeological deposits, and inadvertent vandalism of archeological and ethnographic sites. If

Glen Canyon becomes aware of an eligible cultural resource on the roadway itself, the park would mitigate the effects on that resource. The mitigation techniques are described under alternative C, Lone Rock Beach.

Ferry Swale

Under alternative C, conventional vehicles, OHVs, and street-legal ATVs would be authorized for use on approximately 15 miles of designated ORV routes. Other segments of user-created routes would be closed and restored to natural conditions.

Direct and indirect impacts on National Register-eligible and unevaluated archeological sites, and by extension ethnographic resources, within the designated ORV routes would be similar to those under alternative A. It is assumed that short- and long-term direct adverse impacts on National Register and unevaluated archeological sites in the ORV route have already occurred. Because the integrity of the archeological deposits in the direct impact zone has been compromised continued motor vehicle use of the ORV routes would have no short- or long-term adverse impact. The potential indirect impacts include looting of archeological sites, purposeful vandalism of petroglyph and pictograph sites, deflation of sediments containing archeological deposits, and inadvertent vandalism of archeological and ethnographic sites. Measures designed to mitigate these effects are similar to those presented for Lone Rock Beach and the accessible shorelines.

Short-term beneficial impacts on archeological sites, some of which are ethnographic resources, would result from closing 38 miles of user-created routes. In addition, a long-term benefit to these resources would occur from the reduction and or elimination of ORV traffic in the dispersed areas of Ferry Swale and concentrating the traffic to only 15 miles of designated routes. Under these conditions, natural vegetation in the area of closed routes would be restored stabilizing local soils and by doing so reducing the potential for erosion. This would have a beneficial impact on archeological sites by preserving their physical integrity.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to impact National Register-eligible sites under the no-action alternative would occur, and impacts would be the same as described under alternative A. The impacts of these actions, in combination with the increased motorized access proposed under alternative C could generate significant adverse impacts on these resources and could result in long-term adverse cumulative impacts on these archeological sites, and by extension ethnographic resources, the Hole-in-the-Rock Trail, and the potentially eligible TCP of the Hole-in the-Rock landscape. However, the beneficial impacts on these historic properties accruing from greater protection of these resources by NPS using its administrative ability as stated above would provide long-term beneficial cumulative impacts under this alternative. The net result of the analysis indicates that the impacts on National Register and unevaluated sites under this alternative would be adverse.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Under alternative D, conventional motor vehicles would be authorized for use at Lone Rock Beach, only by permit. No OHVs or street-legal ATVs would be allowed; however, off-road use of conventional motor vehicles would require an ORV permit.

No archeological sites or ethnographic resources have been identified in the Lone Rock Beach study area. Therefore, alternative D would not have a direct impact, beneficial or adverse, on archeological resources in Lone Rock Beach.

There are three unevaluated sites in the buffer (see table 18). Long-term adverse indirect impacts on these sites may result from continued operation of motor vehicles in the area. Indirect impacts would be increased risk of vandalism and looting, as well as long-term soil loss/degradation by erosion that may damage the archeological sites. These impacts are similar to those found under alternative A. Mitigation measures would be the same as those listed for Lone Rock Beach under alternative C.

Lone Rock Beach Play Area

Under alternative D, the Lone Rock Beach Play Area would be closed permanently and restored to natural conditions. Impacts on archeological resources, and by extension ethnographic resources, would be the same as under alternative B.

Accessible Shorelines

Under alternative D, a total of 11 accessible shoreline areas would be closed permanently, whereas four (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp) would be authorized for off-road use by conventional motor vehicles only, by permit, subject to water-level closures.

No archeological sites, and by extension ethnographic resources, either eligible for the National Register or unevaluated are located within the four authorized accessible shorelines study areas (see table 18). Therefore, no impacts on archeological resources would be expected.

The buffer areas of the four open accessible shorelines contain eight archeological sites that are eligible for the National Register and five unevaluated sites. Long-term adverse indirect impacts on these sites may result from continued operation of conventional motor vehicles in the buffer areas. Adverse impacts on National Register-eligible and unevaluated archeological sites would be mitigated or eliminated by the following measures outlined under alternative C. Although these accessible shorelines have been surveyed, the potential exists for un-recorded sites to be impacted by conventional motor vehicles operating off-road in these areas. The potential for adverse impacts on un-recorded archeological sites may be mitigated by monitoring of ORV impacts as stipulated in the Environmental Assessment and Management/Development Concept Plans for Lake Powell's Accessible Shorelines (NPS 1988).

Under this alternative, the archeological sites, and by extension ethnographic resources, found within the 11 closed areas would benefit. The restoration of natural vegetation in these areas would reduce potential soil erosion thereby preserving the physical integrity of these resources.

Travel on GMP Roads in Glen Canyon

Under alternative D, there would be no direct impacts on archaeological resources on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on archaeological resources from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

Under alternative D, off-road use would not be authorized in Ferry Swale and existing user-created ORV routes closed and restored to natural conditions. Impacts on archeological resources, and by extension ethnographic resources, within Ferry Swale would be the same as for alternative B.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to impact National Register eligible sites under the no-action alternative would occur. As a result of discontinuation and non-designation of ORV routes, the impacts of decreased motorized access, under alternative D, would result in reduced long-term adverse cumulative impacts on these historic properties, compared to alternative A. However, the beneficial impacts on archeological sites, the Hole-in-the-Rock Trail, and the potentially eligible Hole-in the-Rock landscape accruing from greater protection of these resources provided under alternative D would provide long-term beneficial cumulative impacts. The net result of the analysis indicates that the impacts on National Register eligible and unevaluated sites under this alternative would be beneficial.

Alternative E: Mixed Use

Lone Rock Beach

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would continue to operate at Lone Rock Beach. However, off-road use of these motor vehicles would require an ORV permit. In addition, a 20-acre area would be designated as a vehicle-free zone (no motor vehicles of any kind would be allowed in this area).

No archeological sites or ethnographic resources have been identified in the Lone Rock Beach study area. Therefore, alternative E would not have a direct impact, beneficial or adverse, on archeological resources in Lone Rock Beach. There are three unevaluated sites in the buffer (see table 18). Long-term adverse indirect impacts on these sites may result from continued operation of motor vehicles in the area. Indirect impacts would be increased risk of vandalism and looting, as well as long-term soil loss/degradation by erosion. These adverse impacts would be similar to those under alternative C and would be mitigation similar to alternative C.

Lone Rock Beach Play Area

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would continue to operate at Lone Rock Beach Play Area. However, off-road use of all motor vehicles would require an ORV permit and a safety flag. Impacts on archeological resources, and by extension ethnographic resources, would be the same as for alternative C.

Accessible Shorelines

Under alternative E, a total of 14 accessible shoreline areas (12 existing areas plus Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles and street-legal ATVs by permit, subject to water-level closures. Off-road use at Warm Creek would be discontinued.

A total of six sites eligible for the National Register and two unevaluated sites are located within the 14 accessible shorelines study areas (see table 18). Some of these sites are regarded as ethnographic resource of value to the descendent communities. Continued use of off-road motor vehicle use may result in long-term direct adverse impacts on these eight sites.

The buffers of the accessible shorelines contain 19 archeological sites that are eligible for the National Register and 37 unevaluated sites. Long-term adverse indirect impacts on these sites may result from continued operation of motor vehicles in the area. Adverse impacts would be mitigated similar to alternatives C and D. Although these accessible shorelines have been surveyed, the potential exists for un-recorded sites to be impacted by motor vehicles operating off-road in these areas. The potential for adverse impacts on un-recorded archeological sites may be mitigated by monitoring of ORV impacts as stipulated in the Environmental Assessment and Management/Development Concept Plans for Lake Powell's Accessible Shorelines (NPS 1988).

By discontinuing off-road use at Warm Creek, fewer not evaluated sites could be impacted under this alternative. In addition, OHVs would not be allowed to operate in the 14 ORV accessible shoreline areas further reducing potential impacts. Under alternative E, the archeological sites, and by extension ethnographic resources, found within Warm Creek would benefit. The restoration of natural vegetation in at this shoreline would reduce potential soil erosion thereby preserving the physical integrity of these resources. The loss of one shoreline access area is not anticipated to result in substantial impacts on archeological resources at the other 14 areas as a result of increased demand for access and visitation to those sites, because the remaining areas is expected absorb the increased demand without additional disturbance of resources.

Travel on Unpaved and Paved GMP Roads in Glen Canyon

Under alternative E, conventional motor vehicles and street-legal ATVs would be authorized on all GMP roads, with the exception of the Orange Cliffs Unit where street-legal ATVs would not be allowed. Additionally, OHVs would be limited to unpaved GMP roads, with the exception of the Orange Cliffs Unit.

Long-term indirect adverse effects on the 39 National Register and 23 unevaluated archeological sites, and by extension ethnographic resources, located within the boundaries of these linear road corridors would continue to occur under this alternative. Archeological sites, the Hole-in-the-Rock Trail, and the potentially eligible TCP of the Hole-in the-Rock landscape in these areas would continue to be impacted by ongoing use. The effects of erosion as a result of runoff from compacted areas, as discussed for other alternatives, would continue to impact areas immediately adjacent to roads, particularly near culverts and in areas of steeper terrain. Similar to alternatives A, B, C, and D, short and long-term direct adverse impacts on National Register and unevaluated archeological sites within the roadway of the GMP roads have already occurred. Because the integrity of the archeological deposits in the direct impact zone has been compromised, continued, and increased in some instances, motor vehicle use of the GMP roads would have no adverse impact. The potential indirect impacts include looting of archeological sites, purposeful vandalism of petroglyph and pictograph sites, deflation of sediments containing archeological deposits, and inadvertent vandalism of archeological and ethnographic sites. If Glen Canyon staff become aware of an eligible cultural resource on the roadway itself, the park would mitigate the effects on that resource. Mitigation techniques are described under alternative C, Lone Rock Beach.

Ferry Swale

Under alternative C, conventional vehicles, OHVs, and street-legal ATVs would be authorized for use on approximately 15 miles of designated ORV routes by permit. Other user-created routes would be closed and restored to natural conditions. Direct and indirect impacts would be the same as alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to impact National Register eligible archeological sites, and by extension ethnographic resources, under the no-action alternative would occur, and impacts would be the same as described under alternative A. The impacts of these actions, in combination mixed use, would result in long-term adverse cumulative impacts on this class of historic properties. However, the beneficial impacts on archeological sites, the Hole-in-the-Rock Trail, and the potentially eligible Hole-in the-Rock TCP landscape accruing from greater protection of these resources provided under alternative E would provide long-term beneficial cumulative impacts. The net result of the analysis indicates that the impacts on National Register eligible and unevaluated sites under this alternative will be beneficial.

Conclusion

Table 37 is a comparison of impacts on archeological resources.

Table 37: Comparison of Impacts on Archeological Resources across Alternatives

Location	Contributing Elements/ Affected Resources (# of sites)	Eligible and Unevaluated Sites Impacted				
		Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Lone Rock Beach	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 3	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 3	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 0	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 3	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 3	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 3
Lone Rock Beach Play Area	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 3 mitigated sites Buffer: 1	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 3 mitigated sites Buffer: 1	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 0	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 3 mitigated sites Buffer: 1	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 0	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 3 mitigated sites Buffer: 1
Accessible Shoreline Areas	**Eligible** Study Area: 6 Buffer: 19 **Unevaluated** Study Area: 4 Buffer: 37	**Eligible** Study Area: 3 Buffer: 19 **Unevaluated** Study Area: 2 Buffer: 25	**Eligible** Study Area: 0 Buffer: 0 **Unevaluated** Study Area: 0 Buffer: 0	**Eligible** Study Area: 6 Buffer: 19 **Unevaluated** Study Area: 4 Buffer: 37	**Eligible** Study Area: 0 Buffer: 8 **Unevaluated** Study Area: 0 Buffer: 5	**Eligible** Study Area: 6 Buffer: 19 **Unevaluated** Study Area: 2 Buffer: 37
GMP Roads	**Eligible** Study Area: 39 **Unevaluated** Study Area: 23	**Eligible** Study Area: 17 **Unevaluated** Study Area: 6	**Eligible** Same as alternative A **Unevaluated** Same as alternative A	**Eligible** Study Area: 39 **Unevaluated** Study Area: 23	**Eligible** Study Area: 0 **Unevaluated** Study Area: 0	**Eligible** Same as alternative A **Unevaluated** Same as alternative A
Ferry Swale	**Eligible** Study Area: 6 **Unevaluated** Study Area: 3	**Eligible** Study Area: 6 **Unevaluated** Study Area: 3	**Eligible** Study Area: 0 **Unevaluated** Study Area: 0	**Eligible** Study Area: 6 **Unevaluated** Study Area: 3	**Eligible** Study Area: 0 **Unevaluated** Study Area: 0	**Eligible** Study Area: 6 **Unevaluated** Study Area: 3

Compared to all the other alternatives including alternative A, alternative B is the most protective of cultural resources because it eliminates most direct and indirect adverse impacts on archeological sites, some of which are ethnographic resources. Alternative B also conveys a long-term benefit through stabilization of areas with archeological sites by restoration of natural vegetation. In terms of protecting these resources alternative B is followed by alternative D which will decrease motorized traffic by prohibiting OHV and street-legal ATV use within Glen Canyon and also discontinuing off-road use at 11 accessible shorelines and at Ferry Swale, resulting in both short and long-term benefits to archeological sites through protection and stabilization. Alternative E falls between alternatives B and D in terms of impacts on archeological sites. Under this alternative off-road use would be allowed at 14 accessible shorelines as well as 15 miles of designated ORV routes in Ferry Swale. Compared to all the other alternatives, alternative C would generate the most direct and indirect adverse impacts by increasing

motorized access from 13 to 15 accessible shorelines, increasing the types of motor vehicles allowed on GMP roads, including the Orange Cliffs Unit, as well as designating 15 miles of ORV routes in Ferry Swale.

Although adverse impacts on archeological sites, some of which are ethnographic resources, could occur under all alternatives, they may not meet the contextual significance criteria defined in NEPA regulations. However, these impacts, particularly under alternatives C and E, will be sufficient to trigger Section 106 of the NHPA, as amended. Section 106 makes no distinction between direct and indirect impacts as any action that negatively affects the integrity of a historic property is regarded as an adverse effect.

Section 106 provides for the identification and resolution of adverse effects (impacts) to National Register listed or eligible archeological sites. In general, resolution of adverse effects is achieved by consultation among federal agency, in this case NPS, relevant SHPOs, appropriate THPOs, and other interested parties like the ranching community. Once the consulting parties have agreed on a set of measures to mitigate the adverse effect on the historic property, the measures are incorporated into a programmatic agreement. The programmatic agreement stipulates the legal authority under which the measures are being undertaken, the responsible parties, and the character and intensity of the measures themselves. Because adverse effects are likely to result from all but alternative B, NPS is currently undertaking Section 106 consultation regarding the management of off-road use and on-road use of OHVs and street-legal ATVs. Documents demonstrating compliance with Section 106 of the NHPA, as amended are presented in the appendix A of this plan/DEIS.

Ethnographic Resources

NPS defines “ethnographic resources” as “objects and places, including sites, structures, landscapes, and natural resources, with traditional cultural meaning and value to associated peoples” (NPS 2006a). These resources are the cultural and natural features of a park that are closely linked with their own sense of purpose, existence as a community, and development as ethnically distinctive peoples. These places may support ceremonial activities, migration routes, or harvesting or collecting places. Continued access and use of ethnographic resources is often essential to the survival of family, community, or regional cultural systems, including patterns of belief and sociocultural and religious life (NPS 2006a).

Some ethnographic resources or places are eligible for inclusion in the National Register of Historic Places as Traditional Cultural Properties (TCP) because of their association with the cultural practices or beliefs of a living community that are (1) rooted in that community’s history, and (2) important in maintaining the continuing cultural identity of the community (NPS 2006a; Parker 1993; and Parker and King 1998).

Further, NPS is directed to allow traditionally associated people access to and use of ethnographic resources that are essential for their cultural survival with the caveat that such use can be sustained without causing unacceptable impacts (NPS 2006a). Additionally, NPS is directed to pursue opportunities to improve management of its resources by pursuing cooperative conservation with traditionally associated peoples (Executive Order 13352, Facilitation in Cooperative Conservation).

The potentially National Register-eligible TCP of the Hole-in-the-Rock landscape, inclusive of the unpaved GMP road, would be the only historic property of this type to be carried through the analysis. This decision was made following consultation with the five contemporary Native American tribes most closely associated with Glen Canyon, The Church of Jesus Christ of Latter-day Saints, and other consulting parties.

The Hole-in-the-Rock site is a part of the historic Hole-in-the-Rock wagon trail directly associated with the colonization of the region by Latter-day Saints pioneers in the late nineteenth-century. It represents an engineered passage traversing a 1000-foot gorge over-looking the Colorado River. This cultural resource is managed by Glen Canyon as part of its unpaved GMP road system. In recent years, members of The Church of Jesus Christ of Latter-day Saints have been permitted to conduct re-enactments of the events leading to the passage of the Colorado River

through the Hole-in-the-Rock. These re-enactments include camping along the historic trail in both Glen Canyon and Grand Staircase – Escalante National Monument.

The Hole-in-the-Rock landscape inclusive of the road corridor seems to meet the criteria for a TCP because it is significant to members of The Church of Jesus Christ of Latter-day Saints as a location associated with their pioneer history, and it continues to be important in the maintenance of their ongoing communal identity and in their development as an ethnically distinctive group (Sucec 2012). The significance of the corridor is documented in the 2011 Programmatic Environmental Assessment for Organized group Activities along Hole-in-the-Rock Road. Nevertheless, impacts can be considered to be for the reasons cited above. Further, in consulting on the Hole-in-the-Rock EA, The Church of Jesus Christ of Latter-day Saints community was a proponent for increased use by organized groups; they do not view pedestrian and vehicular use as having more than impacts.

Alternative A: No Action

The Hole-in-the-Rock is managed as an unpaved GMP road. Consequently, under alternative A, conventional motor vehicles and street-legal ATVs would continue to be authorized to operate inside the boundaries of this potential TCP landscape. This could leave the site vulnerable to the long term indirect adverse impact of purposeful and inadvertent vandalism. Maintenance of current management practices would have a beneficial long term impact because it would allow continued access to the site by members of The Church of Jesus Christ of Latter-day Saints for permitted activities such as re-enactments and over-night camping.

Cumulative Impacts

Under alternative A, the Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road may affect the potential Hole-in-the-Rock TCP; the no-action alternative would have cumulative effects due to the potential for vandalism offered by the continuance of existing management policies. This adverse impact is somewhat off-set by the use of the potential TCP landscape for heritage commemoration by The Church of Jesus Christ of Latter-day Saints community.

Alternative B: No Off-road Use

Under alternative B, conventional motor vehicles and street-legal ATVs would continue to operate on the unpaved GMP road. This would result in the same indirect impacts as those described for alternative A.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within the Glen Canyon that have the potential to affect the Hole-in-the-Rock and potential TCP of the Hole-in-the-Rock under no-action alternative would occur, and cumulative impacts would be the same as described under alternative A.

Alternative C: Increased Motorized Access

Under alternative C, the indirect impacts would be similar to those from the no-action alternative. Conventional motor vehicles and street-legal ATVs would continue to be allowed on unpaved GMP roads, however, under this alternative, OHVs would also be authorized to operate on unpaved GMP roads. Increase motor vehicle access would have a beneficial long term impact because it would allow continued and expanded access to the site by members of The Church of Jesus Christ of Latter-day Saints for permitted activities such as re-enactments and over-night camping. With the addition of OHVs on unpaved GMP roads, however, there is the potential for increased vandalism.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect the Hole-in-the-Rock under the no-action alternative would occur, and impacts would be the same as described under alternative A. The impacts of these actions, in combination with the adverse impacts on the potential TCP landscape under alternative C, would result in long-term adverse cumulative impacts on this historic property.

Alternative D: Decreased Motorized Access

Under alternative D, only conventional motor vehicles would be authorized to operate on all unpaved GMP roads in Glen Canyon, including the Hole-in-the-Rock landscape. This alternative could decrease public access by prohibiting the use of unpaved GMP roads by OHVs and street-legal ATVs. This has the potential to constrain access by members of The Church of Jesus Christ of Latter-day Saints for the purpose of heritage commemoration and would constitute a negative impact on that community. A mitigation strategy could be implemented to allow use of the Hole-in-the-Rock road during permitted group activities. Beneficial effects would flow from this alternative in the form of reduced potential for purposeful and inadvertent vandalism as a result of decreased motorized access.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities would occur within Glen Canyon that have the potential to impact the Hole-in-the-Rock and the potential TCP Hole-in-the-Rock landscape under the no-action alternative and impacts would be the same as described under alternative A. The impacts of these actions, in combination with the adverse impacts on the potential TCP under alternative D, would result in long-term adverse cumulative impacts on the historic property. However, the beneficial impacts on the Hole-in-the-Rock accruing from greater protection of this resource provided under alternative D would provide long-term beneficial cumulative impacts.

Alternative E: Mixed Use

Impacts under alternative E would be the same as alternative C, as the Hole-in-the-Rock would be accessed by conventional motor vehicles, OHVs, and street-legal ATVs.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities would occur within Glen Canyon that have the potential to affect the Hole-in-the-Rock TCP under the no-action alternative and impacts would be the same as described under alternative A. The impacts of these actions, in combination with the adverse impacts on the potential TCP under alternative E, would result in long-term adverse cumulative impacts on this historic property. However, the beneficial impacts on the Hole-in-the-Rock TCP eligible landscape accruing from greater protection of this resource provided under alternative E would provide long-term beneficial cumulative impacts.

Conclusion

Compared to all the other alternatives including alternative A, alternative D is the most protective of cultural resources because it reduces the potential for indirect adverse impacts on the Hole-in-the-Rock and potentially National Register eligible Hole-in-the-Rock landscape TCP as a result of decreased motorized access (no OHVs or street-legal ATVs allowed on unpaved GMP roads, as well as the rest of Glen Canyon). However, this alternative could have long-term adverse impact on The Church of Jesus Christ of Latter-day Saints community by limiting

access of unpaved GMP roads to conventional motor vehicles only. Alternative C and E are the least protective as both alternatives add OHVs to conventional motor vehicles and street-legal ATVs as motor vehicles allowed to operate on unpaved GMP roads. Impacts of alternative B would be similar to alternative A as it allows conventional motor vehicles and street-legal ATVs to operate on unpaved GMP roads.

As stated in the preceding archeological resources section, adverse impacts on National Register listed or eligible properties trigger Section 106 of the NHPA, as amended. In this case, the Hole-in-the-Rock landscape TCP is regarded as potentially eligible. As such it would be afforded the same consideration as the listed Hole-in-the-Rock property until such time as its eligibility for the National Register is evaluated.

All alternatives would have adverse impacts on the Hole-in-the-Rock landscape TCP. Measures to mitigate the adverse effect on the historic property will be incorporated into a programmatic agreement. Because adverse effects are likely to result from all alternatives NPS is currently undertaking Section 106 consultation regarding the management decision that could affect this unpaved GMP road. Documents demonstrating compliance with Section 106 of the NHPA, as amended are presented in the appendix A of this plan/DEIS.

SOCIOECONOMICS

Guiding Regulations and Policies

Although economic or social effects do not by themselves require the preparation of an EIS, when an EIS is prepared and economic or social and natural or physical environmental effects are interrelated, then the EIS must discuss all these effects on the human environment (40 CFR 1508.14). CEQ also requires NPS to consider the effects of actions on the quality, growth, expansion, and use of outlying and gateway communities (40 CFR 1502.16).

NEPA requires the analysis of social and economic impacts resulting from proposed major federal actions in an EIS. From these requirements, NPS has identified conditions that it wants to achieve in association with its management of national parks. These conditions are described in the NPS *Management Policies 2006* (NPS 2006a). Furthermore, Section 2.3.1.4 of NPS *Management Policies 2006* (NPS 2006a) requires that decisions documented in planning products such as environmental analyses be based on the current scientific understanding of park ecosystems, the cultural context, and the socioeconomic environment.

Methodology and Assumptions

The methodology for determining the level of potential socioeconomic impact was based on several factors, including economic data, historic visitor use data, and economic studies related to ORV recreation trip expenditures and economic impacts. A mostly qualitative analysis based on the professional expertise and judgment of planning team members and outside experts was sufficient to compare the impacts of the alternatives for decision-making purposes. However, where possible the planning team incorporated quantitative measures into the analysis. The “Socioeconomics” section in chapter 3 provides a thorough discussion on the socioeconomic environment and the economic impacts of motor vehicle recreation.

This socioeconomic impact analysis considers direct and indirect impacts on the local and regional economies. Direct impacts are defined as those that occur when individuals make expenditures to support their recreational activity, including the purchase of vehicles and related equipment and the costs of maintaining and operating them. Indirect impacts occur when individuals take recreation trips and spend money on restaurants and groceries, lodging (including camping fees), souvenirs, and other trip-related expenditures.

The economic effects of the ORV management alternatives are based on estimated ORV visitation to Glen Canyon, associated visitor spending, and the economic impacts (i.e., jobs, labor income, gross regional product) generated

by this spending. Glen Canyon attracts a large number of visitors, almost all of whom are from outside Glen Canyon. These visitors consume from local businesses, such as restaurants, hotels, and retail outlets, in communities surrounding and in Glen Canyon during their visits, contributing to local economies. The economic contribution of the visitor spending is a function of how many visitors arrive, and how much money they spend while visiting.

Visitor spending benefits for Glen Canyon have been estimated by the MGM2 model (Stynes 2011). Glen Canyon had a total of 2,270,817 recreation visitors in 2011, with 1,311,741 overnight stays (Cui et al. 2013). Total spending associated with Glen Canyon visitation in 2011 was estimated to be $233,895,000, all of which was spent by nonlocal visitors (Cui et al. 2013). The total labor income generated by this spending was over $88,152,000, and the gross regional product was $138,044,000. This economic activity supported 2,755 jobs in the local economy, as further described below (Cui et al. 2011). The economic impacts are typically felt in communities within 60 miles of Glen Canyon. However, because Glen Canyon is located in a remote and isolated area, visitor spending could also occur in communities farther away from Glen Canyon, perhaps even as far as St. George and Flagstaff, Arizona, as campers, boaters, or other recreationists gather supplies for their vacation at Glen Canyon.

The number of jobs (employment) supported by visitor spending to Glen Canyon is estimated to be 2,755, which includes direct jobs in accommodations, food and beverage establishments, grocery stores, other retail sales, and service industries. This employment also includes jobs that are supported by the direct industry workers spending their money in the local economies, supporting indirect jobs and income in other sectors, such as health care, retail sales, and construction.

The socioeconomic analysis uses the vehicle counts, visitation, visitor spending, and economic impact ratios from the MGM2 model (described previously) to estimate, and in some cases quantify, the economic effects of potential reductions in ORV visitation on local economies. Vehicle counts were accessed from NPS Public Use Statistics website or were provided from counts at Glen Canyon. It is assumed that all visitors are nonlocal visitors (unless stated otherwise), coming from more than 60 miles from Glen Canyon, based on Glen Canyon being a remote and isolated global attraction drawing visitors from around the United States and around the world. Additionally, the MGM2 model assumes that the visitor spending associated with Glen Canyon is all generated by nonlocal visitors. Local visitors do not inject new money and spending into the region associated with visiting Glen Canyon; their jobs and income contribute to the local economies, but their spending cannot be attributed to the visitation of Glen Canyon.

On average, each visitor spent approximately $103 per visit in 2011 (Cui et al. 2013). For every $85,000 annually spent by visitors, one job, $32,035 in labor income, and $50,167 in gross regional product is supported in the local economies (Cui et al. 2013); generally, this is considered to be counties within 60 miles of Glen Canyon. Where needed, it is assumed that there are approximately 2.5 people per ORV (NPS Public Use Statistics Office 2012) and 1.5 people per ATV.

It is also assumed that there are other factors also known to affect visitation aside from management decisions, including the price of gas; national and regional economic conditions, which can affect the amount and availability of disposable income; lake levels; the availability and quality of substitute sites; trends in vacation and recreational activities; local celebrations that briefly increase the general population base; and information provided by public and private sources. These factors can be very important in influencing visitation levels.

Context

The geographic area assessed includes counties in the Glen Canyon vicinity, including Garfield, Kane, San Juan, and Wayne Counties in Utah. Additionally, Coconino County is included in the study area; it lies in the Arizona portion of Glen Canyon and is a geographically large county including the city of Flagstaff, Arizona. It is possible that communities in the Utah counties of Washington, Iron, and Sevier would also be affected by visitor spending

associated with Glen Canyon because their labor force is closely associated with the Glen Canyon counties, so these counties are also included as needed in the context.

Alternative A: No Action

Lone Rock Beach

Under the no-action alternative, current management practices would continue at Lone Rock Beach. Lone Rock Beach is currently open to conventional motor vehicles, OHVs, and street-legal ATVs. Motor vehicles may be operated from the operator's camping location to the Lone Rock Beach Play Area. In 2010, approximately 52,000 vehicles entered Lone Rock Beach and/or Lone Rock Beach Play Area, which represented almost 7% of all vehicle counts in Glen Canyon (NPS 2012a). Vehicle counts at Lone Rock have increased by a large amount in 2011, with a 35% increase to almost 77,000 vehicles (not including December counts), which represents 8% of 2011 vehicle counts.

Assuming 2.5 visitors per vehicle, 2010 and 2011 Lone Rock Beach visitation represent 7% and 9%, respectively, of 2010 visitation figures and 6% and 8% of 2011 visitation figures. These visitors to Lone Rock Beach are estimated to spend approximately $13.4 to $19.8 million in local economies in and surrounding Glen Canyon. This visitor spending is estimated to annually contribute from 156 to 233 jobs, $5.0 to $7.8 million in labor income, and $7.5 to $11.7 million in gross regional product. Under this alternative, these visitors would continue to beneficially contribute to the local economies through their visitor spending, having a small but important impact on local communities. Proximate communities are the primary beneficiaries associated with the ORV visitor spending contributions, including jobs, income, and taxes.

An estimated 498 ATVs/OHVs visited Lone Rock Beach and/or Lone Rock Beach Play Area in 2007, with an estimated visitation of 747 ATV/OHV riders. In 2011, 1,681 OHVs and street-legal ATVs were reported in Lone Rock Beach; data included captures vehicles that were trailered in and recorded by the entrance station. However, this figure does not capture off-road use, or the number of ORVs that entered the area when the entrance station was closed, either seasonally or after hours (NPS 2012a). In 2011, these ORVs, with an associated 2,522 visitors to Lone Rock Beach and Lone Rock Beach Play Area represent approximately 0.1% of visitors to Glen Canyon and spend an estimated $234,000 annually, making a limited contribution to jobs and income in the region. Therefore, the bulk of the Lone Rock Beach visitation is likely conventional motor vehicles accessing the beach.

Lone Rock Beach Play Area

The play area is a fenced, 180-acre area that is open to high-intensity motor vehicle use. Under the no-action alternative, the play area would continue to be open to conventional motor vehicle, OHV, and street-legal ATV operators to develop riding skills, operate at high speeds, and perform jumps and hill climbs. An estimated 1,681 OHVs and street-legal ATVs may have visited the Lone Rock Beach Play Area in 2011. The economic benefits associated with the accessibility of Lone Rock Beach Play Area are included in the Lone Rock Beach assessment due to limited data for the play area.

Accessible Shorelines

The 13 accessible shoreline areas, which are intended to provide public conventional motor vehicle access to the shoreline for the purposes of primitive recreation use, would continue to be authorized or would have the potential to be reopened, if the accessible shoreline is currently closed. The most popular accessible shoreline areas have been Bullfrog North and South, Stanton Creek, and Hite Boat Ramp, although Bullfrog North and South have been closed since 2002 due to low water levels. Currently Warm Creek, Crosby Canyon, and Bullfrog North and South are temporarily closed due to low lake elevation, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. The Paiute Farms and Nokai Canyon accessible shorelines are not officially

open, although they are currently being accessed. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access.

There were 5,716 vehicles at Stanton Creek in 2002, whereas 9,680 vehicles visited Bullfrog North and South in 2002. Stanton Creek had fewer vehicle visits in 2007, with 3,953 vehicles recorded. In 2009 and 2011, Stanton Creek off-road visitation also was less than visitation in 2002, 590 to 1,680 vehicles respectively, as higher lake elevations provided a smaller area for off-road use. The Stanton Creek vehicle counts represented less than 1% (0.7% in 2002 and 0.6% in 2007) of all vehicles accessing Glen Canyon. This portion of visitors accounts for approximately $1.5 million in visitor spending in 2011, supporting 18 jobs, $573,000 in labor income, and $897,000 in gross regional product.

Bullfrog visitation in 2002 represented 1.3% of total in Glen Canyon in 2002; this portion of 2011 Glen Canyon visitation supported approximately $3.0 million in visitor spending, 36 jobs, $1.1 million in labor income, and $1.8 million in gross regional product.

The Hite developed area is also a popular area. It includes the Hite Boat Ramp accessible shoreline, primitive and RV camping, a marina, and a gas station. Visitation to this entire developed area, not just the accessible shoreline, accounted for approximately 3% of total visitation to Glen Canyon in 2005 (NPS 2008e). The Hite developed area visitation has varied; lower visitation is associated with lower lake levels. Since 1999, Hite developed area visitation has decreased annually, with the lowest use in 2005 of 59,405 visitors (NPS 2008e).These 59,000 visitors in 2005 represented not only visitors to the accessible shoreline at Hite Boat Ramp, but also those launching boats, visiting the ranger station, driving through the northern part of Glen Canyon, and camping. If it is assumed that one-tenth of the visitors to the Hite developed area have the primary purpose of visiting the accessible shoreline at Hite Boat Ramp, which is likely a conservative figure, then approximately 6,000 people visited Hite Boat Ramp accessible area in 2005, representing 0.3% of visitation in 2005. The Hite Boat Ramp accessible shoreline visitation portion of Glen Canyon visitation is estimated to support approximately $702,000 in visitor spending, 8 jobs, $274,000 in labor income, and $414,000 in gross regional product in 2011.

Visitation to the other accessible shorelines has been limited, and fluctuations in Lake Powell's levels over the last decade have been a contributing factor to the small amount of visitation at these areas. Visitation to Stanton Creek and other accessible shoreline areas would continue under alternative A, with direct beneficial effects on local economies as described above. However, if Stanton Creek visitation represents the bulk of the visitation to the accessible shoreline areas, the beneficial impacts on local economies from this visitation would continue to be limited.

Travel on GMP Roads in Glen Canyon

Under the no-action alternative, conventional motor vehicles and street-legal ATVs would continue to be allowed to operate on all GMP roads in Glen Canyon, except street-legal ATVs would not be allowed at the Orange Cliffs Unit. ATVs that do not meet the street-legal requirements under Utah and Arizona code are prohibited from operating on any road in Glen Canyon.

The prevalence of street-legal ATVs (as well as OHVs because they are generally categorized together) on Glen Canyon roads is not known at this time, although the Glen Canyon Visitor Use Study (University of Idaho 2008) and the NPS suggest that ATV/OHV riding is not a prominent or primary activity at Glen Canyon (NPS 2012c) despite street-legal ATVs being authorized on Utah roads since 2008 under Senate Bill 181, and subsequently authorized for operation on Glen Canyon GMP roads. It is likely that street-legal ATV (and OHV) riders come to Glen Canyon not only to ride their vehicles but also to participate in other activities, such as boating, fishing, swimming, or camping.

There are an estimated 4,210 registered OHVs in the four Utah counties, while 35% of households in Coconino County, Arizona are OHV users (Utah State Parks and Recreation 2012; Arizona State Parks 2003). Wayne County, Utah estimated that there were three street-legal ATVs in the county, while Kane and San Juan counties indicated that there were several street-legal ATVs in their counties. Data on street-legal ATVs in Coconino County, Arizona and Garfield County, Utah were not available but it is likely that only a very small proportion of ATVs are street-legal. Since there are so few street-legal ATVs in these counties in close proximity to Glen Canyon, it is likely that there is not considerable street-legal ATV use of GMP roads. The current level of visitation is expected to continue under this alternative. The ability to continue to ride conventional motor vehicles and street-legal ATVs on Glen Canyon roads is likely to have a minimal impact on socioeconomic resources.

Ferry Swale

Off-road use, though currently illegal, occurs throughout the Ferry Swale area before crossing onto federal lands administered by the BLM, including the Vermilion Cliffs National Monument, an area of sensitive geologic formations. Because of its proximity to Page, Arizona, this area is popular with local ORV users. This illegal use has contributed to the creation of user-created routes (not formally designated routes) in the Ferry Swale area. Under alternative A, approximately 53 miles of ORV routes would be designated for off-road use by conventional vehicles, OHVs, and street-legal ATVs and the remaining user-created routes closed. Due to the increasing popularity of off-road use of Ferry Swale, alternative A could have some beneficial impacts on socioeconomic resources as this previously illegal use would be authorized. However, since a large portion of the visitors already reside in proximate communities, the impacts on socioeconomic resources associated with designating ORV routes in this area would be limited.

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect visitation, visitor spending, with potential impacts on local economies. In recent years, the rising and falling water levels as a result of natural fluctuations and dam operations have exposed more or less of the accessible shoreline areas, impacting the areas available for recreation. Following these events, several popular accessible shoreline areas have been closed due to accessibility issues, resulting in an adverse impact on visitation, visitor spending, and economic contributions to local economies. Additionally, Glen Canyon visitation can also be affected by other factors such as the health of the economy, trends in vacation and recreational activities, the price of gasoline, the character and condition of the recreation and access areas, local celebrations that briefly increase the general population base, and information provided by public and private sources.

Beneficial impacts on visitation and visitor spending have occurred, and would continue to occur into the future, from the implementation of the following actions:

- Buildout of Antelope Point Marina.
- Construction and Operations of Town of Escalante Hole-in-the-Rock Cultural Center.
- Development and Operations of the Amangiri Resort adjacent to Ferry Swale.

Additionally, existing plans and actions that determine the existing uses of Glen Canyon for ORVs would continue to guide and affect visitation and visitor spending in local economies. Adverse impacts may result from these management plans that restrict visitor use, including where OHVs and street-legal ATVs can be operated and which accessible shoreline areas are open to visitor use. In the interest of protecting resources, some of these management plans may restrict some visitor opportunities in certain locations, which may result in slight adverse impacts on visitor spending and local economies.

Additional actions include the development and operation of the Amangiri Resort, which would draw additional visitors to the area, beneficially impacting visitor spending in local economies. The buildout of Antelope Point Marina which includes a floating marina village and boat docks, dry storage for boats, campground and RV park, a resort hotel and cultural center, and supporting infrastructure, is likely to draw additional visitors to Glen Canyon, beneficially impacting visitor spending in local economies. Visitors to the Town of Escalante Cultural Center could also be drawn to visit Glen Canyon Recreation Area, slightly benefiting local economies. Construction activities associated with these actions also bring jobs and income to the local communities surrounding Glen Canyon.

The potentially adverse impacts of rising and falling water levels, higher gasoline prices, and current management plans that restrict access, may adversely affect visitation and visitors spending levels; however, since Glen Canyon is an internationally-renowned destination area and current visitation levels are beneficially supporting local economies, these cumulative impacts are likely to be relatively low in context of the total demand, use and visitation to Glen Canyon. With current and future infrastructure, marina, cultural facility, and adjacent resort development and improvements expected to beneficially affect visitation and visitor spending, the cumulative impacts on local economies in combination with the no-action alternative would be beneficial, although these impacts are not expected to noticeably affect the socioeconomic environment. Long term cumulative impacts associated with alternative A to visitor spending, jobs, and income are expected to beneficially effect local communities, making a small economic contribution to the region; however, these beneficial effects are likely not to be noticeable in the larger regional economic context of the study area socioeconomic resources.

Alternative B: No Off-road Use

Lone Rock Beach

Lone Rock Beach would be closed permanently to all off-road use and restored to natural conditions. Visitation to Glen Canyon would likely decrease without the opportunity to access Lone Rock Beach by a motor vehicle. Without the ability to access Lone Rock Beach, with its unique beach experience, ORV users may seek out other recreation opportunities outside the region, which would have an adverse effect on the local economy. There are other off-road opportunities on lands adjacent to Glen Canyon, managed by the BLM, including the Arizona Strip Field Office, Richfield Field Office, Monticello Field Office, and Grand Staircase – Escalante National Monument. There are an estimated 3,700 miles of designated ORV routes in Richfield Field Office, and 908 miles of ORV routes in Grand Staircase – Escalante National Monument, 553 miles of which are open to OHVs (Downey 2012). To the extent that Glen Canyon visitors would choose to visit nearby substitute ORV areas, the adverse effects on local economies could be partially offset.

It is possible that ORV visitors would still visit Glen Canyon to experience the other attractions, perhaps accessing Lone Rock Beach by boat or parking along Lone Rock Beach Road and walking to the beach area. It is also likely that visitors who value a more natural experience would visit this area on foot. However, the preclusion of off-road use under alternative B is not expected to increase use at the beach.

In 2010 and 2011, Lone Rock Beach vehicle counts and visitation represented 7% and 9%, respectively, of the total 2010 visitation and 6% and 8% of 2011 visitation to Glen Canyon (NPS 2012a). These visitors were primarily ORVs accessing Lone Rock Beach and/or Lone Rock Beach Play Area. If it is assumed that none of the previous Lone Rock Beach users would visit Glen Canyon given the restrictions under alternative B, Glen Canyon visitation could decrease by up to 9% associated with the closure of these areas. It is possible that up to $21.1 million in visitor spending would be lost to the local economies if visitation were to decrease by 9%. The local and regional economies would be directly and adversely affected by these closures, which would result in the loss of up to 248 jobs, $7.9 million in labor income, and $12.4 million in gross regional product in the five-county study area. It is likely that not all Lone Rock Beach users would cease to visit Glen Canyon; therefore, these impacts would be expected to be less than those stated here. There would be adverse effects associated with decreased visitor

spending associated with alternative B; however, within the five-county study area, the loss of 248 jobs represents a very small portion of economic activity, less than 0.3% of employment in the region.

Lone Rock Beach Play Area

Lone Rock Beach Play Area would be closed permanently to all motor vehicles and restored to natural conditions. The play area represents a unique experience in the area, where conventional motor vehicles, OHVs, and street-legal ATVs are authorized for use. Although visitation data does not exist for the play area itself, it is likely that some of the users who visit Lone Rock Beach come for the play area experience. There are no other off-road play area opportunities within the Page, Arizona area. The economic impacts associated with the closure of the Lone Rock Beach Play Area are included in the Lone Rock Beach assessment due to limited data for the play area. As a result of the Lone Rock Beach and Lone Rock Beach Play Area closure, the local economies would be directly and adversely impacted, as described in the Lone Rock Beach section.

Accessible Shoreline Areas

Under alternative B, off-road use at the 13 accessible shorelines, plus Paiute Farms and Nokai Canyon, would be discontinued, and accessible shorelines would be restored to natural conditions. The most popular accessible shorelines include Hite Boat Ramp, Bullfrog North and South and Stanton Creek, although Bullfrog North and South have been closed since 2002 due to low water levels.

Stanton Creek is a popular accessible shoreline area. Hite Boat Ramp also has a fair amount of visitation, likely due to the accessible shoreline, boat launch, ranger station, and camping amenities in the Hite Marina area. The other accessible shoreline areas are not a strong attraction to Glen Canyon and have minimal visitation throughout the year due to their remoteness and isolation. Approximately 1.3% of visitors are estimated to access Stanton Creek and Hite Boat Ramp (Bullfrog North and South are currently closed), which accounts for approximately $3.0 million in visitor spending, supporting 36 jobs, $1.1 million in labor income, and $1.8 million in gross regional product in 2011.

With use of Stanton Creek, Hite Boat Ramp, and the other accessible shoreline areas discontinued, it is possible that visitation related to accessible shorelines could decrease by approximately 1.3%, adversely affecting visitor spending and local economies. Because Glen Canyon provides a unique setting with the ability to drive and recreate on the beaches, it is possible that visitors would no longer choose to visit Glen Canyon because off-road use would be discontinued at accessible shorelines. The impact of the discontinued use would be limited because the contribution of these visitors to the local economies is relatively small. For example, in 2009, 36 jobs represented 0.2% of the four-county region in Utah, and 0.04% of the five-county study area. Additionally, there are other off-road opportunities on lands adjacent to the Glen Canyon, managed by the BLM Arizona Strip Field Office, Richfield Field Office, and Monticello Field Office. To the extent that Glen Canyon visitors would choose to visit these nearby substitute sites, the adverse effects on local economies could be partially offset.

Additionally, it is likely that visitors, such as boaters or hikers, who enjoy and value a more natural, remote, and quiet experience would have an enhanced experience with the closure of these areas to off-road use. It is possible that the increased quality of the experience could increase visitation, although this would be an indirect and minor effect.

Because Bullfrog North and South is currently closed to off-road use, the loss in visitation, spending, and economic impacts from the planned permanent closure under alternative B is already embedded in current visitation levels.

Travel on GMP Roads in Glen Canyon

The impacts on socioeconomic resources associated with conventional motor vehicles and street-legal ATVs on Glen Canyon roads are expected to be the same as those described for alternative A. Since there are so few street-legal ATVs, alternative B is not likely to considerably affect visitation and visitor spending in Glen Canyon, and would have limited impacts on local social and economic resources.

Ferry Swale

Under alternative B, no ORV routes would be designated and existing user-created routes would be closed and restored to natural conditions. Implementation of alternative B could reduce visitation to this region. Since a large portion of the visitors already reside in proximate communities, the impacts on socioeconomic resources associated with the discontinued use of this area would be limited.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to affect visitor use and experience would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the adverse impacts on visitation and visitor spending under alternative B, would result in long-term adverse cumulative impacts on visitation and visitor spending contributions to local economies. These impacts are likely to be experienced primarily in proximate communities and could be adverse in the larger regional context.

Alternative C: Increased Motorized Access

Lone Rock Beach

The impacts on socioeconomic resources associated with off-road use at Lone Rock Beach would be expected to be similar to those of alternative A. Under this alternative, conventional motor vehicles, OHVs, and street-legal ATVs would continue to access Lone Rock Beach, although all motor vehicles would be required to obtain a permit. A permit system would be established to recover the costs of managing these areas, curb illegal activity, and fund education programs. Although the permit system may discourage a small amount of visitation to these sites, visitation is expected to be similar to alternative A, with beneficial implications for visitor spending and local economies.

Lone Rock Beach visitation represents up to 9% of recreation area visitation. These visitors are estimated to spend approximately up to $21.1 million in local economies, contributing up to 248 jobs, $7.9 million in labor income, and $12.4 million in gross regional product to local economies. Under this alternative, these visitors would continue to beneficially contribute to the local economies through their visitor spending.

Lone Rock Beach Play Area

The impacts on socioeconomic resources associated with Lone Rock Beach Play Area would be expected to be similar to those of alternative A. The difference in management of this area under alternative C is that ORV users would be required to obtain a permit to access the area and to possess and use safety flags in the play area. Although the cost to purchase a permit may discourage a small amount of visitation to these sites, visitation is expected to be similar to alternative A, with beneficial implications for visitor spending and local economies. The safety flags requirement would not be expected to affect visitation. The economic impacts associated with the continuation of Lone Rock Beach Play Area visitation are included in the Lone Rock Beach assessment due to

limited data for the play area. Continued off-road use of Lone Rock Beach and Lone Rock Beach Play Area would beneficially affect local economies through visitor spending.

Accessible Shoreline Areas

Under alternative C, 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles, OHVs, and street-legal ATVs by permit, subject to water-level closures. This alternative would allow OHVs and street-legal ATVs to access these shoreline areas, where they have not currently been allowed. A permit system would be established to recover the costs of managing these areas, to curb illegal activity, and to fund education programs.

Increased opportunities for OHV and street-legal ATV use at the 13 existing areas and the authorization of off-road use at two additional shorelines (Pauite Farms and Nokai Canyon) could increase visitation to Glen Canyon. The cost of a permit may discourage visitation to these sites, although the intent of the permit system is not to limit visitation but to fund management activities. The opportunity to operate OHVs and street-legal ATVs in the 15 shoreline areas is likely to enhance the off-road experience and draw additional visitors. It is possible that Lone Rock Beach visitors would choose to visit these sites, dispersing the off-road use from Lone Rock Beach to other areas. However, the remote experience at the shoreline areas would not allow for ORV "playing" as available at Lone Rock Beach Play Area, but would likely attract visitors who would enjoy fishing, hiking, picnicking, and camping in these relatively more remote and isolated locations. However, off-road use has been rapidly increasing in Utah and Arizona (McVay and Racki 2008; Burr et al. 2008; Keith et al. 2008), and with additional areas open to OHV and street-legal ATV use, it is likely that visitation to these areas would increase.

Data provided from Stanton Creek and Bullfrog North and South indicate that these areas during amenable lake elevation conditions each accounted for approximately 1% of Glen Canyon visitation. It is estimated that Hite Boat Ramp accessible area visitation accounts for 0.3% of visitation and possibly more at amenable lake levels. Stanton Creek and Bullfrog areas are located close to the busy and relatively accessible Bullfrog marina, allowing for easier access and relatively more visitation than the other accessible shoreline areas. Remote shoreline areas currently experience very little off-road use. Paiute Farms and Nokai Canyon are currently experiencing some off-road use, although the areas are not currently authorized. Paiute Farms and Nokai Canyon are located on the remote southern shoreline adjacent to the Navajo Indian Reservation, with limited access; therefore, considerable additional visitation associated with these sites is not likely to occur.

The off-road use of these accessible shorelines is likely to increase compared to current levels, primarily associated with increases in visitation associated with the 15 shoreline areas being authorized for use by OHVs and street-legal ATVs. Because street-legal ATV/OHV use is not a prominent or primary draw for visitors to Glen Canyon (University of Idaho 2008), it is expected that beneficial effects on local economies would be limited.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to travel on all GMP roads, including GMP roads in the Orange Cliffs Unit. As described in alternative A, there are currently very few street-legal ATVs in the Utah counties surrounding the recreation area, although there are a considerable number of registered OHVs. There over 4,000 registered OHVs in the Utah 4-county region and almost 200,000 in the state of Utah, many of which are likely ATVs. In Coconino County, Arizona, 35% of households are OHV users, and ATVs were used in 30% of the most recent OHV trip (Arizona 2003). It is likely that opening GMP roads to OHVs will expand visitation to Glen Canyon. Use of OHVs on roads may allow visitors to access multiple locations by OHVs instead of conventional motor vehicle or street-legal ATVs, drawing more visitors to Glen Canyon. To the extent that these visitors already reside in the local communities, the beneficial impact of increased visitation on local economies would be minimal. However, if this new policy were to draw new visitors from outside of the study area, the stimulus of new visitor spending will beneficially affect local economies with additional jobs and income.

However, because OHV and street-legal ATV use is not a prominent or primary reason for people to visit Glen Canyon (University of Idaho 2008), it is expected that beneficial effects on local economies would be limited.

Ferry Swale

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 15 miles of designated ORV routes. The designated ORV routes in this area may induce additional visitation and visitor spending in the area because this use and visitation (that is currently unauthorized) would become authorized. However, most of the visitation is expected to be current residents within the local region, and therefore, there would be limited beneficial impacts on socioeconomic resources.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect visitor use and experience would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the beneficial impacts on visitation and visitor spending under alternative C, would result in long-term beneficial cumulative impacts on visitation and visitor spending contributions to local and regional economies, with proximate communities experiencing most of these effects.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Under alternative D, Lone Rock Beach would remain open to conventional motor vehicles only. Lone Rock Beach and/or Lone Rock Beach Play Area account for approximately 7% to 9% of visitation to Glen Canyon. The vehicle counts at Lone Rock are assumed to include conventional motor vehicles, OHVs, and street-legal ATVs. An estimated 498 ATVs visited Lone Rock Beach and/or the play area in 2007, while in 2011, three times as many ATVs were recorded visiting this area, with 1,681 visitors (NPS 2012b). ATVs represented 1% of vehicle counts in Lone Rock Beach in 2007, and 2% of vehicle counts in 2011.

A portion of the off-road users come to Lone Rock Beach and Lone Rock Beach Play Area with the sole purpose of using OHVs or street-legal ATVs. Visitation would likely decrease due to prohibition of OHV and street-legal ATV use at Lone Rock Beach and the Lone Rock Beach Play Area. Estimates of OHV use at Lone Rock Beach and the play area indicate that approximately 2% of Lone Rock Beach visitors use OHVs. The NPS Visitor Use Study (NPS 2007f) also suggests that ATV riding is not a prominent or primary activity at Glen Canyon. Conventional motor vehicle users who access Lone Rock Beach and desire a quieter, perhaps more remote beach, camping, and picnicking experience may benefit from the prohibition of OHVs and street-legal ATVs on the beach, which could increase conventional motor vehicle use at Lone Rock Beach. Additionally, there are other off-road use opportunities on lands adjacent to Glen Canyon, managed by the BLM, including the Arizona Strip Field Office, Richfield Field Office, Monticello Field Office, and Grand Staircase – Escalante National Monument. There are an estimated 3,700 miles of designated ORV routes in Richfield Field Office, and 908 miles of ORV routes in Grand Staircase – Escalante National Monument, 553 miles of which are open to OHVs and street-legal ATVs (Downey 2012). To the extent that the OHV and street-legal ATV users would chose to visit these nearby substitute sites, the adverse effects on local economies could be partially offset.

Currently, visitors to Lone Rock Beach are estimated to spend approximately $13.4 to $19.8 million in local economies in and surrounding Glen Canyon. This visitor spending is estimated to annually contribute from 156 to 233 jobs, $5.0 to $7.8 million in labor income, and $7.5 to $11.7 million in gross regional product. Under this alternative, conventional motor vehicle user visitation would continue similar to current conditions, beneficially contributing to the local economies through continued visitor spending. Decreased OHV and street-legal ATV

visitation would result from the prohibition of these types of vehicles at Lone Rock Beach and Lone Rock Beach Play Area, although this portion of visitation is very small. Visitation overall would be expected to slightly decrease, with slight adverse effects on local economies.

Lone Rock Beach Play Area

The impacts under alternative D would be the same as those described under alternative B.

Accessible Shoreline Areas

Under alternative D, off-road use at 11 accessible shoreline areas would be discontinued. Visitors would still be able to access these areas either by boat or on foot. Four accessible shoreline areas would remain open to conventional motor vehicles by permit only: Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp. Since Bullfrog North and South closed in 2002, Stanton Creek has become the most visited accessible shoreline area, partly due to its proximity to the busy Bullfrog marina. Stanton Creek and Hite Boat Ramp are estimated to account for 1.3% of Glen Canyon visitation, contributing $3.0 million in visitor spending, 36 jobs, $1.1 million in labor income, and $1.8 million in gross regional product.

Farley Canyon is a popular fishing and camping location that receives a small amount of visitor use. The Dirty Devil shoreline area was previously popular, but it no longer provides access to Lake Powell due to lower water levels. Visitors still camp at this location but it is not as popular is it was when the lake levels were higher.

Although four of the more popular accessible shoreline areas would remain open, off-road use at 11 areas would be discontinued. These areas of discontinued off-road use would be expected to only slightly decrease overall ORV visitation, because the most popular and heavily visited areas would remain open for use. However, visitors seeking a more natural, remote, and quiet experience may have an enhanced experience in these areas, which could be reached either by boat or on foot; this enhanced experience could have implications for slight and indirect increases in visitation.

If the loss of visitation at the 11 closed areas were assumed to equal the total visitation at Stanton Creek (approximately 14,000 annual visitors), local economies would be adversely affected by the loss of $2.3 million in visitor spending and 28 jobs. These economic impacts would account for a very small portion of the employment and economic activity in the study area and would be expected to be lower than these estimates.

Travel on GMP Roads in Glen Canyon

Under alternative D, only conventional motor vehicles would be able to access GMP roads in Glen Canyon; street-legal ATV travel, currently allowed, would not be authorized. The impacts on socioeconomic resources associated with prohibiting street-legal ATVs on Glen Canyon roads would be expected to be limited because ATV riding has not been identified as a prominent or primary activity in Glen Canyon (NPS 2007f) and there are very few registered street-legal ATVs in adjacent counties (Downey pers. comm. 2012). Prohibiting street-legal ATVs on Glen Canyon roads would not be likely to considerably affect visitation and visitor spending in Glen Canyon, resulting in limited to no impact on local economies and socioeconomic resources.

Ferry Swale

The impacts on socioeconomic resources associated with Ferry Swale would be expected to be the same as impacts under alternative B.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to affect visitor use and experience would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the slightly adverse impacts on visitation and visitor spending under alternative D, could result in long-term adverse cumulative impacts on visitation and visitor spending contributions to local economies.

Alternative E: Mixed Use

Lone Rock Beach

Lone Rock Beach would remain open to conventional motor vehicles, street-legal ATVs, and OHVs under alternative E, similar to alternative A. Additionally, a portion (approximately 20 acres) of Lone Rock Beach would be designated as a vehicle-free area to provide a unique experience for tent and car campers. Alternative E would continue OHV and street-legal ATV use of Lone Rock Beach, while also providing an area where non-vehicle beach users can have a quieter experience away from motor vehicles. In addition, a permit would be required to access Lone Rock Beach. Under alternative E, impacts are expected to be similar as those described under alternative C.

Lone Rock Beach Play Area

Impacts on socioeconomic resources associated with alternative E would be the same as those described for alternative C. Visitation and visitor spending associated with users at the play area would continue to support local economies.

Accessible Shoreline Areas

Similar to alternative C, alternative E would formally manage Paiute Farms and Nokai Canyon as accessible shoreline areas. Off-road use at Warm Creek would be discontinued, whereas 14 accessible shoreline areas (including Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles and street-legal ATVs only by permit.

Although Warm Creek provides a more primitive experience for visitors when open, it has been closed since 2003 due to lower lake elevations and it received minimal visitor use while open. Warm Creek provides visitors with access to Warm Creek Bay; however, under alternative E visitors would still be able to access Warm Creek Bay by Crosby Canyon when lake elevations allow (currently, Crosby Canyon is closed). Discontinuation of off-road use in this area would therefore have a minimal adverse impact on local economies.

Conventional motor vehicle users would benefit from the formal management of Paiute Farms and Nokai Canyon, and in total 14 accessible shoreline areas would be available for conventional motor vehicle use. Similar to alternative C, street-legal ATVs would be authorized for use at the 14 accessible shoreline areas, which would expand the availability of street-legal ATV recreation throughout Glen Canyon. Since conventional motor vehicles already use these areas, the additional authorization of street-legal ATVs is likely not to expand visitation considerably since most ATVs are not street-legal in the region. Use of the accessible shorelines would be by permit, and the fees are expected to contribute to the costs of managing the areas. The permit system would possibly limit use levels to protect resources (although the intent of permits is not to specify use levels).

With existing conventional motor vehicle and additional street-legal ATV visitation to these shoreline areas, Glen Canyon could possibly have a minimal increase in visitation compared to current levels. Because ATV riding is not a prominent or primary attraction for visitors to Glen Canyon (University of Idaho 2008) and street-legal ATVs

represent a very small proportion of all OHVs, it is expected that these beneficial effects on local communities would be negligible.

Travel on GMP Roads in Glen Canyon

Alternative E would authorize street-legal ATVs for use on paved roads, while OHVs and street-legal ATVs would be authorized on unpaved GMP roads. No OHVs or street-legal ATVs would be authorized on GMP roads in the Orange Cliffs Unit. Conventional motor vehicles would continue to be authorized on all GMP roads, including those in the Orange Cliffs Unit. The impacts would be very similar to those of alternative C; the exception is that OHVs would not be authorized on paved GMP roads under alternative E and would be authorized under alternative C. Similar to alternative C, there could be a slight increase in visitation associated with beneficial impacts on local and regional economies. Because OHV and street-legal ATV use is not a prominent or primary reason for people to visit Glen Canyon (University of Idaho 2008), it is expected that beneficial effects on local economies would be limited.

Ferry Swale

Similar to alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would also be authorized to operate on approximately 15 miles of designated ORV routes. The impacts on socioeconomic resources would be expected to be the same as those described for alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to affect visitor use and experience would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the minor beneficial impacts on visitation and visitor spending under alternative E, would result in long-term beneficial cumulative impacts on visitation and visitor spending contributions to local economies, with proximate communities experiencing a good portion of these effects.

Conclusion

Alternative C would result in higher levels of visitation compared to alternatives A, B, and D, because under alternative C there would be expanded OHV and street-legal ATV opportunities at existing shoreline areas, the authorization of off-road use at two additional accessible shoreline areas. It is unclear whether alternative C or alternative E would allow for the greatest amount of visitation to the recreation area. Alternative C authorizes OHVs, street-legal ATVs, and conventional vehicle use of 15 accessible shorelines and all GMP roads while alternative E authorizes conventional motor vehicle and street-legal ATV use of 14 accessible shorelines (12 existing accessible shoreline areas plus Paiute Farms and Nokai Canyon) and all GMP roads (OHVs would be authorized on unpaved GMP roads only), and it also creates a vehicle-free area at Lone Rock Beach. Alternative E may attract visitors seeking a vehicle-free experience at Lone Rock Beach. Alternative E would be expected to have higher levels of visitation and visitor spending compared to alternatives A, B, and D, due to the creation of a vehicle-free area at Lone Rock Beach, which may entice visitors seeking this type of experience.

Under alternatives C and E, increases in visitor spending from increased visitation could bring additional jobs, income, tax receipts, indirectly benefiting public services, road maintenance, and other community services. The continued access to Lone Rock Beach, Lone Rock Beach Play Area, and the accessible shoreline areas; the expanded street-legal OHV and ATV opportunities; and the opening of additional accessible shoreline areas would have direct and indirect, beneficially impacts on local economies through increased visitation and visitor spending. Alternative C would allow OHVs on all GMP roads, including Orange Cliffs Unit, and accessible shorelines, while alternative E would create a vehicle-free zone at Lone Rock Beach and no OHV or street-legal ATV use in the

Orange Cliffs Unit. Increases in visitation and visitor spending associated with alternatives C and E would be limited due to the remote location of the new areas (which already experience some visitation) and as a result of the limited existing OHV and street-legal ATV use at the recreation area. Currently, OHV and street-legal ATV riding is not a prominent or primary activity at the recreation area (University of Idaho 2008); however, opening accessible shoreline areas to street-legal ATVs and authorizing OHVs on unpaved GMP roads under alternative E could induce additional visitation in the recreation area. Under alternatives C and E, it is also possible that OHV or street-legal ATV users who would have visited Lone Rock Beach and the play area might choose to visit one of the newly accessible areas or drive on the GMP roads instead, shifting where the visitation would occur but not increasing visitation.

Glen Canyon visitation in 2011 supported approximately 2,755 jobs in local communities. Visitation to Lone Rock Beach, Stanton Creek, and Hite Boat Ramp supports up to an estimated 284 jobs in local economies, or 10.3% of Glen Canyon visitation. Alternatives C and E are expected to result in increased visitation and visitor spending relative to alternative A, although the increases would likely be slight with benefits relative to alternative A.

Alternatives B and D would likely decrease off-road visitation and associated visitor spending to Glen Canyon relative to alternative A. Alternative B could result in up to an estimated 10.3% decrease in Glen Canyon visitation associated with closure of Lone Rock Beach to all off-road use and the discontinuation of off-road use of the accessible shorelines. This discontinuation of use could result in adverse impacts, including the loss of up to $24.1 million in visitor spending, 284 jobs, $9.0 million in labor income, and $14.2 million in gross regional product. Alternative D is expected to have only slightly less visitation compared to alternative A, due to Lone Rock Beach remaining open to conventional motorized vehicles and four of the most-visited accessible shoreline remaining open to conventional motorized use. The adverse effects of alternative D on socioeconomic resources are therefore expected to be relatively small.

Current socioeconomic resource impacts associated with off-road use and on-road motor vehicle use at Glen Canyon would continue, benefiting local economies. Alternatives C and E are expected increase visitation and visitor spending associated with expanded off-road and on-road use at Glen Canyon relative to alternative A. Alternatives B would result in decreased visitor spending, adversely affecting local and regional economies relative to alternative A. Direct and indirect impacts on socioeconomic resources associated with closures at the Lone Rock Beach and the play area associated with alternative B may be locally significant because fewer visitors would be able to visit this part of the recreation area (Lone Rock Beach accounts for approximately 10% of visitation) with adverse effects on the community of Page, Arizona. However, within the five-county regional economy, the employment supported by this reduction in visitor spending represents 0.3% of employment within the five-county study area. Therefore, in the overall context of the five-county regional economy, this impact is likely not significant. Alternative D likely would not have significant adverse effects on the local or regional economy since Lone Rock Beach and four of the most-visited accessible shoreline areas would remain open to conventional motorized use with limited decreases in visitation and visitor spending relative to alternative A.

Alternatives C and E would provide increased opportunities for OHV and street-legal ATV use and would be likely to draw additional visitors to the recreation area at accessible shorelines and on GMP roads. However, the number of visitors and associated visitor spending would likely be relatively small due to limited numbers of street-legal ATVs in the region and OHV and street-legal ATV riding not being a prominent or primary activity at the recreation area. Additionally, the visitation would be dispersed across the accessible shorelines and the GMP roads across the recreation area. Therefore, direct and indirect impacts are likely not to be locally or regionally significant.

HEALTH AND SAFETY

GUIDING REGULATIONS AND POLICIES

CEQ regulations (40 CFR 1508.27) require NPS to consider the effects of proposed actions on visitor health and safety. NPS recognizes that the recreation area resources that attract visitors and some of the specific recreational activities in which visitors participate can present sources of potential hazards. Although NPS strives to provide a safe and healthful environment for visitors, visitors must be aware of risks and assume a substantial degree of responsibility for their own safety when visiting and recreating in the national recreation area. NPS *Management Policies 2006* does not impose park-specific visitor safety prescriptions. Rather, the means by which public safety concerns might be addressed are left to the discretion of the area manager (NPS 2006a, Section 8.2.5.1).

Because motor vehicle use presents a visitor health and safety concern, some alternatives include new requirements for OHVs and street-legal ATVs. Since 2000, there have been 17 incident reports involving personal injury at Glen Canyon due to unsafe operations. ATVs in particular have been the subject of actions by the Consumer Product Safety Commission.

METHODOLOGY AND ASSUMPTIONS

Analysis methods are based on a review of existing data from incident reports and the best professional judgment of Glen Canyon law enforcement staff.

Context

The geographic context for health and safety encompasses the boundary of Glen Canyon National Recreation Area, formally managed by NPS with adjacent land administered by the BLM.

ALTERNATIVE A: NO ACTION

Risk and danger are often associated with ATV or OHV use. Glen Canyon has had 17 incidents involving personal injury due to unsafe operations since 2000 (Carey pers. comm. 2013a). Between 2000 and 2011, more than 7,720 estimated deaths were attributed to ATVs throughout the United States (CPSC 2013). An estimated 1,544,400 people were treated in an emergency room for injuries sustained while riding an ATV during 2001-2011 (CPSC 2013).

Of particular concern is the operation of ATVs by children. Under the Consumer Product Safety Commission ATV Safety recommendations, children and young people under the age of 16 should not be allowed to ride or operate adult-size ATVs. According to Rachel Weintraub, Director of Product Safety and Senior Counsel for the Consumer Federation of America, this is because ATVs are inherently difficult to operate for adults and beyond the development capability of children to control. While children do ride and operate adult size ATVs, many injuries and deaths are attributed to these vehicles that are too large, too fast, and too powerful (ATV Safety, 2007). In 2011, an estimated 29,000 injuries were attributed to people under the age of 16. This accounts for 27% of all injuries reported in 2011 (CPSC 2013). The CFA has recommended the following guidelines for children riding on federal lands (ATV Safety 2007):

- Prohibit children from riding adult size ATVs
- Require the use of helmets
- Ban passengers

- Ban riding on paved roads
- Ban riding at night

Glen Canyon assimilates Utah and Arizona state laws, which encourage the safe operation of ATVs and OHVs for operators under the age of 18 (see chapter 2 for specific state rules regarding OHV and street-legal ATV use). Glen Canyon has only had 17 incidents involving ATV operation to personal injury since 2000.

Lone Rock Beach

Currently, Lone Rock Beach allows off-road use by conventional motor vehicles, OHVs, and street-legal ATVs, and would remain so under the no-action alternative. To help prevent incidents from occurring after dark, Glen Canyon administers quiet hours at Lone Rock Beach from 10:00 p.m. to 6:00 a.m. The use of quiet hours would not completely prevent accidents, however it could substantially decrease use which could lead to a decreased potential for accidents.

Lone Rock Beach and Lone Rock Beach Play Area (described below) are the only locations in Glen Canyon where all types of motor vehicles are authorized for use in Glen Canyon. Utah's OHV program (currently described in Utah Code Annotated 41-22-1 et seq.) and Utah ATV registration processes and requirements are followed at Lone Rock Beach and the play area. By following Utah state regulations and obtaining the required safety inspections, vehicle users would likely drive their vehicles under safe speeds and actions which would be beneficial to other off-road users and non-users. If rules and regulations are disregarded by motor vehicle users, this could result in unsafe operating behavior, such as speeding and riding in unauthorized areas, creating danger to other motor vehicle users and pedestrians. Unsafe operator behavior and/or unsafe operating conditions can create accidents leading to personal injury.

Under Utah state law, no one under the age of 8 is allowed to operate any OHV on public lands, roads, or trails. Operators ages 8 through 15 may drive an OHV provided that they possess an education certificate issued by Utah State Parks and Recreation or the equivalent from their home state. Resident operators aged 16 years or older may operate an OHV if they possess either a valid driver's license or an approved OHV education certificate. Education certificates are issued to anyone aged 8 years or older who completes the Utah State Parks and Recreation "Know Before You GO!" OHV education course. All operators under the age of 18 are required to wear helmets. Operators under the age of 16 may have difficulty operating a full sized OHV or street-legal ATVs as these vehicles were designed for adult riders. The Consumer Product Safety Commission also encourages safety gear such as boots and gloves while operating an ATV. As mentioned above, while a young person may have no problem operating a vehicle in an ideal atmosphere, in case of unforeseen factors (weather, hazards, additional ORVs operating in the area), it is a possibility that their inexperience of operating a vehicle may cause direct adverse impacts on themselves and other off-road users and non-users. Users over the age of 16 would likely have experience in handling vehicles in these types of factors not only on OHVs or street-legal ATVs but with commercial motor vehicle use as well.

Lone Rock Beach Play Area

The Lone Rock Beach Play Area is the only location in Glen Canyon where all vehicles are allowed to operate in an unrestricted manner. The use of all types of motor vehicles at unrestricted speeds may lead to accidents or user conflicts. Since 1998, one incident has occurred between a motor vehicle and an ATV (Carey pers. comm. 2013b). Operators driving conventional motor vehicles may not notice OHVs and street-legal ATVs as they may be smaller than and not as noticeable as conventional motor vehicles. Since all types of vehicles would be allowed at the play area, all motor vehicle operators would need to be aware of the presence of all types of vehicles to help avoid accidents and possible conflict. Since 2000, vehicle accidents have occurred within the play area, however no

specific number is known as Glen Canyon does not differentiate within incident reports between Lone Rock Beach and Lone Rock Beach Play Area (Carey pers. comm. 2013a).

The play area is intended as a location where motor vehicle operators can challenge themselves, including developing riding skills, operating at high speeds, and performing jumps and hill climbs. Operators would continue to need to be aware that while operating their vehicles at high speeds and performing jumps, they need to keep their vehicle under control. Losing control may result in injury to themselves or injury of other users and spectators. Medical attention from the Wahweap Ranger Station, located approximately 8 miles away, might not be quickly available if an accident occurred. All vehicle operators in the play area would have to conform to the same requirements as those for Lone Rock Beach. This would include the prohibition of operating any ORV while under the influence of drugs or alcohol. Adhering to these requirements would be beneficial to operators because they would likely have better control of their vehicles.

Accessible Shorelines

The operation of any OHV or street-legal ATV would not be authorized in 13 accessible shoreline areas (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp), and would be open only to conventional motor vehicles. The Paiute Farms and Nokai Canyon accessible shorelines are not officially open, although they are currently being accessed by. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access. Speed limits are set to keep conventional motor vehicles at 15 mph for the surrounding environment and circumstances. The operation of conventional motor vehicles at the posted speed limit would likely decrease the potential for accidents. Motor vehicle operators must conform to all applicable state licensing, registration, and insurance requirements.

In order to reach the accessible shorelines, visitors are allowed to depart the road, drive directly to the shoreline, and park in designated ORV areas. The ORV areas are not intended to be play areas: climbing hills in vehicles, driving at high speeds, and similar behavior is strictly prohibited to help decrease the potential for accidents or injury. These safeguards would likely continue to result in direct beneficial impacts on the health and safety of visitors.

The remoteness of and difficulty of access to Blue Notch, Red Canyon, and Wilson Mesa, make these sites difficult for Glen Canyon staff to reach quickly by vehicle in case of an accident. Currently, public health and safety facility areas are located at Wahweap, Bullfrog, Halls Crossing, and Hite. The closest hospital/services to Wilson Mesa include Blanding, Utah (90 miles), and Page, Arizona (122 miles).

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on all GMP roads in Glen Canyon, with the exception of the Orange Cliffs Unit where street-legal ATVs are prohibited. ATVs that do not meet the street-legal requirements under Utah code are prohibited from operating on any road in Glen Canyon. Requirements for street-legal ATVs are described in chapter 2. These requirements for lights, reflectors, horns and other safety equipment would help street-legal ATVs be more easily noticed while driving alongside conventional motor vehicles. Street-legal ATV users would continue to follow Utah and Arizona OHV regulations. There would be no change from current management actions for visitors. Because street-legal ATV use would not be allowed at the Orange Cliffs Unit, there would be no potential for conflicts or accidents between conventional motor vehicles and street-legal ATVs in Orange Cliffs.

Because both conventional motor vehicles and street-legal ATVs would continue to operate on GMP roads, this could lead to accidents even with motor vehicle users following state regulations. This could occur when conventional motor vehicle users are not aware of street-legal ATVs or users are not aware of the 20 mph speed

limit difference between paved and unpaved GMP roads. Current speed limits on unpaved GMP roads are set at 45 mph unless otherwise posted, while speed limits on paved GMP roads is 45 mph on State Routes but varies between 35 and 65 mph on U.S. highways. However, users following the posted speed limit and adhering to state regulations would likely be able to avoid or minimize possible accidents or incidents. Since street-legal ATVs have been allowed to drive simultaneously with conventional motor vehicles, there has been one reported incident between a motor vehicle and ATV (Carey pers. comm. 2013b). Because no management changes would be made under this alternative, currently stated health and safety practices would continue to be followed.

Street-legal ATVs complying with Arizona or Utah law may legally operate on Highway 89. Within Arizona, street-legal ATVs may operate on the highway as long as they have the proper rated tires, while in Utah, they must adhere to the 45 mph speed limit (or as posted). In Arizona and Utah, street-legal ATV operators must wear protective headgear if under the age of 18. In addition, in Utah ATV operators under the age of 18 must be under the direct supervision of a person who is at least 18 years of age if operating on a public highway that is open to motor vehicle use. The majority of unpaved GMP roads in Glen Canyon are located within Utah.

According to the Wisconsin Department of Transportation, currently, eight states (Arizona, Idaho, Indiana, Kansas, Minnesota, Montana, North Dakota, and South Dakota) permit the use of on-road operation of street-legal ATVs and five additional states (Alaska, Missouri, Nevada, Oklahoma, and West Virginia) provide detailed exceptions to crossing-only provisions. These states have strict rules and regulations under which ATVs may operate with other vehicles. This includes the requirement of headlights and brakes and operating under posted speed limits (Wisconsin Department of Transportation, 2009).The state of Wisconsin allows street-legal ATVs to operate with conventional motor vehicles. Riders must obey all posted speed limits and regulatory signs, such as stop or yield signs. The requirement of these rules enables street-legal ATVs and conventional motor vehicles to operate in a safe fashion while driving on the same roads (Wisconsin Department of Natural Resources 2011).

Ferry Swale

Under the no-action alternative, approximately 53 miles of ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs. Use of these ORV routes would result in long-term and negligible effects for health and safety because speed limits would be 25 mph or as posted. Illegal use could continue at Ferry Swale, which could include motorized users traveling outside of the designated ORV routes. This could lead to accidents or incidents between motorized and non-motorized users at Ferry Swale. Non-motorized users would include pedestrians, bicyclists, etc. From 1991-2009, 12 incidents were recorded between non-motorized and motorized users throughout Glen Canyon (Carey pers. comm. 2013b). Eleven of these were accidents between motor vehicles and pedestrians and one involved a trailer hitting a pedestrian.

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect the health and safety of visitors. The use of ORVs presents the possibility of potential hazards and injury to both ORV operators and non-vehicular users. Since 2000, 17 incident reports involving personal injury have been filed. These incidents were due to unsafe operations, which result in adverse impact on health and safety.

Unauthorized off-road use on adjacent lands could continue. Because these areas are not authorized for off-road use and may not be heavily traveled, poor condition and remoteness of the roads could lead to an extended wait time for emergency response in case of an accident. This would result in adverse impacts on health and safety.

Beneficial impacts on health and safety have occurred, and would continue to occur into the future, due to the short distance between Ferry Swale to the City of Page. The City of Page would continue to provide long-term emergency response provided by Page to motor vehicle users and non-vehicular users within Glen Canyon.

Continued long-term beneficial impacts would occur as Glen Canyon acquired vehicles and a fireboat. This results in a better response to incidents in remote or rugged areas and fires located along accessible shorelines.

Current and future actions include the Memorandums of Agreement with emergency service provided throughout Glen Canyon, adjacent BLM lands, and mutual air agreements. This will provide long-term beneficial impacts on the health and safety of visitors because more emergency services would be offered to visitors in case of an incident. Additionally, air ambulance services would continue to be offered for backcountry rescues.

The improvements to the Repeater Tower at Navajo Mountain would provide long-term beneficial impacts on law enforcement and rescue teams at Glen Canyon because the improvements would lead to better radio communication capabilities. The improvements may lead to short-term adverse impacts if the radio towers would be "offline" while the improvements were constructed.

The potential adverse impacts resulting from off-road use, in combination with the beneficial health and safety at Glen Canyon, would result in long-term beneficial cumulative impacts on ORV users and non-users within Glen Canyon. The beneficial impacts of Glen Canyon's past, present, and future activities would continue to pursue the health and safety of visitors throughout Glen Canyon and alternative A would not contribute either adverse or beneficial impacts.

Alternative B: No Off-road Use

Lone Rock Beach

Under alternative B, Lone Rock Beach would be closed permanently and restored to natural conditions. Beneficial effects on health and safety would occur because visitors would no longer be allowed to drive or ride vehicles in this area, thus eliminating potential accidents between conventional motor vehicles, OHVs, and street-legal ATVs. This would result in an improvement to the health and safety of visitors, with beneficial impacts on a Glen Canyon-wide basis.

Lone Rock Beach Play Area

Under alternative B, Lone Rock Beach Play Area would be closed permanently and restored to natural conditions. Beneficial effects would be the same as described above under Lone Rock Beach.

Accessible Shorelines

Under alternative B, off-road use at all 15 accessible shoreline areas would be discontinued permanently to all vehicles. Visitors would still be able to access these areas, but only by boat or foot. Because off-road use would be prohibited at the accessible shorelines, potential accidents between motor vehicles would be eliminated. This would result in an improvement to the health and safety of visitors.

Travel on GMP Roads in Glen Canyon

Under alternative B, conventional motor vehicles and street-legal ATVs would be allowed to operate on GMP roads throughout Glen Canyon; no street-legal ATVs would be allowed in the Orange Cliffs Unit. Impacts would be the same as alternative A.

Ferry Swale

Under alternative B, off-road use would not be authorized and the area restored to natural conditions. Health and safety concerns, including vehicle accidents, caused by off-road use would be eliminated.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to affect health and safety would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the beneficial impacts on motor vehicle users and non-vehicular users under alternative B, would result in long-term beneficial cumulative impacts.

Alternative C: Increased Motorized Access

As described under alternative A, there is risk and danger associated with the operation of a conventional motor vehicle with other vehicles, such as OHVs and street-legal ATVs. When street-legal ATVs, OHVs, and conventional motor vehicles operate in the same area, on the same roads or designated routes, even more risk is taken. However, the implementation of state rules and regulations and all traffic laws would help mitigate these possible occurrences.

Lone Rock Beach

Impacts would be similar to alternative A. However, under alternative C, an ORV permit system would implemented, which would be required for all off-road users at Lone Rock Beach. The implementation of the permit system would allow funds collected to be used for education programs, monitoring, place better signs, partnerships, as well as the administrative costs associated with administering the permits. Additionally, users violating the applicable regulations or terms and conditions of the permit could be revoked and not allowed to use their vehicle in the areas mentioned above. These permits could help minimize issues that otherwise may not be addressed without education to motor vehicle operators about rules and regulations, safety, and resource protection within Glen Canyon. The implementation of permits would be long term and beneficial for Glen Canyon.

Lone Rock Beach Play Area

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to operate in an unrestricted manner. Impacts would be similar to alternative A. Additionally, all motor vehicle users would be required to install a safety flag to their vehicle and wear protective headgear, consistent with Utah regulations for designated sand dune areas (ATV Utah 2012). The flag would be beneficial for all motor vehicle users as it would allow for greater visibility, which would likely reduce the risk of accidents.

Under alternative C, mitigation measures implemented at the play area would be similar to Lone Rock Beach, to include an ORV permit system. The implementation of the permit system would allow funds collected to be used for education programs, monitoring, signs, partnerships, as well as the administrative costs associated with administering the permits. Additionally, users violating the applicable regulations or terms and conditions of the permit could be revoked and not allowed to use their vehicle in the areas mentioned above. These permits could help minimize issues that otherwise may not be addressed without education to motor vehicle operators about rules and regulations, safety, and resource protection within Glen Canyon. The implementation of permits would be long term and beneficial for Glen Canyon.

Accessible Shorelines

Under alternative C, a total of 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open to off-road use by conventional motor vehicles, OHVs, and street-legal ATVs, by permit, subject to water-level closures.

Since the accessible shorelines would be open to conventional motor vehicles, OHVs, and street-legal ATVs, this could lead to incidents and issues between the different types of motor vehicles. To help drivers avoid an accident to losing control of their vehicle, the speed limit would be set at 15 mph, unless otherwise posted, throughout all accessible shoreline areas. As stated in the On-Road Operation of ATVs Technical Synthesis Report, speed limits are set at a reasonable limit that regard for existing conditions (Wisconsin Department of Transportation, 2009). These speed limits would help mitigate against accidents in which excessive speed is likely to play a role.

Under alternative C, mitigation measures would be implemented similar to the measures discussed above for Lone Rock Beach and the play area. The implementation of permits would be long term and beneficial for Glen Canyon.

Travel on GMP Roads in Glen Canyon

All GMP roads under alternative C would be open to both conventional motor vehicles, OHVs, and street-legal ATVs, including roads in the Orange Cliffs Unit. The use of conventional motor vehicles, OHVs, and street-legal ATVs in combination on the same roads could lead to incidents and issues between these types of vehicles. This would include the use of street-legal ATVs on paved GMP roads. Since 1998, one incident has occurred between a motor vehicle and an ATV (Carey pers. comm. 2013b). Operators driving conventional motor vehicles may not notice OHVs and street-legal ATVs, which may be smaller than and not as noticeable as conventional motor vehicles. If vehicle drivers are aware of the road and current driving conditions, there should be none to minimal conflicts between OHV and street-legal ATV operators and conventional motor vehicle operators. To help drivers avoid an accident to losing control of their vehicle, the speed limit on unpaved GMP roads would be set at 25 mph unless otherwise posted. Reducing the current 45 mph limit would help to mitigate accidents in which excessive speed would likely play a role. Safety rules governing OHV use would continue to be based on the Utah or Arizona state OHV regulations as described in chapter 2. The use of a helmet would also aid in the protection of operators under the age of 18 in case of an accident. The youth supervision requirement in Utah would also contribute to the safe operation of OHVs. As stated under alternative A, street-legal ATVs complying with Arizona or Utah law may legally operate on Highway 89. Within Arizona, street-legal ATVs may operate on the highway as long as they have the proper rated tires. In Utah, street-legal ATV users must adhere to the 45 mile-per-hour speed limit (or as posted). OHV riders would legally be allowed to operate on Highway 89 while following management requirements as stated in chapter 2. The addition of these regulations could help minimize possible accidents or incidents that could occur to OHV, street-legal ATV users, and conventional vehicle users.

Ferry Swale

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs, would have authorized access to approximately 15 miles of designated ORV routes at Ferry Swale. Under current conditions, approximately 70 miles user-created routes present at Ferry Swales. The reduction of 38 miles would contain all vehicle users to a much smaller area, which could lead to adverse operating conditions as motor vehicle users would be in a much more concentrated area.

These designated routes would have a posted speed limit of 25 mph (or as otherwise posted), to help users stay at a speed at which they can control their vehicles on an unpaved surface and potentially reduce conflict between types of motor vehicles. This would be beneficial to the health and safety of off-road motor vehicle operators at Ferry Swale.

Under alternative C, mitigation measures would be implemented at Ferry Swale similar to the measures discussed above for Lone Rock Beach, the play area, and accessible shorelines. The implementation of permits would be long term and beneficial for Glen Canyon.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect the health and safety of visitors would occur, and impacts would be the same as described for alternative A. More traffic may be present at accessible shorelines thus creating a possibility for more accidents to occur which could create long-term adverse impacts. The reduction of ORV routes designated for off-road use could create a concentration of conventional motor vehicles, OHVs, and street-legal ATVs, which could lead to long-term adverse impacts. However, the impacts of these actions, in combination with the beneficial impacts on motor vehicle users and non-users throughout Glen Canyon under alternative C, would result in long-term beneficial cumulative impacts.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Under alternative D, Lone Rock Beach would remain open to conventional motor vehicles only, as OHVs or street-legal ATVs would not be authorized for use in Glen Canyon. The elimination of OHV and street-legal ATV use would be beneficial to health and safety because this would eliminate the possibility of conflicts between conventional motor vehicles and OHVs or street-legal ATVs. Health and safety impacts would be beneficial at Lone Rock Beach due to the absence of OHVs and street-legal ATVs.

Under alternative D, mitigation measures would be implemented to include an ORV permit system for all ORV users at Lone Rock Beach. The implementation of mitigation measures would have similar impacts on the safety at Lone Rock Beach as under alternative C.

Lone Rock Beach Play Area

Lone Rock Beach Play Area would be closed permanently and the area restored to natural conditions. Impacts on health and safety would be the same as under alternative B.

Accessible Shorelines

Under alternative D, off-road use at 11 accessible shoreline areas would be discontinued permanently, whereas four (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp) would remain open only to conventional motor vehicles by permit, subject to water-level closures. Discontinuation of off-road use at the 11 accessible shoreline areas would result in a decrease in accidents because no vehicles would be authorized to operate at these shoreline areas. However, there is also the possibility that more incidents could occur at the remaining four authorized accessible shoreline lines because conventional motor vehicles could be forced into fewer ORV areas, thus causing more conflicts or issues with one another. Motor vehicle users would still be expected to follow state regulations and to use discretion and caution while operating their vehicles. Impacts on accessible shorelines would likely be beneficial due to the reduction of the number of authorized ORV areas; however, there could be crowding of conventional motor vehicles in these four areas due to the closures of the other areas which could lead to user conflict or the increase chance of accidents.

Under alternative D, mitigation measures would be implemented to include an ORV permit system for all ORV users at accessible shorelines. The implementation of mitigation measures would have similar impacts on the safety at accessible shorelines as under alternative C.

Travel on GMP Roads in Glen Canyon

Only conventional motor vehicles would be authorized to operate on all GMP roads within Glen Canyon. The absence of OHVs or street-legal ATVs operating side by side with conventional motor vehicles would be beneficial as conventional motor vehicle users would not be sharing the road with other generally smaller, vehicles. This would lead to fewer vehicles on the road, which could decrease the possibility of accidents or incidents occurring. Reducing the current 45 mph limit on unpaved GMP roads would help to mitigate accidents in which excessive speed would likely play a role.

Ferry Swale

Under alternative D, no ORV routes would be designated and existing user-created routes would be closed and the areas restored to natural conditions. Impacts would be the same as alternative B.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to affect health and safety would occur, and impacts would be the same as described for alternative A. The closing of 11 accessible shorelines may present more traffic at the four permit-only accessible shorelines thus creating a possibility for more incidents to occur which could create long-term adverse impacts. However, the impacts of these actions, in combination with the beneficial impacts on motor vehicle users and non-vehicular users under alternative D, would result in long-term beneficial cumulative impacts.

Alternative E: Mixed Use

Lone Rock Beach

Under alternative E, a 20-acre section of the beach would be designated as a vehicle-free zone. The vehicle free zone would lead to beneficial impacts on pedestrians as they would not need to worry about the possibility of an incident occurring with vehicles. Outside of the vehicle-free area, both user groups would need to be aware of each other to keep incidents at a low number. OHV users would be required to follow Utah rules and regulations regarding OHV use, which would include the use of helmets for those under the age of 18 years. Impacts for health and safety at Lone Rock Beach would be beneficial as the non-vehicle area of the beach would be clearly marked as off limits to motor vehicles. Both conventional motor vehicle users, OHV and street-legal ATV users would need to be aware of each other and operate their vehicles carefully to keep the possibility of incidents low. Similar to alternative C, the implementation of a permit system would educate operators about the rules and regulations of operating an OHV or street-legal ATV, safety issues, and resource protection. If users violate the permit terms. their permit could be revoked, removing a potentially dangerous OHV or street-legal ATV user.

Lone Rock Beach Play Area

Lone Rock Beach Play Area would remain open to conventional motor vehicles, OHVs, and street-legal ATVs. Impacts would be the same as under alternative C.

Accessible Shorelines

Under alternative E, off-road use at Warm Creek would be discontinued. This permanent closure would create a beneficial health and safety effect as no vehicles would be allowed to drive in this shoreline area thus eliminating user conflicts. Also under this alternative, the remaining 14 accessible shoreline areas (12 managed accessible shorelines plus Paiute Farms and Nokai Canyon) would remain open to conventional motor vehicles and street-

legal ATVs only, by permit, subject to water-level closures. As both conventional motor vehicle and street-legal ATV traffic would be allowed at these shorelines, a speed limit of 15 mph would be enforced. This speed limit would help drivers at safe speeds and reduce the potential for accidents between motor vehicles and motor vehicle and pedestrians.

Under alternative E, mitigation measures would be implemented to include an ORV permit system for all ORV users at accessible shorelines. The implementation of mitigation measures would have similar impacts on the safety at accessible shorelines as under alternative C and D.

Travel on GMP Roads in Glen Canyon

Conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on unpaved GMP roads, with the exception of the Orange Cliffs Unit, whereas only conventional motor vehicles and street-legal ATVs would be allowed to operate on paved GMP roads in Glen Canyon. The use of conventional motor vehicles and street-legal ATVs on paved GMP roads could lead to accidents or incidents, however the person operating the vehicle at prescribed speeds and with caution could reduce the risk of accidents or incidents. The use of OHVs on unpaved GMP roads added to the existing use by conventional motor vehicles and street-legal ATVs could potentially lead to an unsafe environment, as described in alternative C. However, if vehicle operators are aware of the road and conditions, conflicts should not arise. All motor vehicle operators would need to be aware of their speed, making sure they do not drive over the posted 25 mph speed limit (unless otherwise posted). OHV users would follow state regulations (described in chapter 2) while operating their OHV. Drivers under the age of 18 would be required to wear a helmet which would be beneficial in case of an accident.

All GMP roads in the Orange Cliffs Unit would remain open to conventional motor vehicles but OHVs or street-legal ATVs would not be allowed. Drivers of conventional motor vehicles would not have to worry about OHVs or street-legal ATVs driving on the road along with conventional motor vehicles. This would create beneficial long-term impacts on the health and safety of conventional motor vehicle drivers.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would have access to approximately 15 miles of designated ORV routes at Ferry Swale. Impacts would be the same as alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to affect health and safety would occur, and impacts would be the same as described for alternative A. More traffic may be present at the Warm Creek accessible shoreline, thus creating a possibility for more accidents to occur which could create long-term adverse impacts. The reduction of ORV routes designated for off-road use could create a concentration of conventional motor vehicles, OHVs, and street-legal ATVs, which could lead to long-term adverse impacts. However, the impacts of these actions, in combination with the beneficial impacts on ORV users and non-users throughout Glen Canyon under alternative E, would result in long-term beneficial cumulative impacts.

Conclusion

Compared to alternatives A, B, and D, alternatives C and E could lead to increased adverse impacts for health and safety as conventional motor vehicles, OHVs, and street-legal ATVs would be allowed at all accessible shorelines (under alternative C) while only conventional motor vehicles and street-legal ATVs would be allowed at accessible shorelines (under alternative E). Additionally, all types of motor vehicles would be authorized to operate at Lone Rock Beach, Lone Rock Beach Play Area, designated ORV routes at Ferry Swale, and many segments of GMP roads.

However, under alternatives C and E, the ORV permit system could increase health and safety in ORV areas as funds collected from permits would lead to education programs, signs, monitoring, and partnerships. Additionally, users violating the applicable regulations or terms and conditions of the permit could be revoked and not allowed to use their vehicle in the areas mentioned above.

Alternative B would likely have the most beneficial impacts on health and safety of conventional vehicle users, OHV, and street-legal ATVs, as off-road use would be eliminated from Glen Canyon. Alternative D would provide the most beneficial impacts on conventional motor vehicle users compared to alternative A, B, C, or E, because only conventional motor vehicles would be allowed with Glen Canyon, As such, there would be no conflict with OHV and street-legal ATV users.

Adverse impacts on health and safety would not be expected to be significant under any alternative because all motor vehicle users would be subject to state safety regulations within Glen Canyon. As stated above, since 2000, there have been 17 incidents at Glen Canyon (Carey pers. comm. 2013a). Street-legal ATV users on GMP roads would continue to follow Utah and Arizona OHV regulations as described above under alternatives A, B, C, and E. All motor vehicles, including OHVs, would be expected to follow the set speed limits and practice safe driving methods, which in turn could reduce the possibility of an incident. Alternative C, the alternative allowing the most use could pose increase risk exposure as a result of the potential for increase motor vehicle conflict. However, reducing the speed limits on GMP roads and having a set speed of 25 mph on designated ORV routes could reduce conflict and incidents between types of motor vehicles. The use of whip flags would further allow users to better see and identify different motor vehicles operating at Lone Rock Beach Play Area. Additionally, under alternative C, D and E, the implementation of the permit system would allow money collected to fund additional signage, education programs, monitoring, and partnerships which would be beneficial to the health and safety of users within Glen Canyon. The permits would be required for all off-road use, including accessible shoreline areas, Lone Rock Beach, and Lone Rock Beach Play Area, and for designated ORV routes in Ferry Swale. With mitigation measures such as improved signage and additional law enforcement adding beneficial impacts on health and safety, any adverse impacts would not likely be significance.

PALEONTOLOGICAL RESOURCES

GUIDING REGULATIONS AND POLICIES

NPS *Management Policies 2006* recognizes paleontological resources (fossils) as “resources such as fossilized plants, animals, or their traces, including both organic and mineralized remains in body or trace form” (NPS 2006a, Section 4.8.2.1). Paleontological resources are studied and managed in their paleoecological context (that is, the geologic data associated with the fossil that provides information about the ancient environment and their placement in time). Fossils are nonrenewable resources and are managed for their scientific and educational values. The stated purpose of Glen Canyon is “to provide for public outdoor recreation use and enjoyment of Lake Powell and adjacent lands, and to preserve and protect the scenic, scientific, and historic features contributing to public enjoyment of the area” (NPS 1979). NPS is required to take appropriate action to prevent damage to and unauthorized collection of fossils and to protect paleontological resources from harm, theft, or destruction. NPS *Management Policies 2006* further states that “scientifically significant resources will be protected by collection or by on-site protection and stabilization” (NPS 2006a).

METHODOLOGY AND ASSUMPTIONS

The following discussion of impacts on paleontological resources assesses the potential for such resource damage to occur (both erosion and intentional collecting and vandalism) as a result of ORV access under each of the proposed alternatives. The methodology for assessing impacts on paleontological resources included the review of a paleontological resources assessment conducted by Clites (2011), which describes the sensitivity of several

accessible shorelines in Glen Canyon, as well as consultation with NPS resource specialists and the analysis of geospatial data on paleontological sites in Glen Canyon and their proximity to current and proposed ORV access areas. As described in chapter 3, "Paleontological Resources" section, geologic formations at the recreation area have varying degrees of trace paleontological resources. For example, the Moenkopi formation contains the earliest record of Triassic flora and fauna of the southern Colorado Plateau, and this formation is exposed around the Hite Boat Ramp, on the eastern shores of Lake Powell in the San Juan Arm, and in the Escalante canyons of the northwestern part of Glen Canyon. Other resource sensitive formations present at the recreation area include the Chinle formation, which contains fossiliferous lacustrine deposits; the Tropic Shale formation, which contains primarily marine specimens; the Carmel formation, which contains vertebrate tracks; and the Organ Rock Formation, which contains root casts in petrified soil horizons, ferns, pteriodosperms, and conifer, fish, amphibian and reptile fossils. The potential for impacts on sensitive paleontological resources contained within these and other formations located within Glen Canyon is described in further detail below. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Context

The geographic study area for paleontological resources is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

Alternative A: No Action

Glen Canyon contains a very extensive fossil record of Pennsylvanian- to Quaternary-aged resources. Particularly vulnerable to damage are the many dinosaur track ways that are managed in situ. The effects on desert soils from off-road use, such as accelerated surface water runoff and erosion, as documented in "Soils and Geology," also pertain to paleontological resources, which occur in local concentrations in lithologic units (Shipman 1981). Depending on the level of intensity of such activities, prolonged ORV-related damage to soils can result in exposed soil substrate, causing the exposure of paleontological resources and leading to weathering and erosion, as discussed below. Schiffman (2005) and others have described the potential of off-road use to impact resources on public lands by enabling collectors to reach remote areas, which facilitates greater resource damage from intentional collection and vandalism.

Fossil resources are finite and nonrenewable. Santucci et al. (2009) describe weathering and erosion as the primary natural processes that affect the stability of in situ fossils like those found at Glen Canyon. Human disturbances, such as those from off-road use, can accelerate local rates of weathering and erosion through soil damage and the removal of vegetation cover. Other, more direct, impacts on paleontological resources include the outright removal of resources themselves, also referred to as fossil "poaching." Management plans should include basic considerations regarding the type and locations of visitor activities in areas with access to paleontological resources and assess the proximity of developed areas to areas with fossiliferous strata (Santucci et al. 2009).

Lone Rock Beach

Under the no-action alternative, impacts on paleontological resources stemming from erosion resulting from motor vehicle use would continue to occur on approximately 250 acres with ongoing off-road use by conventional motor vehicles, OHVs, and street-legal ATVs. While most paleontological resources at the recreation area are buried deep within the geologic layers underlying Glen Canyon, the geologic strata containing these resources is exposed at various locations. Paleontological resources known to exist at Glen Canyon include fossils of the Quaternary, Triassic, Cretaceous and Jurassic periods. Many of these are found in exposed or seasonally-exposed locations, such as at gravel bars and along the shoreline of Lake Powell. A paleontological resources assessment (Clites et al. 2011) found that Lone Rock Beach contains no known paleontological sites, although fossils of plant material,

mammal bones, and animal dung of many different types (including mammoth, shrub ox, mountain lion, and bison) have the potential to occur. The bedrock of this area consists mostly of eolian and alluvial deposits of Holocene to Pleistocene Age. Overall, these types of deposits occur over approximately 188,000 acres within Glen Canyon. Years of off-road use have resulted in the potential for impacts such as damage through erosion of topsoil and potential impacts on the underlying geologic material and the resources contained therein. These would continue and potentially increase in severity of impact under the no-action alternative.

Lone Rock Beach Play Area

Impacts for Lone Rock Beach Play Area would be similar to those described for Lone Rock Beach. The Lone Rock Beach Play Area is a fence-enclosed, 180-acre area that is open to high-intensity motor vehicle use. The play area is the only location in Glen Canyon where all motor vehicles (conventional motor vehicles, OHVs, and street-legal ATVs) are authorized to operate in an unrestricted manner. The paleontological resources assessment found that the play area contains no known paleontological sites, although fossils of plant material, mammal bones, and animal dung of many different types (including mammoth, shrub ox, mountain lion, and bison) have the potential to occur. With ongoing unrestricted off-road use by conventional motor vehicles, OHVs, and street-legal ATVs at the Lone Rock Beach Play Area under the no-action alternative, the potential for impacts on paleontological resources would continue.

Accessible Shorelines

Paleontological resources are associated with the geology present at several of the accessible shoreline areas. For instance, abundant and widespread significant fossils are present in the Neskahi and Paiute Canyon areas, which overlie portions of the Chinle Formation. The Chinle Formation, the geologic substrate that characterizes Copper Canyon and Nokai Canyon, contains extensive fossiliferous lacustrine deposits, abundant petrified logs, and a variety of invertebrate, leaf, and trace fossils (Clites 2001). Under alternative A, approximately 107.1 acres of ground surface overlying the Chinle Formation could be potentially affected by vehicle disturbances at accessible shorelines (see table 38). By comparison, the recreation area contains approximately 103,808 acres of ground surface overlying the Chinle Formation.

Stanton Creek, which overlies the Carmel formation, has the potential to contain fossils such as vertebrate track sites because the formation is known to preserve such fossils elsewhere. Glen Canyon contains approximately 93,436 acres of ground surface overlying the Carmel Formation. Under alternative A, approximately 18 acres of ground surface overlying the Carmel Formation could be potentially affected by vehicle disturbances at accessible shorelines (see table 38).

Sensitive paleontological resources, including swim tracks and trace fossils, have also been recorded in the vicinity of the Farley Canyon and White Canyon shoreline areas, which overlie portions of the Organ Rock formation. Paiute Farms is also located within the Organ Rock Formation, which contains root casts in petrified soil horizons, ferns, pteriodosperms, and conifer, fish, amphibian and reptile fossils (Santucci et al. 2009). Under alternative A, approximately 367 acres of ground surface overlying the Organ Rock Formation would be potentially affected by vehicle disturbances at accessible shorelines (see table 38). Overall, the recreation area contains approximately 27,494 acres of ground surface overlying the Organ Rock Formation.

Particularly prominent in the Bullfrog area and to the south along the western shore of Lake Powell is the Entrada Sandstone, which is known to contain notable track sites. A particularly notable fossil reported from Glen Canyon is the handprint of a small sauropod dinosaur found near Bullfrog, the first sauropod track with skin impressions (Santucci et al. 2009). Under alternative A, approximately 308 acres of ground surface overlying the Entrada Sandstone Formation would be potentially affected by vehicle disturbances at accessible shorelines (see table 38). By comparison, the recreation area contains approximately 74,252 acres of ground surface overlying the Entrada Sandstone Formation.

Under alternative A, Glen Canyon would retain the authority to administratively designate closures of shoreline areas and would do so if off-road use resulted in impacts on paleontological resources. Currently, Warm Creek, Crosby Canyon, and Bullfrog North and South are temporarily closed due to low water conditions; however, they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. The Paiute Farms and Nokai Canyon accessible shorelines are not officially open, although they are currently being accessed. Under alternative A, off-road use at Paiute Farms and Nokai Canyon would be discontinued and management action taken to prevent access.

As described in the "Geology and Soils" section, a higher susceptibility to erosion exists for soils at Bullfrog North and South. Continued off-road use would lead to impacts on paleontological resources due to continued crushing and shearing of the soil substrate, resulting in accelerated rates of erosion. With increased erosion of the soil, the existing paleontological resources could be exposed and become vulnerable to erosion, as well as to intentional collection and vandalism. As a result, impacts to paleontological resources located in areas on and near the accessible shorelines could occur.

Travel on GMP Roads in Glen Canyon

Under alternative A, GMP roads would remain open to conventional motor vehicle and street-legal ATV use. Street-legal ATVs are prohibited, however, from use on GMP road segments in the Orange Cliffs Unit. Paved and unpaved GMP roads traverse areas of Glen Canyon which are characterized by geologic units classified as sensitive due to their propensity to contain paleontological resources. These resources may include locally important invertebrate and vertebrate sites, tracks and traces. While some roads pass through formations with known paleontological sites (e.g., Warm Creek Road [Tropic Shale] and Moody Canyon Road [Moenkopi Formation]), other roads pass through areas with only the potential for discovery of fossils. No impacts on paleontological resources would result from vehicle use occurring on paved GMP roads because it is assumed that vehicles would travel along the paved portions of the roadways. Paleontological resources are located within geologic strata underlying road locations and would not be impacted by vehicles travelling along paved roadways.

On unpaved GMP roads, direct impacts (areas within 33 feet [10 meters] on either side of the road centerline) currently occur on approximately 153.7 surface acres overlying the Organ Rock formation, which contains notable Permian-era reptiles and reptile-related fossils. Indirect impacts (areas between 33 feet [10 meters] and 200 feet [60 meters] on either side of the road centerline) currently occur on approximately 751.9 acres of the Organ Rock formation. Because the majority of the unpaved GMP roads have compacted dirt surfaces, impacts on paleontological resources on designated unpaved GMP roads would likely be contained to the edges of already disturbed areas. These roadways are previously disturbed through blading, compaction, and other earthmoving activities required for road construction; routine maintenance; and use. As a result, the continued use of conventional motor vehicles and street-legal ATVs would not result in notable harm to paleontological resources.

Ferry Swale

Under the no-action alternative, off-road use would continue on approximately 53 miles of designated ORV routes at Ferry Swale. Ferry Swale is located in an area of Glen Canyon that contains various paleontological resources, including: abundant tracks and scattered skeletal remains; abundant logs, together with a variety of invertebrate, invertebrate, leaf, and trace fossils; extensive fossiliferous lacustrine deposits in the lower Chinle Formation in and near the east side of Glen Canyon; and diverse marine invertebrates and locally important microvertebrate sites. Impacts on paleontological resources would continue but would likely be contained to the edges of already disturbed areas. These designated ORV routes, which were previously user-created routes, have been disturbed through use by conventional motor vehicles, OHVs, and street-legal ATVs. As a result, the continued use of vehicles on these routes would not result in notable harm to paleontological resources.

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect paleontological resources. These cumulatively considerable actions are presented at the beginning of this chapter and described in greater detail in chapter 1. Both adverse and beneficial impacts have occurred as a result of these activities. Adverse impacts include damage to paleontological resources in paleontologically sensitive geologic formations due to past illegal off-road use. Lithologies most vulnerable to indirect and cumulative impacts from off-road use include the Wingate, Kayenta, Navajo, Page, Entrada, Dakota and Straight Cliffs formations. While the potential exists for significant fossil discovery in these units, their vulnerability to cumulative impacts from off-road use varies greatly throughout Glen Canyon. Beneficial impacts on paleontological resources have occurred, and would continue to occur into the future from the implementation of the following plans or actions:

- 1979 Glen Canyon GMP, which considers paleontological resources in managing Glen Canyon resources.
- Implementation of the 1999 Grazing Management Plan, which allows for vehicle use associated with the management of grazing animals.
- Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan which determines how the backcountry areas of Glen Canyon should be managed.
- Road and ORV route improvements at Ferry Swale.

Additional actions include the development of BLM Arizona Strip Office Travel Management Plan which also results in beneficial impacts on paleontological resources. Beneficial cumulative impacts may also result from the above-mentioned management plans where restrictions to where ATVs can be operated are established. Overall, these actions contribute to cumulatively considerable long-term adverse and beneficial impacts on paleontological resources at Glen Canyon.

Alternative B: No Off-road Use

Lone Rock Beach

Under alternative B, off-road use would be discontinued permanently and the area restored to natural conditions. As described under alternative A, the paleontological resources assessment found that Lone Rock Beach contains no known paleontological sites, although fossils have the potential to occur. Eliminating off-road access to Lone Rock Beach would reduce the risk of resource loss and damage caused by the unauthorized collection of materials. Further, by prohibiting off-road use in this area, alternative B would reduce the exposure of underlying geologic material, and the resources contained therein, to damage from off-road use. These beneficial impacts would be localized and long term.

Lone Rock Beach Play Area

Impacts for Lone Rock Beach Play Area are the same as described for Lone Rock Beach.

Accessible Shorelines

By discontinuing off-road use at 15 accessible shorelines in Glen Canyon (13 existing areas in addition to Paiute Farms and Nokai Canyon), alternative B would eliminate off-road access to these areas of Glen Canyon and prevent damage to or loss of paleontological resources from continued off-road access. Under alternative B, ground surface disturbances would not continue at shoreline areas overlying the paleontologically sensitive geologic formations of the Chinle formation, the Carmel formation, the Organ Rock formation, and the Entrada Sandstone formation. Beneficial impacts resulting from the cessation of off-road use would be most apparent at shoreline areas with

particularly sensitive paleontological resources, such as the Bullfrog North and South shoreline areas, near which a particularly notable fossil was reported, as described under alternative A. These beneficial impacts would be Glen Canyon-wide and long term.

Travel on GMP Roads in Glen Canyon

Under alternative B, GMP roads would remain open to conventional motor vehicle and street-legal ATV use, with the exception of the Orange Cliffs Unit where street-legal ATVs would not be authorized. Impacts on paleontological resources would be the same as under alternative A.

Ferry Swale

Under alternative B, no off-road use would be allowed in Ferry Swale. At locations within Ferry Swale where the geologic strata containing sensitive paleontological resources is exposed, these resources would benefit from the cessation of off-road activities. The geology of Ferry Swale reveals bedrock exposures of the Navajo Sandstone and Tropic Shale within which significant fossils are present, although sporadic in occurrence. Under alternative B, approximately 136.3 acres of direct ground disturbances to surfaces overlying Tropic Shale and 18.9 acres of direct ground disturbances to surfaces overlying Navajo Sandstone would be eliminated (see table 38), resulting in a reduced potential for damage to paleontological resources present in underlying lithologies. Thus, beneficial impacts would accrue to paleontological resources present at Ferry Swale under the implementation of alternative B.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to affect paleontological resources under the no-action alternative would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the adverse impacts on paleontological resources under alternative B, would result in long-term adverse cumulative impacts on paleontological resources. However, the beneficial impacts on paleontological resources accruing from greater protection of these resources provided under alternative B would provide long-term beneficial cumulative impacts.

Alternative C: Increased Motorized Access

Lone Rock Beach

Impacts on paleontological resources at Lone Rock Beach under alternative C would similar to the impacts described for these areas under alternative A. However, mitigation measures would be implemented under this alternative, including the requirement of ORV permits, improved signs and education with partners and users, physical barriers, enhanced NPS presence, and closures. Requiring all operators desiring to travel off-road in Glen Canyon to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations and protect resources. NPS also maintains the administrative ability to enforce existing regulations and prevent unauthorized off-road use. These measures likely would reduce impacts on undiscovered paleontological resources to some degree by limiting driving outside of the designated ORV area, thereby limiting erosion and compaction outside of the authorized area.

Lone Rock Beach Play Area

Impacts on paleontological resources at the Lone Rock Beach play area under alternative C would be essentially identical to the impacts described for these areas under alternative A. Mitigation measures noted for Lone Rock

Beach would also be implemented for the play area, thus reducing the potential for impacts on undiscovered paleontological resources within the authorized ORV area.

Accessible Shorelines

Under alternative C, a total of 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles, OHVs, and street-legal ATVs by permit, subject to water-level closures. Impacts under this alternative would result in the same potential for localized impacts on paleontological resources as described for alternative A, with the addition of mitigation measures to minimize adverse impacts. Additionally, abundant and widespread significant fossils present in the Neskahi and Paiute Canyon area, such as petrified logs in the Neskahi Wash, would be affected by increased motorized access. Paiute Farms is located in the Organ Rock Formation, which contains root casts in petrified soil horizons, ferns, pteriodosperms, and conifer, fish, amphibian and reptile fossils that would be affected by increased visitation and increases in ORV traffic, resulting in disturbances to underlying geologic material and the resources contained therein. Approximately 434.4 acres of geologic substrate on the Organ Rock formation would be directly disturbed at shoreline areas under this alternative (see table 38). Similarly, increased access to Copper Canyon and Nokai Canyon would affect the extensive fossiliferous lacustrine deposits, abundant petrified logs, and invertebrate, leaf, and trace fossils found in the Chinle Formation. In other shoreline areas, where the Organ Rock Formation is known to contain plant fossils and vertebrates, such resources would also be affected by increased motorized access. Mitigation measures under this alternative, including improved signs and physical barriers, enhanced NPS presence, and closures, likely would reduce impacts on paleontological resources to some degree by limiting driving outside of designated ORV areas, thereby limiting erosion and compaction outside of the authorized areas.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be allowed on all GMP roads, including all roads in the Orange Cliffs Unit. Impacts would be similar to alternative A and B. No impacts on paleontological resources would result from vehicle use occurring on paved GMP roads because it is assumed that vehicles would travel along the paved portions of the roadways. However, impacts under C could be greater along unpaved GMP roads because of the addition of OHVs and, similarly, the addition of OHVs and street-legal ATVs on roads in Orange Cliffs.

As the majority of Glen Canyon's unpaved GMP roads have compacted dirt surfaces, impacts on paleontological resources on designated unpaved GMP roads would likely be contained to the edges of already disturbed areas. Soils along these roads are previously disturbed through blading, compaction, and other earthmoving activities required for road construction, routine maintenance and motorized use. As a result, the continued use of conventional motor vehicles and street-legal ATVs would not result in notable harm to paleontological resources.

Ferry Swale

Under alternative C, paleontological resources at Ferry Swale would continue to be affected by motor vehicle use, though there would be some beneficial impacts from the restriction of ORV use to approximately 15 miles of designated ORV routes. Direct disturbances occurring within 12 feet of either side of the centerline of the designated ORV routes in Ferry Swale would occur over approximately 11.2 acres of Navajo Sandstone formation, while indirect disturbances (i.e., those disturbances over an area from 12 feet to approximately 200 feet (60 meters) from the centerline of the ORV route) would equate to approximately 160.9 acres under this alternative (see table 38). Mitigation measures under this alternative, such as improved signs, physical barriers, enhanced NPS presence, and closures, would reduce impacts on paleontological resources to some degree by limiting driving outside of designated ORV routes, thereby limiting erosion and compaction outside of the authorized areas.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect paleontological resources under the no-action alternative would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the potential significant adverse impacts on paleontological resources under alternative C, would result in long-term adverse cumulative impacts on paleontological resources. However, the beneficial impacts on paleontological resources accruing from greater protection of these resources provided under alternative C would provide long-term beneficial cumulative impacts.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Under alternative D, Lone Rock Beach would be open only to conventional motor vehicles, and only by permit. As a result, paleontological resources at Lone Rock Beach would benefit from the reduction of motor vehicle activity. The paleontological resources assessment found that Lone Rock Beach contains no known paleontological sites, although fossils have the potential to occur. Limiting access to this area to conventional motor vehicles only could reduce the risk of resource loss and damage caused by the unauthorized collection of materials. By prohibiting off-road use of OHVs and street-legal ATVs, alternative D could reduce the exposure of underlying geologic material, and the resources contained therein, to damage from OHV and street-legal ATV use.

Similar to alternative C, mitigation measures would be implemented under this alternative, to include an ORV permit, improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, and closures. Requiring all operators desiring to travel off-road in Glen Canyon to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations. NPS also maintains the administrative ability to enforce existing regulations and prevent unauthorized off-road use. These measures likely would reduce impacts on undiscovered paleontological resources to some degree by limiting driving outside of the designated ORV area, thereby limiting erosion and compaction outside of the authorized area.

Lone Rock Beach Play Area

Impacts for Lone Rock Beach Play Area are the same as described for Lone Rock Beach.

Accessible Shorelines

Under this alternative, the discontinuation of off-road motor vehicle access at 11 accessible shoreline areas would prevent damage to or loss of paleontological resources from off-road use at these areas. Beneficial effects would be readily apparent at shoreline areas with particularly sensitive paleontological resources, such as Bullfrog North and South. However, beneficial effects would not be apparent at the four shoreline areas that would remain open, and the impact in these areas would be the same as described for alternative C.

Travel on GMP Roads in Glen Canyon

Under alternative D, there would be no direct impacts on paleontological resources on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on paleontological resources from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

Under alternative D, impacts on paleontological resources at Ferry Swale would be the same as those described for alternative B. Because no off-road use would be allowed in Ferry Swale, resources present at locations where geologic strata is exposed would benefit from the cessation of off-road activities.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to affect paleontological resources under the no-action alternative would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the beneficial impacts on paleontological resources accruing from greater protection of these resources provided under alternative D, would result in long-term beneficial cumulative impacts on paleontological resources.

Alternative E: Mixed Use

Lone Rock Beach

Impacts on paleontological resources at Lone Rock Beach under alternative E would be similar to the impacts described for this area under alternative C. Established a 20-acre vehicle-free zone on the beach could slightly lessen impacts on paleontological resources, but no substantial beneficial impacts would accrue over time from this restriction.

Similar to alternatives C and D, mitigation measures would be implemented and would include the requirement of ORV permits, improved signage and communication with partners and users, physical barriers, enhanced NPS presence, and closures. Requiring all operators desiring to travel off-road in Glen Canyon to obtain a permit would provide a means to monitor use and educate operators about rules and regulations. NPS also maintains the administrative ability to enforce existing regulations and prevent unauthorized off-road use. These measures likely would reduce impacts on undiscovered paleontological resources to some degree by limiting driving outside of the designated ORV area, thereby limiting erosion and compaction outside of the authorized area.

Lone Rock Beach Play Area

Impacts on paleontological resources at Lone Rock Beach Play Area under alternative E would be the same as described for these areas under alternative C.

Accessible Shorelines

Under alternative E, off-road use at Warm Creek would be discontinued permanently. Fourteen areas (12 existing areas plus Paiute Farms and Nokai Canyon) would remain open to conventional motor vehicles and street-legal ATVs (approximately 6,000 acres), only by permit, subject to water-level closures. Under this alternative, impacts on accessible shoreline areas would be similar to those under alternative C but to a lesser degree. The prohibition of vehicle entry into Warm Creek would prevent damage to or loss of paleontological resources at this site from continued off-road access. Paleontological resources in the Warm Creek site vicinity include abundant marine vertebrates and invertebrates. These resources would be afforded greater protection under this alternative. The loss of Warm Creek as a shoreline access area would not be anticipated to result in substantial impacts on paleontological resources at the other accessible shoreline areas as a result of increased demand for access and visitation to that site. The incorporation of additional mitigation measures, as described above under alternative C and D, would result in additional protection for paleontological resources from impacts stemming from off-road driving.

Travel on GMP Roads in Glen Canyon

Under alternative E, paved GMP roads would be open to conventional motor vehicles and street-legal ATVs while unpaved GMP roads would be open to conventional motor vehicles, OHVs, and street-legal ATVs, with the exception of roads in Orange Cliffs where no OHVs or street-legal ATVs would be authorized. Impacts on paleontological resources on paved GMP roads would be the same as described under alternative A and B.

Unpaved GMP roads traverse areas of Glen Canyon that are characterized by geologic units classified as sensitive due to their propensity to contain paleontological resources. These resources may include locally important invertebrate and vertebrate sites, tracks and traces. While some roads pass through formations with known paleontological sites (e.g., Warm Creek Road [Tropic Shale] and Moody Canyon Road [Moenkopi Formation]), other roads pass through areas with only the potential for discovery of fossils. Because the majority of Glen Canyon's unpaved GMP roads have compacted dirt surfaces, impacts on paleontological resources on designated unpaved GMP roads would likely be contained to the edges of already disturbed areas. Soils along these roads are previously disturbed through blading, compaction, and other earthmoving activities required for road construction and routine maintenance and through use. As a result, the expanded use of OHVs, and street-legal ATVs on unpaved GMP roads, but not within Orange Cliffs, would not result in notable harm to paleontological resources.

Ferry Swale

Impacts on paleontological resources at Ferry Swale under alternative E would be the same as those described under alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to affect paleontological resources under the no-action alternative would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the potential significant adverse impacts on paleontological resources under alternative E, would result in long-term adverse cumulative impacts on paleontological resources. However, the beneficial impacts on paleontological resources accruing from greater protection of these resources at Ferry Swale provided under alternative E would provide long-term beneficial cumulative impacts.

Conclusion

Table 38 provides additional detail regarding the amounts of disturbance to various Paleontological Resources, as estimated by their associated lithologies, across each alternative considered in this analysis.

TABLE 38: COMPARISON OF IMPACTS ON PALEONTOLOGICAL ACROSS ALTERNATIVES

Geologic Formation	Associated Paleontological Features	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Lone Rock Beach and Play Area (acres impacted)						
Holocene to Pleistocene Age eolian and alluvial deposits	Fossils of plant material, mammal bones, and animal dung	250 (Lone Rock Beach) 180 (play area)	0	250 (Lone Rock Beach) 180 (play area)	250 (Lone Rock Beach) 180 (play area)	230 (Lone Rock Beach) 180 (play area)
Accessible Shorelines (acres impacted)						
Entrada Sandstone	Notable track sites	308.8	0.0	309.7	5.4	247.2
Organ Rock	Permian reptiles or reptile-related fossils	367.0		434.4	206.9	Same as alternative C
Moenkopi Formation	Locally common tracks and traces	256.5		258.3	0.0	Same as alternative C
Chinle Formation	Petrified wood, carbonaceous debris, gastropods, crayfish burrows, bones, coprolites, and dinosaur tracks	107.1		131.2	0.0	Same as alternative C
Carmel Formation	Vertebrate tracks	18.0	0.0	Same as alternative A	Same as alternative A	2.6
TOTAL		1,057.4	0	1,151.6	230.3	1,073.7
Unpaved GMP Roads						
Tropic Shale	Primarily marine specimens	Direct: 169.3 Indirect: 865.8	Same as alternative A	Same as alternative A	No Impact	Same as alternative A
Organ Rock	Permian reptiles or reptile-related fossils	Direct: 153.7 Indirect: 751.9	Same as alternative A	Direct: 178.7 Indirect: 776.9	No Impact	Same as alternative A
Moenkopi	Locally common tracks and traces	Direct: 223.5 Indirect: 1,117.6	Same as alternative A	Same as alternative A	No Impact	Same as alternative A
Chinle	Petrified wood, carbonaceous debris, gastropods, crayfish burrows, bones, coprolites, and dinosaur tracks	Direct: 192.5 Indirect: 909.6	Same as alternative A	Same as alternative A	No Impact	Same as alternative A

Geologic Formation	Associated Paleontological Features	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Kayenta	Dinosaur tracks, trace fossils including coprolites and tracks of small (Grallator) and large (Eubrontes) theropods	Direct: 157.1 Indirect: 764.5	Same as alternative A	Direct: 182.1 Indirect: 789.5	No Impact	Same as alternative A
Navajo Sandstone	Eubrontes prosauropods, small theropods, large bipeds, both small and large tridactyl tracks, ornithopod tracks, and mammal-like reptile tracks	Direct: 200.8 Indirect: 1,000.5	Same as alternative A	Same as alternative A	No Impact	Same as alternative A
TOTAL (direct)		1,096.9	Same as alternative A	1,146.9	0	Same as alternative A
TOTAL (indirect)		5,409.9	Same as alternative A	5,459.9	0	Same as alternative A
Ferry Swale (acres impacted)						
Tropic Shale	Primarily marine specimens	Direct: 136.3 Indirect: 668.9	0	Direct: 0 Indirect: 0	0	Same as alternative C
Organ Rock	Permian reptiles or reptile-related fossils.	Direct: 0.0 Indirect: 0.0	0	Direct: 0.0 Indirect: 0.0	0	Same as alternative C
Moenkopi	Locally common tracks and traces	Direct: 0.0 Indirect: 0.0	0	Direct: 0.0 Indirect: 0.0	0	Same as alternative C
Chinle	Petrified wood, carbonaceous debris, gastropods, crayfish burrows, bones, coprolites, and dinosaur tracks	Direct: 0.0 Indirect: 0.0	0	Direct: 0.0 Indirect: 0.0	0	Same as alternative C

Geologic Formation	Associated Paleontological Features	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Navajo Sandstone	Eubrontes prosauropods, small theropods, large bipeds, both small and large tridactyl tracks, ornithopod tracks, and mammal-like reptile tracks	Direct: 18.9 Indirect: 295.5	0	Direct: 11.2 Indirect: 160.9	0	Same as alternative C
TOTAL (direct)		155.2	0	11.2	0	Same as alternative C
TOTAL (indirect)		964.4	0	160.9	0	Same as alternative C

Note: Direct impacts apply to geology and associated paleontological features contained within 12 feet (3.65 meters) on either side of designated ORV route centerlines at Ferry Swale and within 33 feet (10.05 meters) on either side of road centerlines on GMP roads. Indirect impacts apply to geology and associated paleontological features contained within an area between 12 feet (3.65 meters) and 196.85 feet (60 meters) on either side of designated ORV route centerlines at Ferry Swale and between 33 feet (10.05 meters) and 200 feet (60 meters) on either side of road centerlines on GMP roads.

Compared to the no-action alternative, alternative B would provide the greatest protection to paleontological resources through elimination of off-road use and an accompanying decreased area of disturbance where underlying geologic strata and formations bear notable fossil resources. Alternatives C and E would result in an increased potential for impacts on paleontological resources because both alternatives would result in increased off-road use by adding additional types of motor vehicles authorized for off-road use at accessible shorelines (OHVs and street-legal ATVs under alternative C; street-legal ATVs under alternative E), formalizing off-road use at Paiute Farms and Nokai, and designating ORV routes in Ferry Swale.

While off-road use has the potential to cause impacts on geologic features containing sensitive paleontological resources, it should be noted that most paleontological resources are buried deep within the geologic layers underlying Glen Canyon. The geologic strata containing these resources is exposed at various locations at Glen Canyon, and years of off-road use have resulted in the potential for damage through erosion of topsoil and resulting impacts on the underlying geologic material and the resources contained therein. As a result, where adverse impacts are likely to occur, they would be highly localized.

Direct impacts on paleontological resources at Lone Rock Beach and the play area would not be significant under any of the alternatives considered in this plan/DEIS. While fossils have been known to occur in the eolian and alluvial deposits present in the bedrock material found at Lone Rock Beach and the play area, this area does not contain any known paleontological sites. The NPS has intentionally confined the type of off-road use that results in concentrated and prolonged disturbance to the play area in order to ensure that this high level of repeated impact does not occur throughout the recreation area. Off-road use at the play area severely impacts roughly 120 acres of the ground surface material present there. However, 188,000 acres of this type of eolian and alluvial lithology are found throughout the recreation area. Therefore, in the overall context of the full extent of potentially fossil containing eolian and alluvial deposits throughout the park, this impact likely would not be significant.

Paleontological resources at accessible shoreline areas under alternatives C and E, where off-road use would be the most intense, would be impacted only to a relatively limited extent by off-road use in comparison to the entire

approximately 2,000 miles of Lake Powell shoreline available at Glen Canyon. Adverse impacts may be locally severe where exposed lithologies of the recreation area contain sensitive paleontological resources. Locally intense and prolonged off-road use would occur under alternatives C and E, and such use likely would be anticipated to result in significant impacts on paleontological resources through the exposure of underlying geologic material and the fossil resources contained therein. Different lithologies occur throughout Glen Canyon. Lithologies most vulnerable to direct impacts from off-road use and which are found near accessible shoreline areas include the Entrada Sandstone, Organ Rock, Moenkopi and Chinle formations. These formations contain notable track sites, reptile fossils and other sensitive paleontological resources. The resulting potential for loss of these resources could likely be significant. Impacts would rise to the level of significance if the adverse effect represented direct, localized impacts on the landscape of which the possible effects on the human environment are highly uncertain and which may establish a precedent for future actions with significant effects. Direct impacts occurring under alternatives C and E, where off-road use would be the most intense compared to alternatives B and D and the no-action alternative, would be locally significant but would not rise to the level of significance at the broader scale.

Paleontological resource-containing lithologies present at the most highly visited accessible shorelines—Bullfrog North and South (though currently closed) and Stanton Creek—may experience localized severe impacts associated with off-road use within the authorized areas. However, impacts are concentrated to certain portions within authorized accessible shorelines and generally do not extend beyond authorized areas. If paleontological resources present within these shorelines were affected, the resulting impacts would be highly noticeable, apparent, and severe at the specific accessible shorelines; however, in the context of the entire Lake Powell shoreline, impacts would be barely discernible. As a result, impacts on paleontological resources are not likely to be significant because the proportion of impacts is small in the wider context of Glen Canyon National Recreation Area.

Under alternative C, where motor vehicle use would be the most intense, impacts on paleontological resources from conventional motor vehicles, OHVs, and street-legal ATVs on GMP roads would not likely be significant because the roads are designated for motor vehicle use and are constructed and maintained for such use. The soft geologic materials of the Kayenta formation, which is found along GMPs roads, are vulnerable to damage caused by off-road use. This formation is known to contain dinosaur tracks and trace fossils including tracks of small and large theropods. However, roadways are previously disturbed through blading, compaction, and other earthmoving activities required for road construction; routine maintenance; and use. As a result, the continued use of conventional motor vehicles and street-legal ATVs would not result in notable new harm to paleontological resources. Taken together, direct impacts would occur on approximately 1,097 acres of the sensitive lithologies of Tropic Shale, Organ Rock, Moenkopi, Chinle, Kayenta, and Navajo Sandstone found along unpaved GMP roadways. Within the greater context of Glen Canyon National Recreation Area, which contains nearly 1,000,000 acres of surface area overlying these geologic formations, this represents less than 1% of the total extent of those sensitive lithologies within the entire park unit. Overall, the total footprint of surface disturbances from off-road use estimated under alternative C (from direct and indirect impacts along unpaved GMP and ORV routes in Ferry Swale as well as at accessible shorelines) is 19,970 acres. This represents less than 2% of the total 1,249,934 acres of the recreation area. Impacts from the addition of OHVs and street-legal are thus not likely to be significant.

WILDERNESS

GUIDING REGULATIONS AND POLICIES

The Wilderness Act, passed on September 3, 1964, established a national wilderness preservation system, "administered for the use and enjoyment of the American people in such manner as will leave [these areas] unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness" (16 USC 1131). The Wilderness Act further defined wilderness as "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, and which is protected and managed to preserve its natural conditions" (16 USC 1131). The Wilderness Act gives the agency managing the wilderness responsibility for preserving the wilderness character of the area and devoting the area to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use (16 USC 1133). Certain uses are specifically prohibited, except for areas where these uses have already become established. The act states that "there shall be no commercial enterprise and no permanent road within any wilderness area designated by this chapter and except as necessary to meet minimum requirements for the administration of the area… There shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area" (16 USC 1133).

The United States Forest Service national framework applied the legal definition of wilderness character to identify four tangible qualities of wilderness that make the idealized description of wilderness character relevant and practical to wilderness stewardship (Landres et al. 2008):

- *Untrammeled* – The Wilderness Act states that wilderness is "an area where the earth and its community of life are untrammeled by man," and "generally appears to have been affected primarily by the forces of nature." In short, wilderness is essentially unhindered and free from modern human control or manipulation. This quality is degraded by modern human activities or actions that control or manipulate the components or processes of ecological systems inside the wilderness.
- *Natural* – The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." In short, wilderness ecological systems are substantially free from the effects of modern civilization. This quality is degraded by intended or unintended effects of modern people on the ecological systems inside the wilderness since the area was designated.
- *Undeveloped* – The Wilderness Act states that wilderness is "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation," "where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable." This quality is degraded by the presence of structures, installations, habitations, and by the use of motor vehicles, motorized equipment, or mechanical transport that increases the ability of people to occupy or modify the environment.
- *Solitude or a primitive and unconfined type of recreation* – The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is about the opportunity for people to experience wilderness; it is not directly about visitor experiences per se. This quality is degraded by settings that reduce these opportunities, such as visitor encounters, signs of modern civilization, recreation facilities, and management restrictions on visitor behavior.

These four qualities together comprise an approximation of wilderness character for wilderness planning, stewardship, and monitoring. All four qualities are equally important and none is held in higher or lower regard than the others. In addition to these four tangible wilderness qualities, there are important intangible aspects of wilderness character that would be difficult or even impossible to quantify or monitor. These intangible aspects are

diverse and include the scenic beauty and immensity of an area and the opportunity for self-discovery, self-reliance, and challenge that comes from wilderness settings. These intangible aspects are important contributors to the inspirational and psychological benefits that many people experience in wilderness (Landres et al. 2008).

Wilderness character may be either preserved or degraded by the actions or inactions of managers. For example, the choices to not use a chain saw, build a footbridge across a stream, or suppress a naturally ignited fire may preserve certain qualities of wilderness character. In contrast, other management actions, such as requiring visitors to use designated campsites or authorizing administrative use of motorized equipment and mechanical transportation, may diminish certain qualities of wilderness character.

The challenge of wilderness stewardship, however, is that decisions and actions taken to protect one aspect of wilderness character may diminish another aspect. For example, a bridge built to protect a stream bank from erosion caused by people or horses crossing the stream may also diminish the opportunity for people to experience the challenge of crossing a stream. Similarly, the required use of designated campsites to prevent the proliferation of sites and associated impacts on soil and vegetation may also diminish the opportunity for unconfined recreation and the sense of freedom from the constraints of regulation. In addition, the accumulated result of seemingly small decisions and actions may cause a significant gain or loss of wilderness character over time. Because of this complexity, preserving wilderness character requires that managers approach wilderness stewardship with humility, respect, and restraint (Landres et al. 2008).

Section 6.3.5 of NPS *Management Policies 2006* requires that all management decisions affecting wilderness must be consistent with the minimum requirement concept. This concept is a documented process used to determine if administrative actions, projects, or programs undertaken by NPS or its agents and affecting wilderness character, resources, or the visitor experience are necessary, and if so how to minimize impacts (NPS 2006a). This analysis was conducted for all alternatives using the Minimum Requirements Decision Guide from the Arthur Carhart National Wilderness Training Center.

As described in section 6.3.7 of NPS *Management Policies 2006*, "The principle of nondegradation will be applied to wilderness management.… Natural processes will be allowed, insofar as possible, to shape and control wilderness ecosystems. Management should seek to sustain the natural distribution, numbers, population composition, and interaction of indigenous species. Management intervention should only be undertaken to the extent necessary to correct past mistakes, the impacts of human use, and influences originating outside of wilderness boundaries" (NPS 2006a).

Director's Order 41: Wilderness Preservation and Management (NPS 1999b) was developed to provide accountability, consistency, and continuity to NPS wilderness management efforts and to otherwise guide NPS efforts in meeting the requirements set forth by the Wilderness Act of 1964.

Director's Order 41 sets forth guidance for applying the minimum requirement concept to protect wilderness and for the overall management, interpretation, and uses of wilderness. With regard to natural resource management in wilderness, it reaffirms management policies and states, "Management intervention should only be undertaken to the extent necessary to correct past mistakes, the impacts of human use, and the influences originating outside of wilderness boundaries" (NPS 1999b).

Methodology and Assumptions

In considering environmental impacts on wilderness, which includes proposed and potential wilderness since NPS treats potential and proposed wilderness equally and manages both as if they are wilderness, NPS *Management Policies 2006* requires that the analysis take into account (1) wilderness characteristics and values, including the primeval character and influence of the wilderness; (2) the preservation of natural conditions (including the lack of man-made noise); and (3) assurances that there will be outstanding opportunities for solitude, that the public will

be provided with a primitive and unconfined type of recreational experience, and that wilderness will be preserved and used in an unimpaired condition (NPS 2006a).

All of the unpaved GMP roads that appear to be within proposed wilderness are in fact adjacent to proposed wilderness areas; they are "cherry stemmed" in the proposed wilderness areas. "Cherry-stemming" is a method of excluding non-conforming uses such as roads from areas proposed as wilderness (NPS 2007g). Further, the unpaved GMP roads are the official unpaved GMP roads as designated in the 1979 Glen Canyon GMP, and the wilderness recommendation wasn't established until 1980; therefore those unpaved GMP roads were already in use and continue to be in use, even if crossing through proposed wilderness. Consequently, the analysis of impacts on wilderness will be presented as impacts of motorized use on unpaved GMP roads adjacent to proposed wilderness areas that are already being managed as wilderness. The existing unpaved GMP roads will be included in the baseline condition for the analysis, since they were designated as unpaved GMP roads prior to the wilderness recommendation (Landres et al. 2008). No paved GMP roads are located within proposed wilderness; however, there are segments of paved GMP roads that are adjacent to proposed wilderness.

During internal scoping and subsequent consultations with NPS staff, it was determined that, under the proposed actions in this plan/DEIS, noise from motor vehicles would be the only impact on proposed wilderness under all alternatives. Noise from motor vehicles has the potential to disturb proposed wilderness characteristics and values, primarily the potential for visitors to experience solitude and an untrammeled, natural, and undeveloped setting. Further, we must acknowledge in this plan/DEIS that there is potential for ORVs to travel off designated routes and GMP roads, which could expand impacts on proposed wilderness areas. However each alternative contains monitoring and mitigation strategies to preclude and reduce these incidents from being consistent long-term impacts. Therefore, with these monitoring and mitigation strategies in place, NPS staff determined that the impacts from ORVs traveling off designated routes and GMP roads is not likely to be a threat to proposed wilderness areas, and as such, will not be discussed further within this Wilderness section.

Similar to the methodologies and assumptions used for the soundscapes analysis, the metric chosen for noise impacts on proposed wilderness areas is the A-weighted L_{max} (maximum sound level during the pass-by of one ORV). While consideration of other indicators could be desirable, there is insufficient information on the number of ORVs using each area/road and the precise location of the vehicles at specific times to accurately model time-dependent metrics such as L_{eq} or percent time audible. The analysis of L_{max} provides a reasonable basis for comparing the sound levels resulting from the various alternatives that involve restrictions on operating areas and vehicle sound emissions limits.

As stated in the soundscapes analysis, the composite source for proposed limits on ORV sound levels is referred to as the "96 dBA composite source" and is used for this analysis because the concept of imposing a 96 dBA limit (measured 0.5 meters from the tailpipe) is under consideration at Glen Canyon. The "96 dBA composite source" results in a L_{max} of 75.2 dBA at a distance of 6 meters from the source.

The NPS Natural Sounds Program created a spreadsheet noise model (described further in the soundscapes analysis of this chapter), which was used to determine the distance from the source at which OHV and street-legal ATV noise would decrease to be equivalent to the natural ambient level. The natural ambient level selected for the analysis based on the monitoring data was a uniform 20 dBA across all areas of Glen Canyon. The 20 dBA natural ambient level is representative of daytime summer conditions. Although higher natural ambient levels were estimated in some areas of Glen Canyon near Lone Rock, those estimates were not considered reliable because human-caused sounds were audible for greater than 75% of the time in those locations. The 20 dBA natural ambient level is supported by the majority of the monitoring sites.

Based on the input assumptions described above, it takes 8,020 feet for the average composite ORV noise to drop down to be equal to the natural ambient level of 20 dBA. With the proposed 96 dBA tailpipe noise limit, this distance is reduced 5,460 feet. For ORV areas open to conventional motor vehicles only operating at a maximum

speed of 15 mph (such as Lone Rock Beach under alternative D, and accessible shorelines under alternatives A and D), noise levels would drop to equal the natural ambient level of 20 dBA at 2,900 feet from the source. These off-road uses of conventional motor vehicles on accessible shorelines were evaluated as part of direct impacts. As part of the assessment of cumulative impacts, conventional motor vehicle-only GMP roads were analyzed. Conventional vehicle use on GMP roads was not included as part of direct impacts because it is not the subject of this EIS. Thus, the cumulative impact scenario for each alternative includes all the direct impacts, plus the use of conventional motor vehicles on GMP roads. Although the speed limit on GMP roads varies, these roads were conservatively assumed to operate at 55 mph (except in Orange Cliffs Unit where 15 mph is the speed limit) (NPS 2013a). At 55 mph, conventional motor vehicle noise would take 10,850 feet to drop to equal the natural ambient level.

Within these distances, OHVs and street-legal ATVs would result in a 3 dBA or greater increase in sound levels over the natural ambient level. This is because decibels are expressed on a logarithmic scale and cannot be added together directly. Through "decibel addition," two sources at the same sound level combine to create a total sound level 3 dBA higher. A 3 dBA increase in the natural ambient level is an important indicator because it results in a 50% reduction in listening area.

The focus of the direct and cumulative impact analyses was on determining the impact of motorized vehicle use on soundscapes within the Glen Canyon boundaries only. Given the prevalence of motor vehicle use on surrounding federal lands and the already elevated noise levels associated with such uses, analysis of impacts on areas outside the boundaries of Glen Canyon was not the focus of this study.

Similar to soundscapes analysis, the analysis for proposed wilderness includes direct and cumulative impacts. Direct impacts on wilderness included only impacts from OHVs and street-legal ATVs noise on Lone Rock Beach, play area, accessible shorelines, GMP roads, and designated ORV routes, where a change in management actions are being considered. The analysis of direct impacts did not include GMP roads accessible to conventional motor vehicles only because these roads would not be changed within the scope of this plan/DEIS. However, a separate impact calculation was performed for purposes of analyzing cumulative wilderness impacts that included roads and accessible shoreline areas allowed to be used by conventional motor vehicles only and not by OHVs or street-legal ATVs.

Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Context

The geographic study area for proposed wilderness is contained within the areas of Glen Canyon that have been identified as proposed wilderness in the 1980 Wilderness Recommendation Plan. As stated in NPS *Management Policies 2006* chapter 6 and Director's Order 41, lands that are identified as "proposed wilderness" will be managed as wilderness in accordance with the wilderness preservation provisions, and lands proposed by the Director but not forwarded as "proposed wilderness" by the Secretary to the President will be managed to preserve their wilderness resources and values.

Alternative A: No Action

Lone Rock Beach

There would be no impacts on proposed wilderness at Lone Rock Beach under alternative A, because there are no proposed wilderness areas at Lone Rock Beach.

Lone Rock Beach Play Area

There would be no impacts on proposed wilderness at the Lone Rock Beach Play Area under alternative A, because there are no proposed wilderness areas at the Lone Rock Beach Play Area.

Accessible Shorelines

Under alternative A, 13 accessible shoreline areas would remain open to conventional motor vehicle use (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp). Impacts on proposed wilderness areas adjacent to accessible shorelines would occur in areas where noise from conventional motor vehicles is audible to visitors within proposed wilderness areas, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. Under alternative A, only the Dirty Devil, Hite Boat Ramp, Blue Notch and Red Canyon accessible shorelines would create impacts from conventional motor vehicle use to proposed wilderness areas, because these are the only accessible shorelines that are adjacent to proposed wilderness areas that would be open to conventional motor vehicle use. Further, these accessible shoreline areas generally do not experience high vehicle use, so the impacts on the proposed wilderness areas adjacent to these accessible shorelines are expected to be low. Visitors in proposed wilderness areas would likely only hear noise from vehicles infrequently and temporarily, because the vehicles would typically drive to the beach and park, thus the duration of impacts would be low. Impacts from conventional vehicles operating at 15 mph would extend up to 2,900 feet from each shoreline areas before reaching the 20 dBA natural ambient level, during times when the vehicles are operating. Occasional illegal use under alternative A could result in areas adjacent to the designated accessible shorelines, or along other shorelines where motorized vehicles are not permitted. The extent to which illegal use would occur is not known. Access to Pauite Farms and Nokai Canyon would be discontinued and no direct impacts on soundscapes would occur

Travel on GMP Roads in Glen Canyon

Under alternative A, proposed wilderness areas adjacent to GMP roads would experience negative impacts from street-legal ATV use. Areas that would be directly and negatively impacted include (please refer to figure 36a for exact locations):

- The proposed wilderness area surrounding Routes 330 and 450, separating the Escalante and Warm Creek areas
- The proposed wilderness area east of Paiute Farms (just west of Rout 261)
- The proposed wilderness area adjacent to Route 332 in the Escalante region
- The proposed wilderness area adjacent to Route 276, southeast of Stanton Creek
- The proposed wilderness area across Lake Powell from Blue Notch
- The proposed wilderness areas adjacent to ORV routes in the Hite region
- One proposed wilderness areas within Ferry Swale that is near GMP roads

Impacts on proposed wilderness areas adjacent to GMP roads would occur in areas where street-legal ATV noise is audible to visitors, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. Without

the 96 dBA noise limit mitigation measure, noise from street-legal ATVs is expected to travel 8,020 feet from the GMP roads before it reaches the 20 dBA natural ambient level (see figure 36a). However, visitors in proposed wilderness areas would likely only hear noise from street-legal ATVs infrequently (based on the analysis in the "Soundscapes" section of this chapter) and temporarily, because the vehicles would be traveling through the area (pass-by).

Ferry Swale

Under alternative A, approximately 53 miles of ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs. Proposed wilderness areas east and south of designated ORV routes would be authorized for use. As a result, proposed wilderness areas in Ferry Swale would experience negative impacts from off-road use due to the noise particularly from the OHVs and street-legal ATVs, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. Without the 96-dBA noise limit mitigation measure, noise from OHVs and street-legal ATVs is expected to travel 8,020 feet from the authorized routes before it reaches the 20 dBA natural ambient level (see figure 36a). The extent of impacts could be greater than shown in figure 36a as a result of occasional illegal off-road use. The impacts from vehicular use on these routes would be minimal with the 96 dBA noise limit.

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect the quality of proposed wilderness areas. Cumulative impacts for proposed wilderness within Glen Canyon are the same as those presented under the "Soundscapes" section of this chapter (represented in figure 36b). Additionally, illegal off-road use into proposed wilderness areas could be currently occurring, which is a cumulative impact under alternative A. Occasionally ORVs will illegally drive into proposed wilderness areas (particularly on Rincon Road, which has been closed by the GMP), which results in adverse impacts on proposed wilderness. Without the 96 dBA limit, 25.72% of proposed wilderness areas would be impacted by motor vehicle noise (this includes all roads, ORV routes, and ORV areas within Glen Canyon). Refer to the "Soundscapes" section for full descriptions on cumulative impacts that have the potential to impact proposed wilderness areas in Glen Canyon. The impacts of these actions, in combination with the adverse impacts on proposed wilderness areas under alternative A, would result in, adverse cumulative impacts on proposed wilderness.

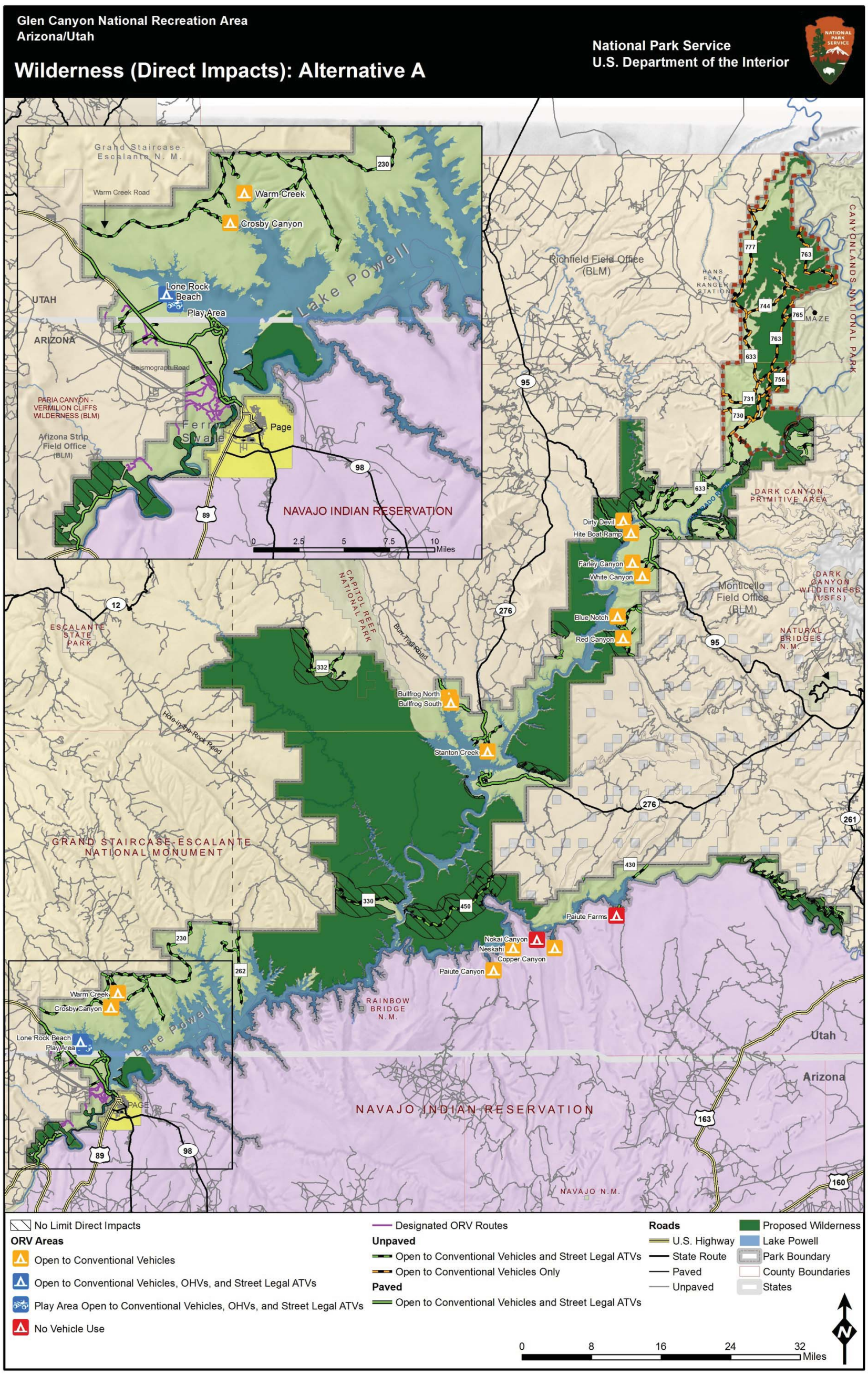


FIGURE 36A: DIRECT IMPACTS ON WILDERNESS FROM ALTERNATIVE A

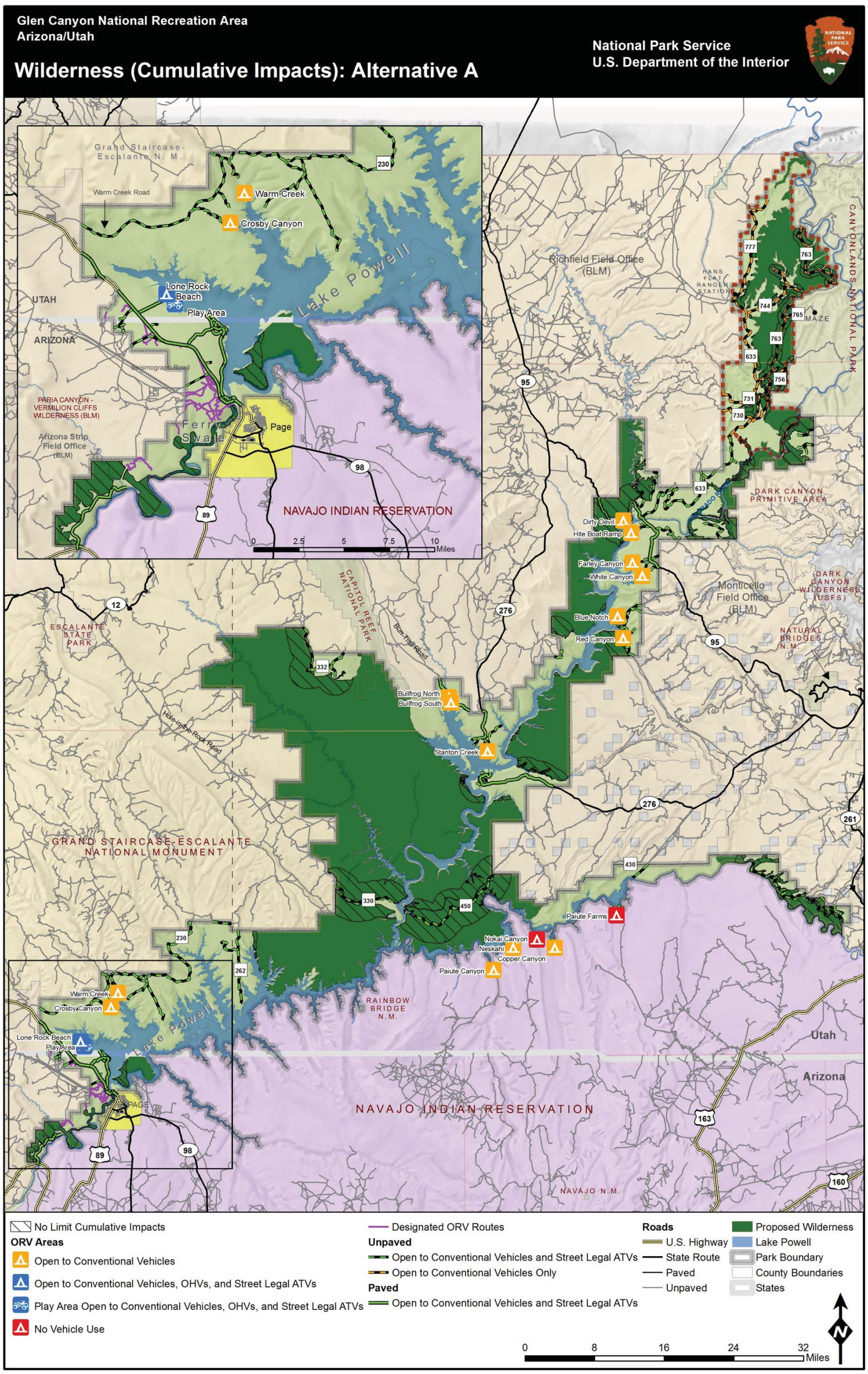


FIGURE 36B: CUMULATIVE IMPACTS ON WILDERNESS FROM ALTERNATIVE A

Alternative B: No Off-road Use

Lone Rock Beach

There would be no impacts on wilderness at Lone Rock Beach under alternative B, because all off-road use would be discontinued and there are no proposed wilderness areas at Lone Rock Beach.

Lone Rock Beach Play Area

There would be no impacts on wilderness at the Lone Rock Beach Play Area under alternative B, because all off-road use would be discontinued and there are no proposed wilderness areas at the Lone Rock Beach Play Area.

Accessible Shorelines

Under alternative B, off-road use would be discontinued at all 13 accessible shoreline areas, in addition to Paiute Farms and Nokai Canyon. Therefore, there would be no noise impacts from any type of motor vehicles encroaching on proposed wilderness areas adjacent to accessible shoreline areas, which would result in a beneficial impacts on proposed wilderness.

Travel on GMP Roads in Glen Canyon

Under alternative B, impacts on proposed wilderness areas adjacent to GMP roads due to noise from street-legal ATV use would be similar as under alternative A (see figure 37a). Impacts on proposed wilderness areas adjacent to GMP roads would occur in areas where noise from street-legal ATVs is audible to visitors, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. Adoption of the 96-dBA tailpipe limit would provide a noticeable reduction in overall motorized vehicle sound levels by eliminating the loudest street-legal ATVs. However, with the 96-dBA tailpipe noise limit, impacts would extend 5,460 feet from the GMP roads during an ATV pass-by. Visitors in proposed wilderness areas would likely only hear noise from street-legal ATVs infrequently and temporarily, because the vehicles would be traveling through the area.

Ferry Swale

In Ferry Swale, no off-road use would be authorized and the area would be restored to natural conditions under alternative B. Therefore impacts on proposed wilderness areas in the Ferry Swale area under alternative B would be beneficial because there would be no noise from ORVs (OHVs and street-legal ATVs) that would be audible in the wilderness areas in Ferry Swale, thus preserving the natural condition of the proposed wilderness.

Cumulative Impacts

Under alternative B, the same past, present, and future activities within Glen Canyon have the potential to affect the quality of proposed wilderness areas as under alternative A. Overall, with and without the 96 dBA limit, 25.57% of proposed wilderness areas would be impacted by motor vehicle noise (see figure 37b). The impacts of these actions, in combination with the beneficial impacts on proposed wilderness areas under alternative B, would result in slightly negative cumulative impacts on proposed wilderness. However, the beneficial restrictions on motor vehicle use, including closure of accessible shoreline areas under alternative B would also provide cumulative benefits to proposed wilderness areas.

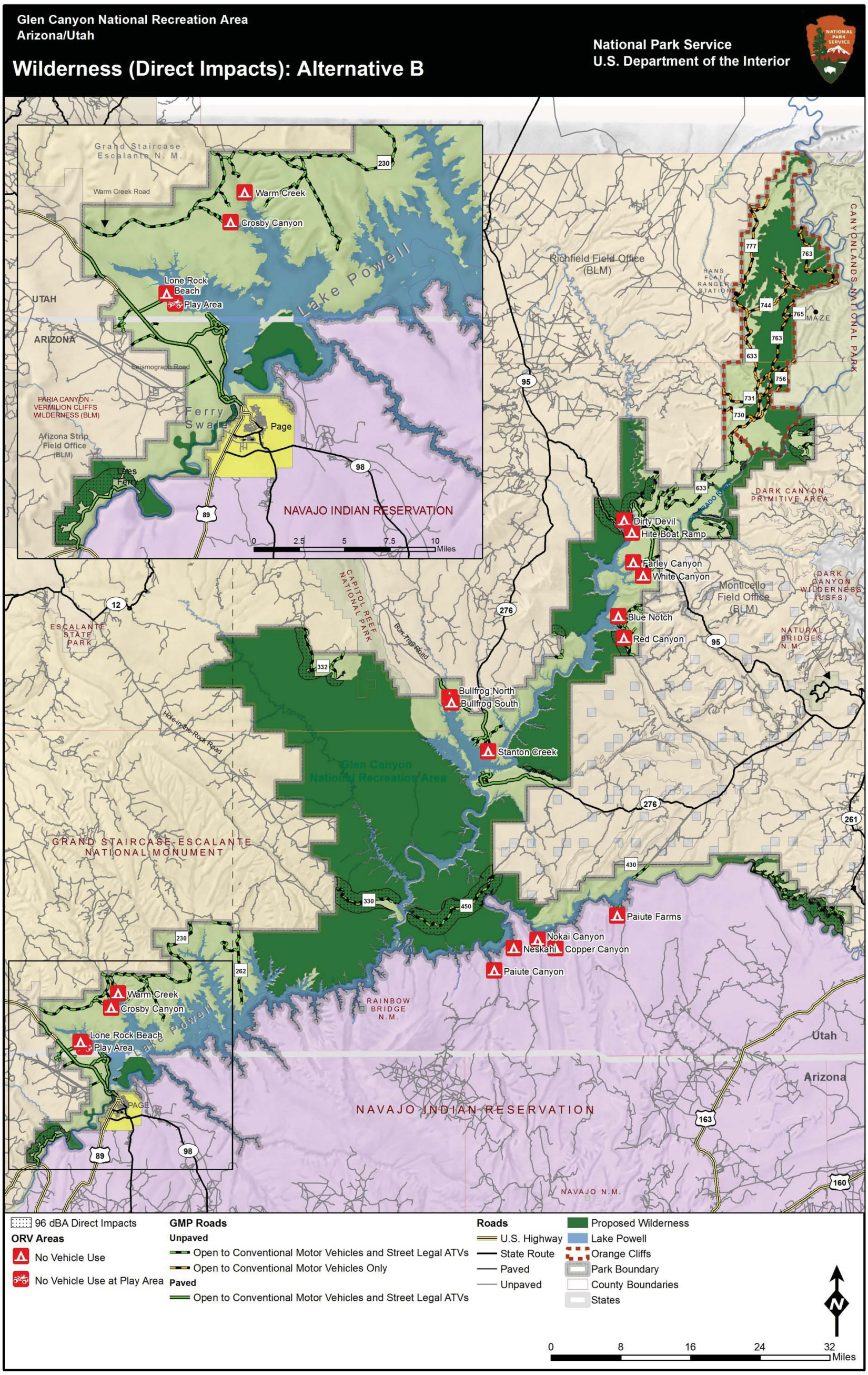


FIGURE 37A: DIRECT IMPACTS ON WILDERNESS FROM ALTERNATIVE B

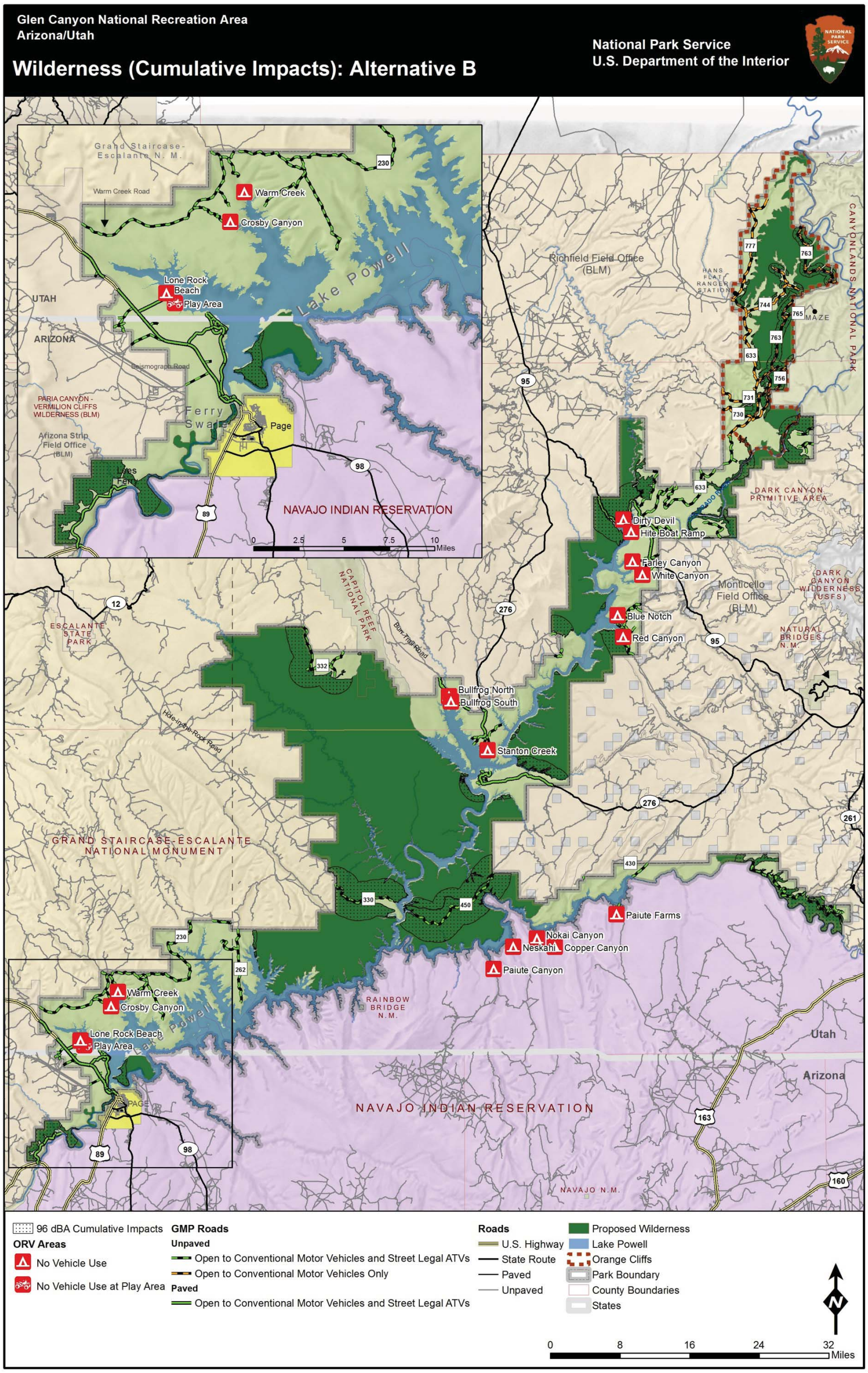


FIGURE 37B: CUMULATIVE IMPACTS ON WILDERNESS FROM ALTERNATIVE B

Alternative C: Increased Motorized Access

Lone Rock Beach

Similar to alternative A, no impacts on proposed wilderness at Lone Rock Beach would be expected under alternative C, because there are no proposed wilderness areas at Lone Rock Beach.

Lone Rock Beach Play Area

Similar to alternative A, no impacts on wilderness at the Lone Rock Beach Play Area would be expected under alternative C, because there are no proposed wilderness areas at the Lone Rock Beach Play Area.

Accessible Shorelines

Under alternative C, adverse impacts on proposed wilderness areas adjacent to accessible shoreline areas would occur at 15 accessible shoreline areas (13 existing shoreline areas as well as Paiute Farms and Nokai Canyon) because these areas would be authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs, by permit only, and subject to water-level closures. Impacts on proposed wilderness areas adjacent to accessible shorelines would occur in areas where ORV noise is audible to visitors, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. With the 96-dBA noise limit mitigation measure, noise from ORVs is expected to travel 5,460 feet from the shoreline areas before it reaches the 20-dBA natural ambient level. Under alternative C, only the Dirty Devil, Hite Boat Ramp, Blue Notch and Red Canyon accessible shorelines would create impacts from conventional motor vehicle, OHV, and street-legal ATV use to proposed wilderness areas, because these are the only accessible shorelines that are adjacent to proposed wilderness areas that would be open to these vehicles. Further, these accessible shoreline areas generally do not experience high vehicle use. The typical usage pattern at these accessible shorelines is that vehicles drive to the shoreline and park, thus the duration of impacts short-term and impacts would be low.

Travel on GMP Roads in Glen Canyon

OHVs and street-legal ATVs would be authorized to operate on all GMP roads, including roads in the Orange Cliffs Unit. As a result, adverse impacts on proposed wilderness areas adjacent to all GMP roads would occur due to noise from these vehicles (see figure 38a). Impacts on proposed wilderness areas adjacent to GMP roads would occur in areas where OHVs and street-legal ATVs noise is audible to visitors, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. With the 96-dBA noise limit mitigation measure, noise from OHVs and street-legal ATVs is expected to travel 5,460 feet from GMP roads before it reaches the 20-dBA natural ambient level. The impacts from vehicular use on these GMP roads would be minimal with and without the 96 dBA noise limit. However, visitors in proposed wilderness areas would likely only hear noise from OHVs and street-legal ATVs infrequently and temporarily, because the vehicles would be traveling through the area.

Ferry Swale

Under alternative C, approximately 15 miles of ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs and street-legal ATVs, and proposed wilderness areas within Ferry Swale would experience detectable impacts from motor vehicle noise. There are proposed wilderness areas east and south of designated ORV routes that would be authorized for use by conventional motor vehicles, OHVs, and street-legal

ATVs (see figure 38a). As a result, proposed wilderness areas in Ferry Swale would experience negative impacts due to the noise from these motor vehicles, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. With the 96 dBA noise limit mitigation measure, noise from OHVs and street-legal ATVs is expected to travel 5,460 feet before it reaches the 20 dBA natural ambient level. The impacts on proposed wilderness from OHVs and street-legal ATV noise on these routes would be minimal with and without the 96 dBA noise limit.

Cumulative Impacts

Under alternative C, the same past, present, and future activities within Glen Canyon have the potential to affect the quality of proposed wilderness areas as under alternative A. Overall, without the 96 dBA limit, 30.61% of proposed wilderness areas would be impacted by motor vehicle noise, whereas 28.39% of proposed wilderness would be impacted with the 96 dBA limit (see figure 38b). The impacts of these actions, in combination with the negative impacts on proposed wilderness areas under alternative C, would result in negative cumulative impacts on proposed wilderness, as described in the “Soundscapes” section.

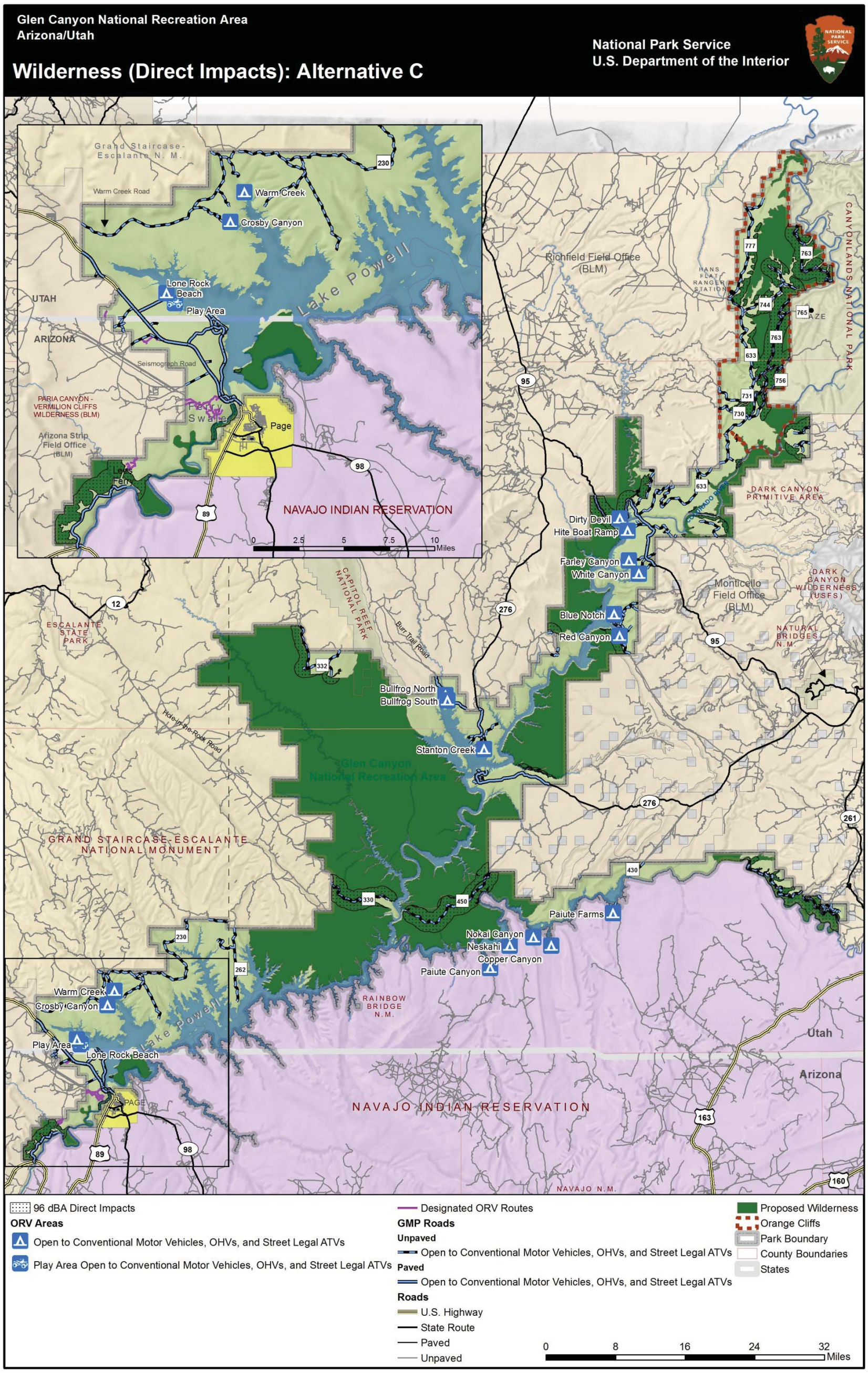


FIGURE 38A: DIRECT IMPACTS ON WILDERNESS FROM ALTERNATIVE C

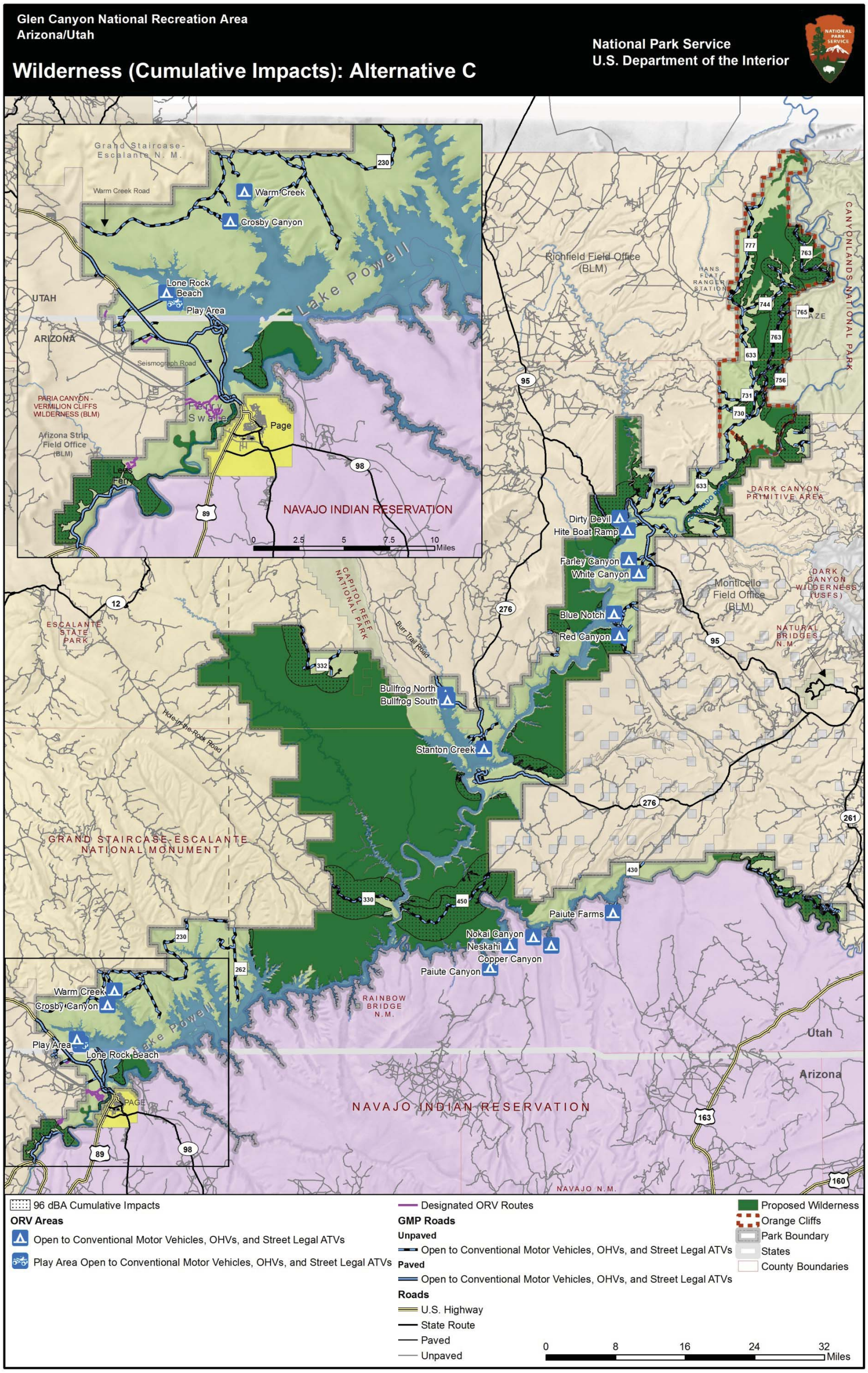


FIGURE 38B: CUMULATIVE IMPACTS ON WILDERNESS FROM ALTERNATIVE C

Alternative D: Decreased Motorized Access

Lone Rock Beach

There would be no impacts on wilderness at Lone Rock Beach under alternative D, because there are no proposed wilderness areas at Lone Rock Beach.

Lone Rock Beach Play Area

Similar to alternative B, no impacts on wilderness at the Lone Rock Beach Play Area would be expected under alternative D, because off-road use would be discontinued and there are no proposed wilderness areas at the Lone Rock Beach Play Area.

Accessible Shorelines

Under alternative D, off-road use at 11 accessible shoreline areas would be permanently discontinued and the areas would be restored to natural conditions. Four accessible shoreline areas (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp) would be authorized for use by conventional motor vehicles, only by permit, subject to water-level closures. Impacts on proposed wilderness areas adjacent to accessible shorelines would occur in areas where conventional vehicle noise is audible to visitors, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. Impacts on proposed wilderness from conventional motor vehicles operating on accessible shorelines could extend up to 2,900 feet from the source (at 15 mph). The only accessible shorelines that would be open to conventional motor vehicle use that are adjacent to proposed wilderness are Dirty Devil and the Hite Boat Ramp; the scale and labeling of figure 39a do not make this small area of noise effects visible. The typical usage pattern at the accessible shorelines is that vehicles drive to the beach and park, thus the duration of impacts would be low. Conversely, proposed wilderness areas adjacent to accessible shorelines under alternative D would also experience beneficial impacts, because off-road use would be discontinued at 11 accessible shorelines, and those areas would be restored back to natural conditions.

Travel on GMP Roads in Glen Canyon

Under alternative D, only conventional motor vehicles would be authorized to operate on all GMP roads (paved and unpaved) in Glen Canyon. Therefore, impacts from noise to proposed wilderness areas adjacent to GMP roads would decrease and would still be negligible.

Ferry Swale

In Ferry Swale, off-road use would not be authorized and the area would be restored to natural conditions under alternative D. Impacts on proposed wilderness would be the same as under alternative B. Therefore impacts on proposed wilderness areas within Ferry Swale under alternative D would be beneficial because no ORV noise would extend into wilderness areas in Ferry Swale, thus preserving the untrammeled, natural, and undeveloped condition of the proposed wilderness (see figure 39a).

Cumulative Impacts

Under alternative D, the same past, present, and future activities within Glen Canyon have the potential to affect the quality of proposed wilderness areas as under alternative A. Overall, without the 96 dBA limit, 25.57% of proposed wilderness areas would be impacted by motor vehicle noise. The 96 dBA limit on OHV and street-legal

ATVs is not applicable under alternative D because no OHVs or street-legal ATVs would be allowed. The impacts of these actions, in combination with the beneficial impacts on proposed wilderness areas under alternative D, would result in negative cumulative impacts on proposed wilderness. Although the closure of 11 accessible shoreline areas to motor vehicle use under alternative D would provide beneficial impacts, as well as the closure of all GMP roads to OHVs and street-legal ATVs, overall cumulative impacts on proposed wilderness areas would be adverse, as described in the "Soundscapes" section.

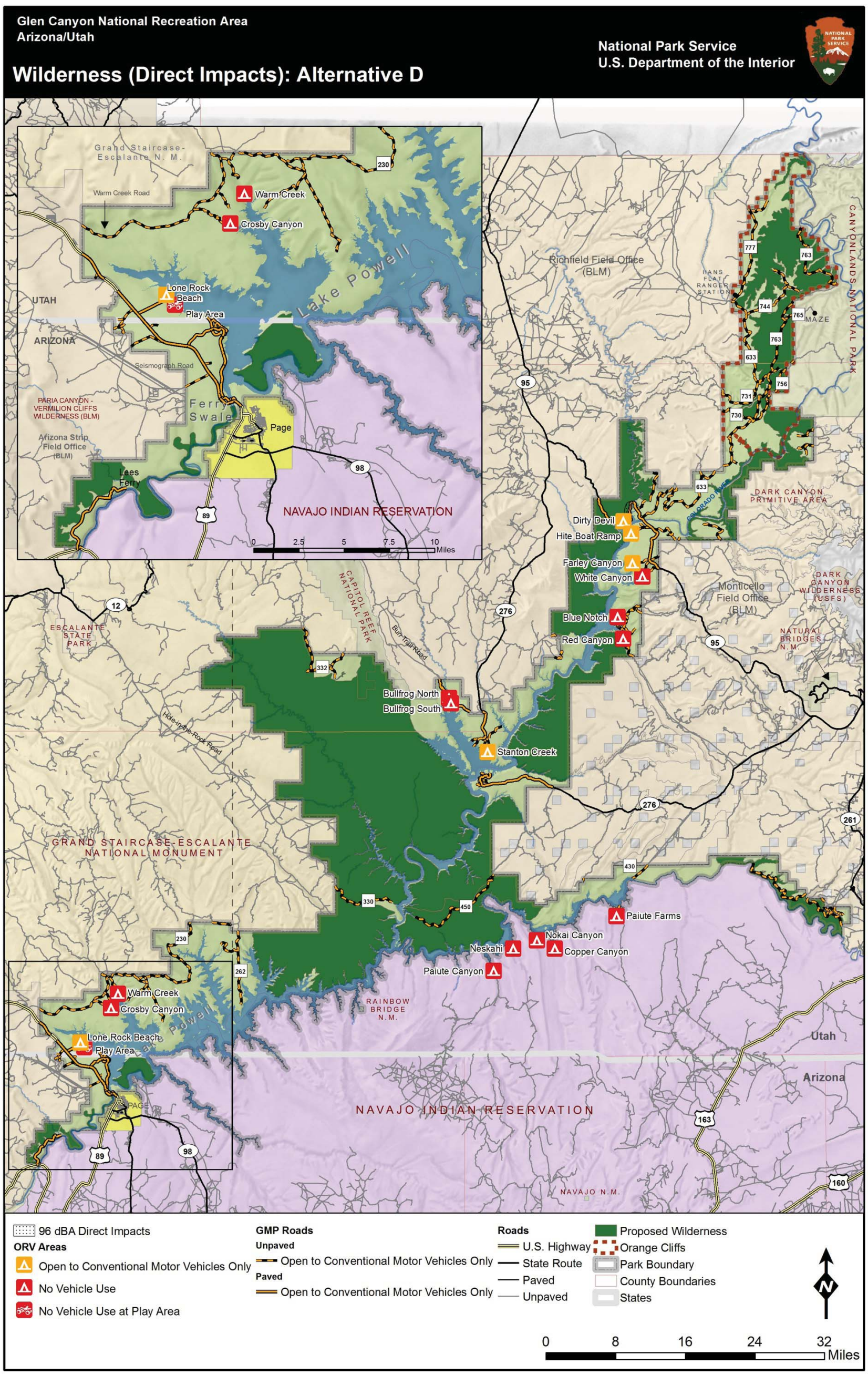


FIGURE 39A: DIRECT IMPACTS ON WILDERNESS FROM ALTERNATIVE D

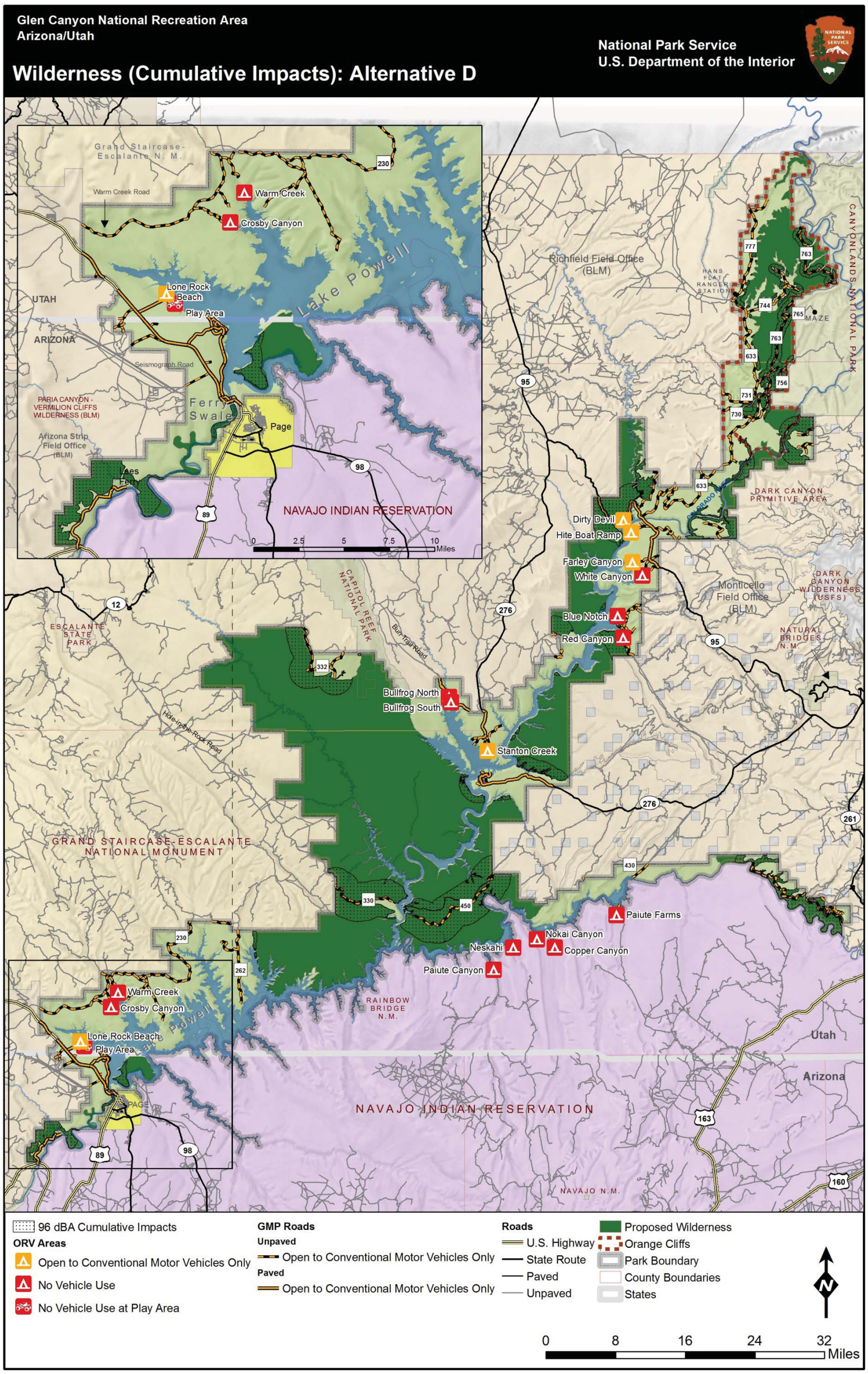


FIGURE 39B: CUMULATIVE IMPACTS ON WILDERNESS FROM ALTERNATIVE D

Alternative E: Mixed Use

Lone Rock Beach

Similar to alternatives A and C, no impacts on proposed wilderness at Lone Rock Beach would be expected under alternative E, because there are no proposed wilderness areas at Lone Rock Beach.

Lone Rock Beach Play Area

Similar to alternatives A and C, no impacts on proposed wilderness at the Lone Rock Beach Play Area would be expected under alternative E, because there are no proposed wilderness areas at the Lone Rock Beach Play Area.

Accessible Shorelines

Under alternative E, off-road use Warm Creek would be discontinued permanently. Fourteen accessible shorelines (12 existing areas plus Paiute Farms and Nokai Canyon) would be authorized for use by conventional motor vehicles and street-legal ATVs. Areas of proposed wilderness could experience negative impacts due to the noise that is expected to be emitted by conventional motor vehicles and street-legal ATVs, based on the soundscapes analysis. This noise would degrade the untrammeled, natural, and undeveloped condition of the proposed wilderness area (including the introduction of manmade noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval characteristics of the proposed wilderness area. Under alternative E, noise from conventional motor vehicles and street-legal ATVs is expected to travel approximately 8,020 feet into the proposed wilderness area that is adjacent to the shoreline areas before it is reduced to the 20 dBA natural ambient level. With the 96-dBA noise limit mitigation measure, noise from ORVs is expected to travel 5,460 feet from the shoreline areas before it reaches the 20 dBA natural ambient level. Under alternative E, only the Dirty Devil, Hite Boat Ramp, Blue Notch, and Red Canyon accessible shorelines would create impacts from conventional motor vehicle and street-legal ATV use to proposed wilderness areas, because these are the only accessible shorelines that are adjacent to proposed wilderness areas that would be open to these vehicles. Further, these accessible shoreline areas generally do not experience high vehicle use. The typical usage pattern at the accessible shorelines is that vehicles drive to the shoreline and park, thus the duration would be short term and impacts would be low.

Travel on GMP Roads in Glen Canyon

Under alternative E, conventional motor vehicles and street-legal ATVs would be authorized to operate on all GMP roads (paved and unpaved) while OHVs would be authorized to operate on unpaved GMP roads. No OHVs or street-legal ATVs would be authorized on GMP roads in the Orange Cliffs Unit. As a result, adverse impacts on proposed wilderness areas adjacent to GMP roads would occur in areas where OHV or street-legal ATV noise is audible to visitors, which would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude, and compromise the primeval and untrammeled characteristics of the proposed wilderness areas. With the 96 dBA noise limit mitigation measure, noise from OHV or street-legal ATV is expected to travel 5,460 feet from the GMP roads before it reaches the 20 dBA natural ambient level. However, visitors in proposed wilderness areas would likely only hear noise from OHVs and street-legal ATVs infrequently and temporarily, because the vehicles would be traveling through the area.

Ferry Swale

Under alternative E, impacts on proposed wilderness areas within Ferry Swale would be the same as under alternative C (see figure 40a).

Cumulative Impacts

Under alternative E, the same past, present, and future activities within Glen Canyon have the potential to affect the quality of proposed wilderness areas as under alternative A. Overall, without the 96 dBA limit, 25.67% of proposed wilderness areas would be impacted by motor vehicle noise, whereas 25.57% of proposed wilderness would be impacted with the 96 dBA (see figure 40b). The impacts of these actions, in combination with the negative impacts on proposed wilderness areas under alternative E, would result in negative cumulative impacts on proposed wilderness. Although the closure of one accessible shoreline area (Warm Creek) adjacent to proposed wilderness to off-road use under alternative E would provide beneficial impacts, overall long-term cumulative impacts on proposed wilderness areas would be adverse, as described in the “Soundscapes” section.

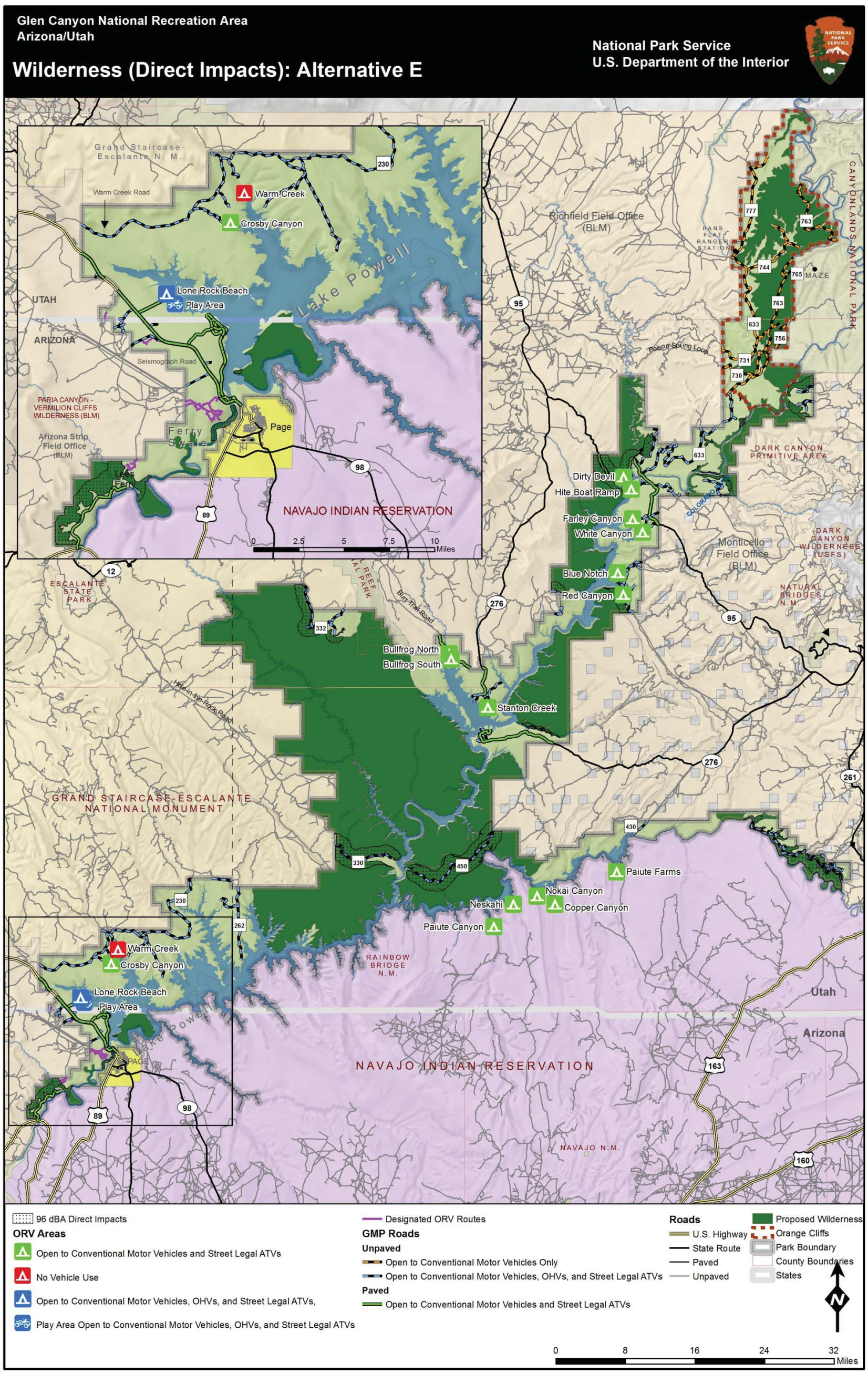


FIGURE 40A: DIRECT IMPACTS ON WILDERNESS FROM ALTERNATIVE E

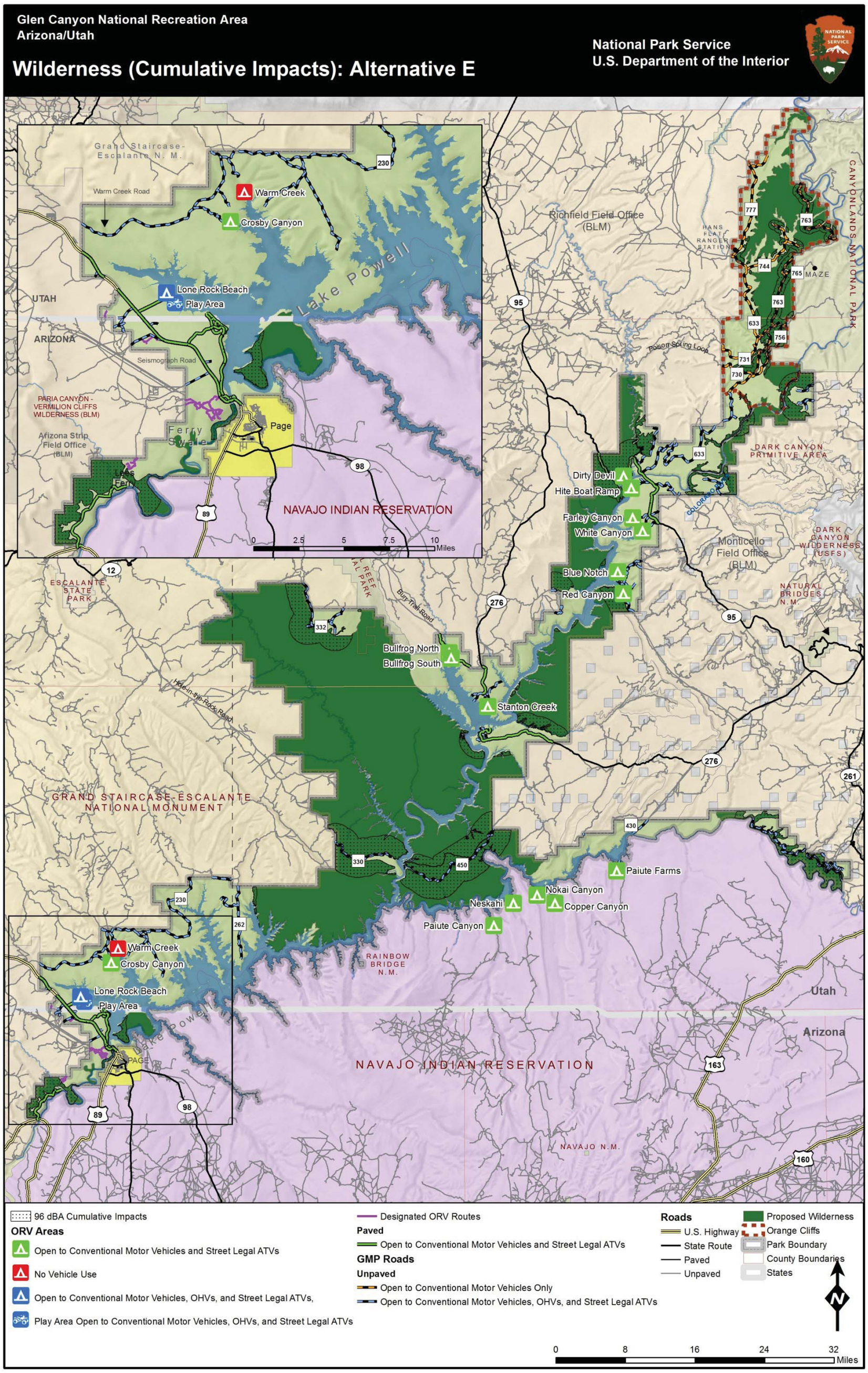


FIGURE 40B: CUMULATIVE IMPACTS ON WILDERNESS FROM ALTERNATIVE E

CONCLUSION

Table 39 provides an overview of the direct and cumulative impact analysis results for each alternative for Glen Canyon as a whole. Figures 36a, 37a, 38a, 39a, and 40a show the direct impact zone of OHV and street-legal ATV use on proposed wilderness areas, while figures 36b, 37b, 38b, 39b, and 40b show the cumulative noise effect zone taking into account all types of motorized vehicles (including conventional motor vehicles).

TABLE 39: ACRES OF WILDERNESS IN GLEN CANYON THAT WOULD BE IMPACTED BY NOISE FROM MOTORIZED VEHICLES, WITH AND WITHOUT THE 96-DBA LIMIT

	No Limit on OHV and ATV Noise[a,b]				96-dBA Limit on OHV and ATV Noise[b]			
	Direct Impacts		Cumulative Soundscape Impact: All Motorized Vehicles[a]		Direct Impacts		Cumulative	
Alternative	Acres of Wilderness Affected	Percent of Wilderness Affected[c]	Acres of Wilderness Affected	Percent of Wilderness Affected	Acres of Wilderness Affected	Percent of Wilderness Affected[a]	Acres of Wilderness Affected	Percent of Wilderness Affected
A	102,903.23	16.13%	164,059.02	25.72%	N/A	N/A	N/A	N/A
B	101,745.09	15.95%	163,083.53	25.57%	67,767.76	10.63%	163,083.53	25.57%
C	157,361.73	24.67%	195,211.66	30.61%	109,372.19	17.15%	181,066.25	28.39%
D	670.03	0.11%	163,083.53	25.57%	670.03	0.11%	163,083.53	25.57%
E	102,939.96	16.14%	163,710.64	25.67%	68,506.54	10.74%	163,111.58	25.57%

Notes: This table includes impacts on proposed and potential wilderness because both are treated equally and managed as wilderness.

a. The 96-dBA limit would not be established under alternative A, the no-action alternative.

b. The shaded areas of the table are not applicable, and are shown for comparison purposes only. No OHV or street-legal ATV use would be allowed under alternative D; therefore, the 96-dBA limit is not applicable to this alternative.

c. The direct impacts scenario examines the impact of motorized vehicle use that is the subject of this plan/DEIS, which does not include conventional vehicle use on GMP roads (OHV and street-legal ATV use on such roads is included as part of direct impacts). The cumulative noise analysis includes conventional vehicle use on all unpaved and paved roadways within Glen Canyon. Although conventional vehicle use on GMP roads is not affected by any of the action alternatives, they were included in the analysis to provide a more realistic understanding of the cumulative area of the recreation area that is affected by motorized vehicle noise.

Based on the "Soundscapes" analysis, without the 96-dBA limit, 16.13% of proposed wilderness areas would be impacted by motor vehicle noise under alternative A. Compared to alternative A, alternative D would have the greatest beneficial impacts on proposed wilderness areas, because only 0.11% of proposed wilderness would be directly impacted from noise, compared to 16.13% of proposed wilderness areas under alternative A. Conversely, alternative C would result in the greatest increase of impacts from noise on proposed wilderness areas compared to alternative A, because 17.15% of proposed wilderness would be directly impacted under alternative C (24.67%, without the 96 dBA noise limit). Alternatives B and E would have very similar impacts on proposed wilderness compared to alternative A. Under alternative B, 10.63% of proposed wilderness would be directly impacted by noise, while 10.74% of proposed wilderness would be impacted by noise under alternative E (these percentages would increase to 15.95% and 16.14% respectively, without the 96 dBA noise limit).

As stated in chapter 3, proposed and potential wilderness encompasses approximately 51% of the total area of Glen Canyon. Based on the direct impact analysis for all alternatives, between 0.11% and 17.15% of proposed wilderness could be impacted by noise from motor vehicles. While the highest percentage (24.67% under alternative C without a 96 dBA limit for OHVs and street-legal ATVs) may appear to be a significant percentage of proposed wilderness

expected to experience noise from motor vehicles, it must be noted that this noise is expected to encroach on proposed wilderness areas infrequently and intermittently. Impacts on proposed wilderness areas would likely be noticeable in areas where motor vehicle noise is audible to visitors because motor vehicle use would degrade the natural condition of the proposed wilderness areas (including the introduction of man-made noise), negatively impact the opportunity for visitors to experience natural quiet and solitude and a unique experience provided by the proposed wilderness areas, and compromise the primeval characteristics of the proposed wilderness area. However, because the areas where motor vehicles would be allowed to operate adjacent to proposed wilderness areas would be used intermittently, visitors within those proposed wilderness areas would still be able to experience solitude and natural quiet without the intrusion of man-made noise a majority of the time (for example, visitors in these areas would likely only hear noise from motor vehicles for a few minutes, and only a few times a day). Further, there would still be ample opportunity for solitude and natural quiet within portions of proposed wilderness that are not impacted by motor vehicle noise.

When considering the impacts on proposed wilderness, the wilderness qualities must also be considered: the ability to experience solitude, or a primitive and unconfined type of recreation, in an untrammeled, natural, and undeveloped setting. Because visitors in proposed wilderness areas are expected to only be exposed to noise from motor vehicles intermittently, and only a few times a day, it is highly plausible that visitors to proposed wilderness areas would be able to enjoy these wilderness qualities far more frequently than not. That is, visitors would consistently enjoy the natural quiet and solitude substantially more frequently than they would hear noise from motor vehicles. As a result, impacts on proposed wilderness areas are not likely to be significant under any alternative.

UNAVOIDABLE ADVERSE IMPACTS

NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA section 101[c][ii]).

ALTERNATIVE A: NO ACTION

Under alternative A, there would be long-term, unavoidable adverse impacts on soils, vegetation, wildlife and wildlife habitat, special-status species, archeological resources, and paleontological resources due to the continued off-road use of Lone Rock Beach, the play area, and designated ORV routes in Ferry Swale by all types of motor vehicles and the accessible shoreline areas by conventional motor vehicles. Associated physical damages to these resources would result from continued motor vehicle use in areas where these resources exist. These impacts would be more prevalent at accessible shorelines because the Lake Powell shoreline has fluctuated in recent years and more topography has been exposed in these ORV areas. In some instances the designated ORV area is no longer bounded by natural features resulting in land beyond the designated ORV area being exposed to off-road use. Unavoidable impacts on proposed wilderness would result from motor vehicle noise (from conventional motor vehicles and street-legal ATVs on GMP roads) being audible to visitors and impacting the opportunity for visitors to experience natural quiet and solitude, thus compromising the primeval characteristics of the proposed wilderness area. In addition, there would be continued unavoidable minor adverse impacts on soundscapes from continued use at the play area from the high intensity motor vehicle activities; potential impacts on ethnographic resources from continued use of Hole-in-the-Rock (an unpaved GMP road) by conventional motor vehicles and street-legal ATVs and from purposeful and inadvertent vandalism; and health and safety as conventional motor vehicles, OHVs, and street-legal ATVs would continue to operate together at Lone Rock Beach and the play area, but only conventional motor vehicles would be authorized for use at accessible shorelines.

Alternative B: No Off-road Use

Unavoidable adverse impacts for this alternative would be greatly reduced compared to alternatives A, C, D, and E, because the prohibition of off-road use within Glen Canyon would result in the recovery of resources (soils, vegetation, wildlife and wildlife habitat, special-status species) in highly impacted off-road areas and prevent future disturbances to some degree of archeological and paleontological resources. This would mitigate adverse impacts on these resources. There would be some unavoidable adverse impacts on visitors no longer being able to access Lone Rock Beach, the play area, and 15 accessible shoreline areas (13 existing areas plus Nokai Canyon and Paiute Farms) and to the local economy from loss of visitor spending, jobs, and income. Unavoidable impacts on proposed wilderness would also result from motor vehicle noise (from conventional motor vehicles and street-legal ATVs on GMP roads) being audible to visitors and impacting the opportunity for visitors to experience natural quiet and solitude, thus compromising the primeval characteristics of the proposed wilderness area. In addition, there could be continued unavoidable minor adverse impacts on ethnographic resources from continued use of Hole-in-the-Rock by conventional motor vehicles and street-legal ATVs and from purposeful and inadvertent vandalism.

Alternative C: Increased Motorized Access

Under alternative C, there would be long-term, unavoidable adverse impacts on soils, vegetation, wildlife and wildlife habitat, special-status species, archeological resources, and paleontological resources due to the continued off-road use of Lone Rock Beach and the play area by all types of motor vehicles, increased access by all types of vehicles at the 15 accessible shoreline areas, and on designated ORV routes in Ferry Swale. Associated physical damages to these resources would result from continued and increased motor vehicle use in areas where these resources exist. These impacts would be more prevalent at accessible shorelines because the Lake Powell shoreline has fluctuated in recent years and more topography has been exposed in these ORV areas combined with the potential increase in the number of motor vehicles using the areas, could result in greater adverse impacts than the other alternatives. In some instances the designated ORV area is no longer bounded by natural features resulting in land beyond the designated ORV area being exposed to off-road use. Unavoidable impacts on proposed wilderness would result from motor vehicle noise (from conventional motor vehicles, OHVs, and street-legal ATVs on GMP roads) including in the Orange Cliffs Unit being audible to visitors and impacting the opportunity for visitors to experience natural quiet and solitude, thus compromising the primeval characteristics of the proposed wilderness area. In addition, there would be continued unavoidable minor adverse impacts on soundscapes from continued use at the play area from the high intensity motor vehicle activities; ethnographic resources from continued and increased use of Hole-in-the-Rock by conventional motor vehicles, OHVs, and street-legal ATVs and from purposeful and inadvertent vandalism; and health and safety as conventional motor vehicles, OHVs, and street-legal ATVs would operate together at Lone Rock Beach, the play area, all accessible shorelines areas, and on GMP roads. Off-road use would be monitored and mitigation measures, including barricading and closures would be used to reduce impacts on resources in places where evidence of illegal use occurs.

Alternative D: Decreased Motorized Access

Under alternative D, there would be long-term, unavoidable adverse impacts on soils, vegetation, wildlife and wildlife habitat, special-status species, archeological resources, and paleontological resources due to the continued off-road use of Lone Rock Beach by conventional motor vehicles, and the four accessible shoreline areas by conventional motor vehicles. Associated physical damages to these resources would result from continued motor vehicle use in areas where these resources exist. These impacts would be more prevalent at accessible shorelines authorized for use because the Lake Powell shoreline has fluctuated in recent years and more topography has been exposed in these ORV areas and unavoidable adverse impacts from conventional motor vehicle use on these accessible shorelines would be the same as alternative C. In some instances the designated ORV area is no longer bounded by natural features resulting in land beyond the designated ORV area being exposed to off-road use. Unavoidable impacts on proposed wilderness would be slight and result from noise emitted from conventional

motor vehicles on GMP roads potentially being audible to visitors near Dirty Devil and impacting the opportunity for visitors to experience natural quiet and solitude, thus compromising the primeval characteristics of the proposed wilderness area. In addition, there could be continued unavoidable minor adverse impacts ethnographic resources from continued use of Hole-in-the-Rock by conventional motor vehicles, OHVs, and street-legal ATVs and from purposeful and inadvertent vandalism; and health and safety as conventional motor vehicles would continue to be authorized to operate at Lone Rock Beach and the four accessible shorelines. Off-road use would be monitored and mitigation measures, including barricading and closures would be used to reduce impacts on resources in places where evidence of illegal use occurs.

Alternative E: Mixed Use (Preferred Alternative)

Under alternative E, there would be long-term, unavoidable adverse impacts on soils, vegetation, wildlife and wildlife habitat, special-status species, archeological resources, and paleontological resources due to the continued off-road use of Lone Rock Beach and the play area by all types of motor vehicles, 14 accessible shoreline areas authorized for use by conventional motor vehicles and street-legal ATVs (12 existing accessible shoreline areas plus Paiute Farms and Nokai Canyon), and along unpaved GMP roads authorized for increase motor vehicle use by OHVs. Associated physical damages to these resources would result from continued motor vehicle use in areas where these resources exist. These impacts would be more prevalent at accessible shorelines because the Lake Powell shoreline has fluctuated in recent years and more topography has been exposed in these ORV areas. In some instances the designated ORV area is no longer bounded by natural features resulting in land beyond the designated ORV area being exposed to off-road use. Unavoidable impacts on proposed wilderness would result from motor vehicle noise being audible to visitors and impacting the opportunity for visitors to experience natural quiet and solitude, thus compromising the primeval characteristics of the proposed wilderness area. In addition, there would be continued unavoidable adverse impacts soundscapes from continued use at the play area from the high intensity motor vehicle activities; ethnographic resources from continued use of Hole-in-the-Rock by, and from purposeful and inadvertent vandalism; and health and safety as conventional motor vehicles, OHVs, and street-legal ATVs would continue to operate together at Lone Rock Beach and the play area and on unpaved GMP roads, and conventional motor vehicles and street-legal ATVs would operate together 14 accessible shorelines. Off-road use would be monitored and mitigation measures, including barricading and closures would be used to reduce impacts on resources in places where evidence of illegal use occurs.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

NPS must consider if the effects of the alternatives cannot be changed or are permanent (that is, the impacts are irreversible). NPS must also consider if the impacts on recreation areas resources would mean that once gone, the resource could not be replaced; in other words, the resource could not be restored, replaced, or otherwise retrieved (NEPA section 102[c][v]).

> **An irreversible commitment of resources** is defined as the loss of future options. The term applies primarily to the effects of using nonrenewable resources, such as minerals or cultural resources, or to those factors such as soil productivity that are renewable only over long periods. It could also apply to the loss of an experience as an indirect effect of a “permanent” change in the nature or character of the land.
>
> **An irretrievable commitment of resources** is defined as the loss of production, harvest, or use of natural resources. The amount of recreational activities foregone is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume production. An example of such a commitment would be the loss of motor vehicle access in a particular accessible shoreline area as a result of a decision to close an area. If the decision were reversed, visitor experiences related to motorized access, though lost in the interim, would be available again.

Alternative A: No Action

Under alternative A, impacts on soils, archeological resources, and paleontological resources due to the continued off-road use of Lone Rock Beach and the play area by all types of motor vehicles, the accessible shoreline areas by conventional motor vehicles, and designated ORV routes in Ferry Swale by all types of motor vehicles could result in irreversible and irretrievable impacts on Glen Canyon's natural and physical resources. Impacts on these resources would continue, especially at accessible shorelines open to conventional motor vehicle use because the Lake Powell shoreline has fluctuated in recent years and more topography has been exposed in these ORV areas. In some instances the designated ORV area is no longer bounded by natural features resulting in land beyond the designated ORV area being exposed to off-road use. Impacts on these resources would be concentrated along designated ORV routes rather than scattered along user-created routes in Ferry Swale. Continued off-road use has already resulted in the structure and composition of soils in off-road areas being subject to continual degradation over prolonged exposure to compaction and associated erosion caused by off-road use, as well as the disturbance of vegetation communities in areas of off-road use. In addition, vegetation, wildlife and wildlife habitat, special-status species, could suffer irretrievable adverse effects if no action is taken.

Alternative B: No Off-road Use

Alternative B has the least potential for irreversible impacts (soils, archeological resources, and paleontological resources) since no off-road use would be authorized at Glen Canyon. Alternative B has the potential for irretrievable impacts related to the prohibition of off-road use within Glen Canyon and the forgone visitor use and experiences related to off-road use.

Alternative C: Increased Motorized Access

Alternative C has the most potential for irreversible impacts, if Glen Canyon's resources (soils, archeological resources, ethnographic resources, and paleontological resources) are adversely affected from increased motorized access to include increased off-road opportunities and vehicle numbers. Alternative C also has the potential for irretrievable impacts on vegetation, wilderness, soundscapes, wildlife and wildlife habitat, and special-status species, due to the continued and increased off-road use at Lone Rock Beach, the play area, 15 accessible shoreline areas, and at Ferry Swale by all types of motor vehicles.

Alternative D: Decreased Motorized Access

Alternative D has the potential for some irreversible impacts if Glen Canyon's resources (soils, archeological resources, ethnographic resources, and paleontological resources) are adversely affected by continued off-road use by conventional motor vehicles at accessible shorelines. Alternative D also has the potential for irretrievable impacts on vegetation, wilderness, soundscapes, wildlife and wildlife habitat, special-status species, and visitor use and experience due to off-road use of Lone Rock Beach, and four accessible shoreline areas by conventional motor vehicles only.

Alternative E: Mixed Use (Preferred Alternative)

Alternative E has the potential for irreversible impacts. Glen Canyon's resources (soils, archeological resources, ethnographic resources, and paleontological resources) could be adversely affected from increased motorized access by conventional motor vehicles and street-legal ATVs at 14 accessible shorelines and continued off-road use at Lone Rock Beach, the play area, and on designated ORV routes in Ferry Swale. Alternative C also has the potential for irretrievable impacts on vegetation, wilderness, soundscapes, wildlife and wildlife habitat, and special-status species, due to the continued off-road use at Lone Rock Beach, the play area, 14 accessible shoreline areas, and at Ferry Swale.

Chapter 5 Consultation and Coordination

CHAPTER 5: CONSULTATION AND COORDINATION

The intent of the National Environmental Policy Act (NEPA) is to encourage the participation of federal and state involved agencies and affected citizens in the assessment procedure, as appropriate. This section describes the consultation that occurred during development of this Off-Road Vehicle Management Plan / Draft Environmental Impact Statement (plan/DEIS), including consultation with stakeholders and other agencies. This chapter also includes a description of the public involvement process and a list of the recipients of the draft document.

HISTORY OF PUBLIC INVOLVEMENT

The public involvement activities for this plan/DEIS fulfill the requirements of NEPA and National Park Service (NPS) Director's Order 12 (NPS 2011a).

THE SCOPING PROCESS

NPS divides the scoping process into two parts: internal scoping and external or public scoping. Internal scoping involved discussions among NPS personnel regarding the purpose of and need for management actions, issues, management alternatives, mitigation measures, appropriate level of documentation, available references and guidance, and other related topics.

Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure people have an opportunity to comment and contribute early in the decision-making process. For this plan/DEIS, project information was distributed to individuals, agencies, and organizations early in the scoping process, and each was given the opportunity to express concerns or views and to identify important issues or other alternatives.

Taken together, internal and public scoping are essential elements of the NEPA planning process. The following sections describe the various ways scoping was conducted for this impact statement.

INTERNAL SCOPING

The internal scoping process began in 2007. The Glen Canyon National Recreation Area (Glen Canyon) conducted various internal scoping meetings on site from 2007 through 2010. Internal scoping involves discussions among NPS staff to decide what is necessary to analyze in the plan/DEIS. Personnel from Glen Canyon attended these meetings to define the purpose, need, and objectives of the plan; identify potential issues; discuss preliminary alternatives; and define data needs. Members at the meetings also discussed potential adaptive management strategies, indicators for such strategies, and issues and topics related to the Environmental Screening Form. Various roles and responsibilities for developing the off-road vehicle (ORV) management plan were also clarified. Initial internal scoping involved only Glen Canyon personnel; however, NPS Environmental Quality Division and The Louis Berger Group, Inc. participated in internal scoping later in the process.

As part of the scoping process, Glen Canyon met with their cooperating agencies. Cooperating agencies serve an important role ensuring that the lead agency (NPS) considers and evaluates a wide range of issues, alternatives, and outcomes during an environmental review. Additional information regarding the project's cooperating agencies is discussed below under "Agency Consultation."

Public Scoping

Public Scoping Meetings and Comments

The public scoping process began on August 31, 2007, with the publication of a Notice of Intent in the Federal Register (FR) (72 FR 169). Informational public scoping brochures were mailed to 60 interested parties the week of August 27, 2007. In support of the public scoping effort, NPS hosted three public scoping meetings intended to initiate public involvement early in the planning stages of the plan/DEIS and to obtain community feedback on the initial purpose, need, and objective statements for ORV management at Glen Canyon. The meetings were held at the following locations:

- On Wednesday, September 5, 2007, a public meeting was held in Escalante, Utah, at the Interagency Visitor Center from 4:00 p.m. to 7:00 p.m.; six people attended.
- On Thursday, September 20, 2007, a public meeting was held in Page, Arizona, at the Glen Canyon National Recreation Area Headquarters from 4:00 p.m. to 7:00 p.m.; 30 people attended.
- On Monday, September 24, 2007, a public meeting was held in Monticello, Utah, at the Welcome Center from 4:00 p.m. to 7:00 p.m.; 25 people attended.

Meeting attendees were provided information on the issues related to ORV management and the planning process, and NPS staff were on hand to respond to questions. Attendees were encouraged to provide feedback on NPS forms and were informed how to use the NPS Planning, Environment, and Public Comment (PEPC) public comment system, at http://parkplanning.nps.gov/glca/. In addition, NPS staff kept freeform notes regarding relevant comments and topics of discussion.

The Comment Analysis Process

Comment analysis is a process used to compile and correlate similar public comments into a usable format for decision makers and the plan/DEIS interdisciplinary planning team. Comment analysis assists the team in organizing, clarifying, and addressing technical information pursuant to NEPA regulations.

The foremost topics that were raised during the public scoping period are listed below:

- The feeling of solitude that already had existed at the Glen Canyon National Recreation Area
- Opposition to all ORVs that are not street legal
- Opposition to new roads and ORV areas
- Support for continued and expanded off-road use in the Glen Canyon National Recreation Area
- Visitor use and visitor conflicts
- Water quality
- Species of special concern found within the Glen Canyon National Recreation Area
- Wilderness areas within the Glen Canyon National Recreation Area.

Public Scoping on the Preliminary Range of Alternatives

In the fall of 2010, the Glen Canyon National Recreation Area released a range of preliminary alternatives for the plan/DEIS for public review and comment. The draft range of alternatives, which was developed in part with the

input received during public scoping, was presented in a brochure that was available locally at the Glen Canyon National Recreation Area, at public meetings, and on the NPS planning website (http://parkplanning.nps.gov/glca). In addition, brochures were mailed to the Glen Canyon National Recreation Area mailing list in October 2010. The public was invited to submit comments on the scope of the planning process and potential alternative elements from October 18, 2010, through November 30, 2010.

NPS held seven meetings to inform the public about the preliminary alternatives for the plan/DEIS at the following locations:

- On November 1, 2010, a public meeting was held in Page, Arizona, at the Glen Canyon National Recreation Area Park Headquarters from 4:00 p.m. to 7:00 p.m.; 45 people attended.
- On November 2, 2010, a public meeting was held in Blanding, Utah, at the Utah State University College of Eastern Utah San Juan Campus Blanding Arts and Events Center from 4:00 p.m. to 7:00 p.m.; 16 people attended.
- On November 3, 2010, a public meeting was held in Escalante, Utah, at the Escalante Interagency Visitor Center from 4:00 p.m. to 7:00 p.m.; seven people attended.
- On November 4, 2010, a public meeting was held in Kanab, Utah, at the Kanab Middle School from 4:00 p.m. to 7:00 p.m., 14 people attended.
- On November 5, 2010, a public meeting was held in Flagstaff, Arizona, at the Summit Fire District Station 33 from 3:00 p.m. to 6:00 p.m. Zero people attended.
- On November 9, 2010, a public meeting was held at the Navajo Mountain Chapter House (Navajo Route 16, approximately 35 miles north of the Highway 98 junction) from 4:00 p.m. to 7:00 p.m.; six people attended.

Each of the public meetings began with an open house, allowing the public to circulate between information stations. Each station had display boards describing the project background, the purpose of and need for the plan, management considerations, and preliminary alternatives. NPS staff were available at each station to answer any questions or concerns presented by the community and to record comments.

In addition to the public meetings noted above, selected NPS employees attended a monthly Oljato Chapter meeting on November 7, 2010 (San Juan County Road 420/Monument Valley Rd/Oljato Road, approximately 12 miles west of the Highway 163 Junction) from 11:00 a.m. to 3:00 p.m. The Chapter meeting allowed the NPS employees to present to the tribal members the same information that had been presented at the public meetings. There were 15 tribal members and 5 Chapter officials in attendance.

Comments were either carried forward for further evaluation or dismissed from further consideration, see chapter 2. During the comment period for the preliminary range of alternatives, 557 correspondences were received, containing 1,858 comments. Correspondences were received at the public meeting (on flipcharts or NPS provided comment forms), entered directly into PEPC by the commenter, via email, or via postal mail.

Generally, these comments focused on wilderness, support for off-road use, new alternatives or new elements to the alternatives, land management laws and policies, and the value of the natural resources or setting found within Glen Canyon. Several commenters suggested conducting a baseline analysis of wilderness areas inside Glen Canyon, and that wilderness areas (potential and designated) should be protected from vehicle use. Several commenters stated their support for continuing, or expanding, off-road use and off-road use areas within Glen Canyon. Several commenters provided new alternatives or elements to the alternatives, such as allowing unlicensed all-terrain vehicles (ATVs) on some or all of the unpaved roads in Glen Canyon, developing new ORV areas, combining alternatives C and D, providing a shuttle service within the Glen Canyon National Recreation Area, constructing

additional rest areas, establishing ORV capacity limits for certain areas, granting livestock permittees administrative access, establishing pedestrian-only areas that are far away from off-road use areas, and enabling volunteers to help with enforcement activities. Some commenters also urged NPS to comply with the Executive Order No. 11644 governing off-road use in Glen Canyon, which requires NPS to protect the natural resources and public lands from ORV impacts, to promote public safety of all users of those lands, and to minimize impacts to natural resources. Lastly, some commenters stated that they would not be able to enjoy the natural resources and scenery within Glen Canyon if they were prohibited from driving ORVs.

AGENCY CONSULTATION

During public scoping, agencies were afforded the opportunity to provide comments on the initial purpose, need, and objectives of the plan. These and all agency correspondences can be found in appendix A. Additionally, on June 4, 2007, NPS sent letters to the five counties neighboring Glen Canyon National Recreation Area inviting them to become cooperating agencies in the environmental impact statement (EIS) process in recognition of their involvement with road maintenance, travel management and recreation planning. Four counties in southern Utah - Kane, Garfield, San Juan and Wayne - accepted this offer; Coconino County in Arizona declined. On September 17, 2010 NPS provided additional information to the four Utah counties about their roles as a cooperating agency. Copies of this correspondence are located in appendix A of this document. During the public comment period in November 2010 regarding the draft preliminary alternatives that had been developed, NPS held open houses in Kane, Garfield, and San Juan counties and met informally with county officials. A formal briefing was held with San Juan County Commission members during this same time frame. After draft alternatives had been revised, NPS invited all four Utah counties to a meeting to discuss the current state of the planning effort. Representatives from Kane, Garfield, and San Juan County attended a meeting at Glen Canyon headquarters on June 28, 2011.

The Bureau of Land Management (BLM) manages lands adjacent to Glen Canyon under the auspices of the Monticello, UT Field Office, Hanksville, UT Field Office, Arizona Strip Field Office and Grand Staircase-Escalante Field Office. NPS has coordinated with the individual field offices and the BLM-Utah state office to ensure that roads that cross between the lands managed by each agency are evaluated consistent with ongoing planning efforts.

ENDANGERED SPECIES ACT CONSULTATION

In accordance with the Endangered Species Act of 1973, Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS) concerning impacts to threatened and endangered species have been initiated by NPS, as needed. To date, this has involved sending a scoping newsletter to the USFWS, both Utah and Arizona Ecological Service Field Offices, during initial scoping in August 2007. The Arizona Ecological Services Field Office sent the Glen Canyon National Recreation Area a letter, dated October 5, 2007, which provided a list of threatened and endangered species that occur in or close to Glen Canyon. This list was reviewed by NPS biologists and narrowed down to a list of special-status species that could possibly occur within the boundaries of Glen Canyon in Arizona. The list was narrowed further to those species that could be expected to be affected by the actions proposed in the various alternatives presented under this plan/DEIS. These species were included in the affected environment and impacts analysis conducted for this plan/DEIS.

On January 7, 2008, NPS requested species and habitat information from the Utah Ecological Services Field Office. Email communication follow-up occurred later that month. On November 3, 2010, the Arizona Ecological Services Office sent a letter reiterating the information from the 2007 letter, providing additional information on California condors, and recommending additional communication with the Arizona Game and Fish Department and affected tribes with regards to sensitive species.

Tribal Consultation

In support of the NPS commitment for government-to-government consultation with the 19 associated Native American tribes and bands, and as a reflection of the shared boundary of Glen Canyon and the Navajo Nation, NPS has engaged in a continuing process of consultation with these tribes and bands. See appendix A for copies of letters and correspondence.

- On February 6, 2009, NPS wrote to the Navajo Nation and the Oljato, Navajo Mountain, and Shonto Chapters requesting information about cultural resources and public use at Piute Canyon, Neskahi, and Copper Canyon accessible shoreline sites.
- On June 20, 2010, an update on the ORV EIS planning process was provided for the Rainbow Bridge Native American Consultation Committee meeting.
- On September 12, 2010, NPS staff provided updates on the planning process at the Oljato and Navajo Mountain Chapter meetings.
- On October 20, 2010, NPS wrote to the 19 associated tribes and bands to provide an update on the ORV EIS process and provided a copy of the purpose, need and objectives brochure.
- On October 28, 2010, an update on the ORV EIS planning process was provided for the Rainbow Bridge Native American Consultation Committee meeting.
- On November 7 and November 9, 2010, NPS employees attended public meetings at the Oljato and Navajo Mountain Chapters and presented the preliminary draft alternatives.
- On June 14, 2011, NPS wrote the 19 associated tribes and bands to provide an update on the next steps in the ORV EIS planning process.
- On June 15, 2011, an update on the ORV EIS planning process was provided for the Rainbow Bridge Native American Consultation Committee meeting.
- On October 11, 2011, NPS wrote the 19 associated tribes and bands to provide an update on the ORV EIS planning process and notify them of pending phone communications from NPS.
- During December 2011 and January 2012, NPS made follow-up calls to the 19 associated tribes and bands to update the mailing lists and provide an opportunity for the identification of relevant issues. The Pueblo of Zuni and Ts'ah Bii Kin Chapter House requested face-to-face consultation upon release of the plan/DEIS.
- On May 9, 2012, an update on the ORV EIS planning process was provided for the Rainbow Bridge Native American Consultation Committee meeting.
- On April 23, 2013, NPS wrote the 19 associated tribes and bands to provide a copy of the draft executive summary of the plan/DEIS for review and comment.
- On July 10, 2013, NPS met with the Ts'ah Bii Kin Chapter at a monthly chapter meeting and provided an update on the plan/DEIS. The NPS provided a vicinity map, table of alternatives, and excerpt from the executive summary.
- On July 16, 2013, NPS met with the Governor and Council of the Pueblo of Zuni in Zuni, New Mexico, and provided a presentation on the plan/DEIS. The Council asked questions about the plan and requested that communication continue so that they can provide support for the plan.

- On July 19, 2013, NPS met with Navajo Mountain Vice-President Jamie Holgate and provided an update on the plan/DEIS. NPS provided a vicinity map, table of alternatives, and excerpt from the executive summary.
- On July 22, 2013, NPS wrote to the 19 associated tribes and bands to invite them to participate in the Section 106 consultation process and attend an August 22, 2013 meeting. The "Clarification of Cultural Considerations" document was provided and comments solicited on determination of the area of potential effects and the level of effort for identification of historic resources.
- On August 22, 2013, a meeting was held at Glen Canyon headquarters in Page, Arizona, to present the NPS recommendations on determination of area of potential effects and level of effort for identification of historic properties. Two representatives from the Kaibab Band of Paiute Indian Tribe attended.
- On September 10, 2013, NPS provided a recap of the August 22, 2013, meeting and again requested comment on the topics under consideration.
- On September 13, 2013, NPS received a letter from the Hopi Tribe commenting on the "Clarification of Cultural Considerations" document and the draft executive summary. The Hopi Tribe claims a cultural affiliation with prehistoric cultural groups in Glen Canyon and supports the identification and avoidance of prehistoric archeological sites. The Hopi Tribe generally supports the most restrictive alternative in federal agencies' travel management plans and supports alternative B in the plan/DEIS.
- On September 18, 2013, NPS wrote to the 19 associated tribes and bands and provided a digital copy of the plan/DEIS for review and comment.

Government-to-government consultation with the 19 associated tribes and bands will continue throughout the remaining planning process.

National Historic Preservation Act Consultation

NPS initiated consultation with the Utah State Historic Preservation Office (SHPO) during the public scoping process in September 2007. On September 19, 2007, the Utah SHPO responded by letter, expressing interest in consulting on potential consulting parties, determining the area of potential effects, reasonable and good faith identification efforts, and resource eligibility and effects. An update on the planning process was provided during the biennial program meeting with the Arizona and Utah SHPOs on September 30, 2010. On October 5, 2012, NPS provided both SHPO offices with a draft documents to review and on which to comment: "Clarification of Cultural Considerations" and "Accessible Shorelines Addendum for Design for Archeological Survey." On November 2, 2012, the Arizona SHPO communicated via email that they concurred with the NPS recommendations. On March 29, 2013, the Utah SHPO responded via letter that their response was delayed. They recommended that the documents be provided to formal consulting parties and recommended additional contacts. They commented that the area of potential effects and identification efforts seemed highly appropriate. Consultation with both SHPO offices is continuing throughout the Section 106 consultation process.

In an effort to include other parties with a demonstrated interest in the undertaking due to their legal or economic relation to the undertaking or the affected historic properties, or their concern with the undertaking's effect on historic properties, NPS has initiated consultation with federal and state agencies, local governments, federally recognized Indian tribes, additional consulting parties and the general public for the federal undertaking, the ORV Management Plan. Several organizations have been invited to apply to become a consulting party for the plan/DEIS per 36 CFR §800.2(c)(3)(5):

> Grand Canyon Trust, Great Old Broads for Wilderness, Old Spanish Trail Association, Utah Rock Art and Research Association, Utah Statewide Archeological Society, San Juan Public Entry and Access Rights, Southern Utah Wilderness Alliance, Utah Professional Archeological Council, Utah

Shared Access Alliance, Colorado Plateau Archaeological Alliance, and the Utah 4 Wheel Drive Association.

To date, NPS has accepted the application of the Colorado Plateau Archaeological Alliance, Great Old Broads for Wilderness, Old Spanish Trail Association, San Juan Public Entry and Access Rights, Utah Professional Archeological Council and Western Watersheds Project as additional consulting parties.

NPS has corresponded with the following groups during the first phase of Section 106 consultation; these letters, and any responses received are provided in appendix A:

- Garfield County, UT
- Kane County, UT
- San Juan County, UT
- Wayne County, UT
- City of Escalante, UT
- City of Blanding, UT
- City of Kanab, UT
- City of Big Water, UT
- Bluff, UT, Service Area
- City of Boulder, UT
- City of Moab, UT
- City of Panguitch, UT
- City of Monticello, UT
- City of Hanksville, UT
- Utah Parks and Recreation
- State Historic Preservation Office – UT
- Navajo Parks and Recreation Department
- BLM Utah
- BLM Monticello Field Office
- BLM Kanab Field Office
- BLM Richfield Field Office
- BLM Henry Mountains Field Station
- Grand Staircase-Escalante National Monument
- Dixie National Forest
- Manti-La Sal National Forest
- Canyonlands National Park
- Capitol Reef National Park
- Coconino County, AZ
- City of Page, AZ
- Arizona State Parks
- State Historic Preservation Office – AZ
- BLM Arizona
- BLM Arizona Strip District
- BLM Arizona Strip Field Office
- Vermilion Cliffs National Monument
- John Wesley Powell Memorial Museum, Page, AZ

- Friends of the Earth, Bluewater Network Division
- National Parks Conservation Association, Southwest Region
- Wildlands CPR
- Great Old Broads for Wilderness
- Utah Professional Archeological Council
- San Juan Public Entry and Access Rights
- Old Spanish Trail Association, Armijo Chapter
- Western Watersheds Project
- Cedar City Stake, The Church of Jesus Christ of Latter-day Saints
- Church Historic Department, The Church of Jesus Christ of Latter-day Saints
- Manti 4th Ward, The Church of Jesus Christ of Latter-day Saints
- Tropic Ward, The Church of Jesus Christ of Latter-day Saints
- Escalante Heritage Center
- Hole-in-the-Rock Foundation
- Sons of Utah Pioneers
- Navajo Nation
- LeChee Chapter, Navajo Nation
- Navajo Mountain Chapter, Navajo Nation
- Oljato Chapter, Navajo Nation
- Ts'ah Bii Kin Chapter, Navajo Nation
- Shonto Chapter, Navajo Nation
- Coppermine Chapter, Navajo Nation
- Bodaway Gap Chapter, Navajo Nation
- Kaibeto Chapter, Navajo Nation
- Pueblo of Zuni
- Paiute Indian Tribe of Utah
- Kanosh Band of Paiute Indian Tribe of Utah
- Koosharem Band of Paiute Indian Tribe of Utah
- Shivwits Band of Paiute Indian Tribe of Utah
- Ute Mountain Ute Tribe
- San Juan Southern Paiute Tribe
- Kaibab Band of Paiute Indians
- Hopi Tribe

On August 22, 2013, NPS met with consulting party representatives to provide NPS proposals for and receive feedback from participants on:

1. Determining the scope of identification efforts (per 36 CFR §800.4(a)) to include determining the area of potential effects (per 36 CFR 800.4(a)(1)); and

2. Determining the agency's reasonable and good faith efforts to carry out appropriate identification efforts (per 36 CFR 800.4(b)(1)).

Invitees and participants were provided with a document entitled "Clarification of Cultural Resource Considerations for the Glen Canyon National Recreation Area Off-Road Vehicle Management Plan / Environmental Impact Statement." This document identifies the proposed parameters used to model the area of

potential effect, provides a rationale for determining the agency's reasonable and good faith efforts to carry out appropriate identification efforts, and recommends a strategy to initiate identification efforts.

Section 106 consultation will continue throughout the remainder of NPS efforts to identify historic properties, assess adverse effects and resolve adverse effects, if any, of the federal undertaking.

LIST OF RECIPIENTS OF THE DRAFT PLAN / ENVIRONMENTAL IMPACT STATEMENT

FEDERAL AGENCIES

- Bryce Canyon National Park
- Canyonlands National Park
- Bureau of Land Management
- Bureau of Land Management, Arizona Strip Field Office
- Bureau of Land Management, Henry Mountains Field Station
- Bureau of Land Management, Kanab Field Office
- Bureau of Land Management, Moab Field Office
- Bureau of Land Management, Monticello Field Office
- Bureau of Land Management, Richfield Field Office
- Bureau of Land Management, Utah
- Bureau of Reclamation, Glen Canyon Dam
- Capitol Reef National Park
- Dixie National Forest
- Grand Canyon National Park
- Manti-La Sal National Forest
- National Park Service
- National Park Service, Utah
- U.S. Army Corps of Engineers
- U.S. Army Corps of Engineers – Durango Regulatory Office
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

CONGRESSIONAL DELEGATES

- Senator Orrin G. Hatch, Utah, U.S. Senate
- Senator Mike Lee, Utah, U.S. Senate
- Senator Jeff Flake, Arizona, U.S. Senate
- Senator John McCain, Arizona, U.S. Senate
- Representative Jason Chaffetz, Utah, U.S. House of Representatives
- Representative Ann Kirkpatrick, Arizona, U.S. House of Representatives

STATE AND LOCAL GOVERNMENTS

- Office of the Governor, State of Arizona
- Office of the Governor, State of Utah
- Arizona Department of Transportation
- Arizona Game and Fish
- Arizona Historic Preservation Office
- Arizona State Parks
- Arizona State Trails Coordinator
- Utah Department of Environmental Quality

- Utah Department of Natural Resources
- Utah Division of Wildlife Resources
- Utah Environmental Congress
- Utah Historic Preservation Office
- Utah Parks and Recreation
- Off-highway Vehicle Coordinator, State of Utah
- Coconino County Board of Supervisors, Arizona
- City of Page, Arizona
- Page Chamber of Commerce, Arizona
- City of Escalante, Utah
- Escalante Chamber of Commerce, Utah
- Garfield County, Utah
- Garfield County Commission, Utah
- Kanab City Council, Utah
- Kane County Commission, Utah
- San Juan County, Utah
- San Juan County Commission, Utah
- Wayne County Commission, Utah

Associated Native American Groups

- Hopi Tribe
- Kaibab Band of Paiute Indian Tribe
- Navajo Nation
  - Gap/Bodaway Chapter
  - Coppermine Chapter
  - Kaibeto Chapter
  - LeChee Chapter
  - Navajo Mountain Chapter
  - Olijato Chapter
  - Shonto Chapter
  - Ts'ah Bii Kin Chapter
- Paiute Indian Tribe of Utah
  - Shivwits Band
  - Koosharem Band
  - Kanosh Band
- Pueblo of Zuni
- San Juan Southern Paiute
- Ute Mountain Ute
  - White Mesa Ute Band

Other Organizations and Businesses

- Adventure Partners
- Amangiri
- Antelope Point Holdings
- Aramark
- Arizona Daily Sun
- ATV Jamboree
- ATV Utah/Bushman Web
- ATV Riders of Greenehaven, AZ
- ATV Safety Institute
- Backyards of America
- Blue Ribbon Coalition
- Blue Energy Corporation
- Canyon Country 4×4
- Canyon Country Heritage
- Capital Trail Vehicle Association
- Cedar Breaks Trailblazers ATV Club
- Center for Biological Diversity
- Coalition of National Park Service Retirees

- Coconino County Trailriders
- Defenders of Wildlife
- Desert Marina Management LLC
- Desert News
- Dirt Tricks Inc.
- Double J ATV Tours
- Dunes and Trails ATV Club
- Explore Publishing, Inc.
- Friends of the Earth
- Glen Canyon Institute
- Gouldings Trading Post
- Grand Canyon Trust
- Great Old Broads for Wilderness
- Health Matters
- Healthy Lands Project
- High Plains Off-road Association
- Huntley Group, LLC
- John Hopkins Bloomberg School of Public Health
- John Wesley Powell Memorial
- Lake Powell Yacht Club
- Maryland Ornithological Society
- Mountain Biking Association
- National Parks Conservation Association
- Natural Resources Defense Council
- Nature Conservancy
- Nature Conservancy, Arizona Field Office
- Nature Conservancy, Utah Field Office
- Navajo Times (The)
- North Wash Outfitters
- Oklahoma Cross Country Racing Association
- Page Honda
- Prescott Open Trails Association
- Public Employees for Environmental Responsibility, Southwest Chapter
- Public Lands Equal Access Alliance
- Rainbow Harbor
- Red Rock 4 Wheelers
- Salem Audubon Society
- Salt Lake Tribune
- San Juan Public Entry and Access Rights
- Sierra Club
- Southern Utah Wilderness Alliance
- St. George Spectrum
- Top of Utah Snowmobile Association
- Treasure Mountain Inn
- Tri-State ATV Club & Northern Utah ATV Club
- Toyota Land Cruiser Association
- United Four Wheel Drive Association
- University of Illinois
- Utah-Arizona ATV Club
- Utah/Arizona ATV Club of Kanab
- Utah Shared Access Alliance
- Utah State University, College of Eastern Utah
- UUWA
- Wasatch Mountain Club
- The Wilderness Society
- Wildlands CPR

LIST OF PREPARERS AND CONSULTANTS

Staff Member	Position	Experience	Role
National Park Service, Glen Canyon National Recreation Area			
Todd Brindle	Superintendent	B.A. Political Science 35 years NPS	Interdisciplinary team (IDT) team member Document reviewer
Brian Carey	Management Assistant, Former Deputy Superintendent	Acting Superintendent at Glen Canyon National Recreation Area B.S., Biology 31 years with NPS; 3 years as Deputy	IDT team member Document reviewer Park liaison for the Environmental Quality Division project manager
Mark Anderson	Aquatic Ecologist	M.S. 10 years NPS, Glen Canyon	Review data, provide input, and concept development
Thann Baker	Archeologist	M.A., Anthropology; B.A., Anthropology 13 years of experience; 3 years NPS	Assisted with the writing and review of chapters 2, 3, and 4 related to cultural resources.
Erica Clites	Physical Science Technician	M.Sc., Paleontology 5 years NPS	Review data, provide input, and concept development
Lance Mattson	Chief of Operations	B.S., Park and Recreation Management 20 years NPS	Provide input and concept development
John Spence	Terrestrial Ecologist	Ph.D., Botany Adjunct Faculty, Northern Arizona University (NAU) 23 years NPS	Review data, provide input, and concept development
Rosemary Sucec	Chief, Branch of Cultural Resources	B.A. Anthropology (emphasis in archeology); MA Anthropology (emphasis in cultural/applied) 8 years experience, archeological work 16 years experience, cultural anthropologist	Assisted with the writing and review of chapters 2, 3, and 4 related to cultural resources. Developing the National Historic Preservation Act (NHPA) Programmatic Agreement associated with this planning process.
Teri Tucker	Chief, Planning & Compliance	B.S., Natural Resources Planning 12 years NPS	NPS Glen Canyon National Recreation Area NEPA Liaison

Staff Member	Position	Experience	Role
Scott Whitesides	Environmental Protection Specialist	M.A., Maritime Studies East Carolina University B.A., Anthropology Utah State University 3 years NPS	NPS Glen Canyon National Recreation Area NEPA Liaison
National Park Service, Environmental Quality Division			
Lindsay Gillham	Environmental Protection Specialist/Project Manager	B.S. Natural Resources Recreation Tourism Juris Doctorate 8 years NPS 4 1/2 years USFWS	Project management, document review, and NEPA compliance
Doug Wetmore	Environmental Protection Specialist	B.A. Liberal Arts and Sciences (Biology, Geology, Geography) M.U.R.P. Environmental Planning 13 Years	Assisted with project management and data gathering.
National Park Service/Intermountain Region			
Christine Turk	Regional Environmental Quality Coordinator	B.A. Biological Sciences 34 years NPS, Natural Resource Specialist, Planning and Compliance 5 years U DE College of Marine Studies, marine biologist	Responsible for review of the EIS and project coordination
The Louis Berger Group, Inc.			
Julia Yuan	Senior Environmental Scientist	MPS, Forest and Natural Resources Management BS, Environmental and Forest Biology/Forest Resources Management 12 years experience	Project Manager, responsible for project management
Jeff Gutierrez	Environmental Planner	M.A., Urban and Regional Planning BA, Environmental Studies 8 years experience	Deputy Project Manager, responsible for daily tasks and Wilderness
Lori Fox	Senior Planner	B.S. Environmental Policy, University of Michigan M.C.P. Environmental and Land Use Planning, University of Maryland 14 years environmental compliance experience	Quality Assurance and Quality Control

Staff Member	Position	Experience	Role
Nancy Van Dyke	Senior Scientist	B.A. Biology and Geography, University of Delaware M.S. Environmental Sciences (Ecology), University of Virginia 35+ years environmental planning and compliance experience	Quality Assurance and Quality Control
Holly Bender	Senior Economist	PhD, Mineral Economics MS, Mineral Economics BA, Economics and Political Science 16 years experience	Responsible for Socioeconomics
Megan Blue-Sky	Environmental Planner	B.A. Geography, University of Colorado Denver 5 years environmental planning and cartography experience	Responsible for all mapping and Health and Safety
Rudi Byron	Environmental Planner	MURP, Environmental Planning BS, Environmental Policy and Politics 8 years experience	Responsible for Visitor Use and Experience
Christopher Dixon	Environmental Planner	MURP, Urban and Regional Planning MBA, Business Administration BS, Environmental Economics and Management 4 years experience	Supported Socioeconomics
Alynda Foreman	Environmental Scientist	MS, Environmental Research and Education, Multidisciplinary Studies BA, Biology, minor, Environmental Science 15 years experience	Responsible for Wildlife and Special-status Species
Lia Peckman Jenkins	Environmental Scientist	BS, Biology BA, Spanish 4 years experience	Responsible for Wildlife and Special-status Species
Charles LeeDecker	Principal Archeologist	MA, Anthropology BA, Anthropology 35+ years experience	Supported Cultural Resources
David Plakorus	Environmental Planner	MURP, Urban and Regional Planning MBA, Business Administration BA, History 5 years experience	Responsible for Vegetation
Joshua Schnabel	Environmental Planner	MA, Geography BA, Sociology 10 years experience	Responsible for Soils and Geology and Paleontology

Staff Member	Position	Experience	Role
Spence Smith	Environmental Scientist	MA, Biology BS, Zoology 17 years experience	Quality Assurance and Quality Control for Wildlife and Special-status Species and Vegetation
Leo Tidd	Senior Planner	B.S. Environmental Studies. SUNY College of Environmental Science and Forestry MPA Environmental Policy. Columbia University 8 years experience with environmental impact analysis	Responsible for Soundscapes
Joseph Tippet	Senior Archeologist	MA, Anthropology BA, Anthropology 30+ years experience	Responsible for Cultural Resources
The Final Word			
Juanita Barboa	Editor	B.S. Technical Communication, New Mexico Institute of Mining and Technology 24 years experience	Responsible for editing
Sherrie Bell	Editor / Document Designer	Business Management Coursework, New Mexico State University 24 years of experience	Responsible for editing and document layout

References, Glossary, Index

REFERENCES

Adams, J.A., A.S. Endo, L.H. Stolzy, P.G. Rowlands, H.B. Johnson

1982 Controlled Experiments on Soil Compaction Produced by Off-road Vehicles in the Mojave Desert, California. *Journal of Applied Ecology*, 19 pp 167-175.

Allen E.B.

1995 Restoration ecology: limits and possibilities in arid and semiarid lands. In: Proceedings of the Wildland Shrub and Arid Land Restoration Symposium. USDA Forest Service INT-GTR-315, pp. 7–15.

Amangiri

n.d. Website. scenic flights. Accessed on October 30, 2012. Accessed at: http://www.amanresorts.com/amangiri/scenic_flights.aspx

Ambrose, S.

2006 Sound Levels in the Primary Vegetation Types in Grand Canyon National Park, July 2005, NPS Report No. GRCA-05-02. January 25, 2006. Accessed December 5, 2010. Available: http://www.nps.gov/grca/naturescience/upload/ambient-sound.pdf.

Ambrose, S. and C. Florian

2005 Sound Levels in the Primary Vegetation Types in Grand Canyon National Park, July 2005. Unpublished report to Grand Canyon National Park, Grand Canyon, AZ.

2008 Sound Levels and Audibility of Off Road Vehicles, Lone Rock Beach, Glen Canyon National Recreation Area, August-September 2007. Unpublished report to Glen Canyon National Recreation Area, Page, AZ.

2011 Draft Glen Canyon National Recreation Area and Rainbow Bridge National Monument Acoustic Inventory 2010.

2013 Glen Canyon National Recreation Area and Rainbow Bridge National Monument Acoustic Inventory 2010. Revised Draft. September 4, 2013.

Arizona

n.d. *Arizona State Parks. Arizona Off-Highway Vehicle Guide. OHV Laws and Places to Ride.*

2003 Economic Importance of Off-Highway Vehicle Recreation to Arizona. Arizona State Parks. 34 pp.

Arizona Game and Fish Department (AZGFD)

n.d. Arizona Bald Eagle Management Program. Accessed online at: http://www.azgfd.gov/w_c/nongameandendangeredwildlifeprogram/Raptors/ArizonaBaldEagleManagementProgramBase.shtml.

2004 Plant Abstract – *Astragalus preussii* var. *cutleri*. Heritage Data Management System.

2009 Big Game Species – Bighorn Sheep. Available online at http://www.azgfd.gov/h_f/game_bighorn.shtml. Updated April 2009. Accessed January 9, 2011.

Arizona State Parks

2003 Economic Importance of Off-Highway Vehicle Recreation to Coconino County. Accessed on 3.16.2012. Available: http://azstateparks.com/ohv/downloads/OHV_EI_coconino.pdf.

ATV Safety

2007 ATV Safety: Hearing before the Subcommittee on Consumer Affairs, Insurance, and Automotive Safety of the Committee on Commerce, Science, and Transportation, United States Senate. 110th Cong. 1. (Statement of Rachel Weintraub, Director, Product Safety and Senior Counsel, Consumer Federation of America).

ATV Utah

2012 Utah Off-Highway Vehicle Laws and Rules. Available Online at: http://www.atvutah.com/utah_ohv_laws.htm. Accessed on August 30, 2012.

Baker, C.

2004 Glen Canyon National Recreation Area: Archaeological Survey Summary: Hite, Bullfrog, Halls Crossing, and Associated Areas. Report prepared for Glen Canyon National Recreation Area and ARAMARK Sports and Entertainment Services, Inc. Copy of report on file at LBG's Raleigh, North Carolina office.

Baker, T., NPS Archaeologist

2010 *Draft Accessible Shoreline Cultural Considerations for the Glen Canyon National Recreation Area (NRA) Off-Highway Vehicle (OHV) Environmental Impact Statement (EIS)*. Prepared for the Glen Canyon National Recreation Area, Page Arizona.

2012a Personal communication via telephone to Lee Tippett, The Louis Berger Group Inc., January 6, 2012.

2012b Personal communication via email to Lee Tippett, The Louis Berger Group Inc., January 6, 2012.

Baker, T. and R. Burrillo

2013 Draft Archaeological Inventory and Significance Evaluations in Ferry Swale, Glen Canyon National Recreation Area, Coconino County Arizona and Kane County, Utah. Copy of draft report on file at LBG's Raleigh, North Carolina office.

Belnap, J.

1990 Microbiotic crusts: their role in past and present ecosystems. *Park Science* 10(3): 3-4.

1993 Recovery Rates of Cryptobiotic Crusts: Inoculant Use and Assessment Methods. *Great Basin Naturalist* 53(1):89-95.

1994 Potential role of cryptobiotic soil crust in semiarid rangelands. In: Monsen, S. B., and S. G. Kitchen, eds. Proceedings—Ecology and Management of Annual Rangelands. General Technical Report INT-GTR-313. USDA Forest Service, Intermountain Region Research Station, Ogden, UT. Pages 179-185.

1996 Soil Surface Disturbances in Cold Deserts: Effects on Nitrogenase Activity in Cyanobacterial-lichen Soil Crusts. *Biology and Fertility of Soils* 23:362-367.

2002 Impacts of off-road vehicles on nitrogen cycles in biological soil crusts: resistance in different US deserts. *Journal of Arid Environments*, 52 pp 155-165.

2004 Cryptobiotic Soils: Holding the Place in Place. Institute of Water Research (IWR) Michigan State University. "K Factor" [Online] http://www.iwr.msu.edu/rusle/kfactor.htm [Last Accessed: October 6, 2009].

Belnap, J. and J. S. Gardner

1993 Soil microstructure of the Colorado Plateau: the role of the cyanobacterium *Microcoleus vaginatus*. *Great Basin Naturalist* 53:40-47.

Belnap, J., J. H. Kaltenecker, R. Rosentreter, J. Williams, S. Leonard, D. Eldridge

2001 *Biological Soil Crusts: Ecology and Management*. Ed. Pam Peterson. USDI, BLM, National Science and Technology Center, Information and Communications Group. Technical Reference 1730-2. Denver, Colorado.

Belnap, J.L. and O.L. Lange (eds)

2001 Biological Soil Crusts: Structure, Function and Management. Springer, New York. 503 pp.

Berry, K.H.

1980 A review of the effects of off-road vehicles on birds and other vertebrates. Management of western forests and grasslands for nongame birds—Workshop proceedings, Salt Lake City, Utah. 1980.

Bogan, M.A. and C.A. Ramotnik

1995 Baseline Surveys for Mammals in Four Riparian Areas in Glen Canyon National Recreation Area. Final Report. January 30, 1995.

Brattstrom, B.H. and M.C. Bondello

1983 Effects of off-road vehicle noise on desert vertebrates. In R.H. Webb and H.G Wilshire, editors. Environmental effects of Off- Road Vehicles: Impacts and Management in Arid Regions. Springer-Verlag. New York, New York, USA.

Bratvold, C.

2011 "Viewpoint: Slower speed limits on gravel roads is safer, saves county's tax dollars." *Ravalli Republic*. Posted July 6, 2011. Accessed online at: http://www.ravallirepublic.com/news/opinion/viewpoint/article_ae13ac94-a840-11e0-99e7-001cc4c03286.html, on March 29, 2012.

Brennan, T.C.

2008 Glossy Snake (*Arizona elegans*). Online Field Guide to The Reptiles and Amphibians of Arizona. Available online at: http://www.reptilesofaz.org/.

Brooks

1999 Chapter 4, (Wildlife and Wildlife Habitat, requested missing reference from Glen Canyon NRA).

2000 Chapter 4, (Wildlife and Wildlife Habitat, requested missing reference from Glen Canyon NRA).

Bryce, W.D.

2010 *Glen Canyon National Recreation Area Accessible Shorelines: Design for Archaeological Survey*. Northern Arizona University Anthropology Laboratories Report No. 1315, submitted to the National Park Service Glen Canyon National Recreation Area under Colorado Plateau Cooperative Ecosystems Studies Unit Agreement No. H1200-09-0005.

Buehler, D.A.

2000 Bald Eagle (*Haliaeetus leucocephalus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/506. Accessed February 13, 2012.

Bureau of Economic Analysis (BEA)

2010a CA1-3 Per Capita Personal Income, Coconino County, Arizona. Regional Economic Accounts. Accessed online, January 24, 2010. Available: http://www.bea.gov/regional/reis/drill.cfm.

2010b CA1-3 Per Capita Personal Income, Utah. Regional Economic Accounts. Accessed online, January 27, 2010. Available: http://www.bea.gov/regional/reis/drill.cfm.

2011 CA25N Total Employment by Industry for the years 2008 and 2009. Coconino County, Arizona; Garfield, Iron, Kane, San Juan, Sevier, Washington, and Wayne Counties, Utah. Regional Economic Accounts. Accessed online, December 2011. Available: http://www.bea.gov/regional/reis/default.cfm#step3.

Bureau of Labor Statistics (BLS)

2010a Local Area Unemployment Statistics. Garfield, Iron, Kane, San Juan, Sevier, Washington, and Wayne Counties, Utah. Accessed online, January 29, 2010. Available: http://www.bls.gov/data/.

2010b Local Area Unemployment Statistics. Coconino County, Arizona. Accessed online, January 29, 2010. Available: http://www.bls.gov/data/.

2010c Labor Force Statistics From the Current Population Survey. United States. Accessed online, January 29, 2010. Available: http://www.bls.gov/data/.

Bureau of Reclamation

1996 Record of Decision Operation of Glen Canyon Dam Final Environmental Impact Statement. October 1996.

2007 Final Environmental Impact Statement. Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead. October 2007.

2008 Final Environmental Assessment for Experimental Releases from Glen Canyon Dam, Arizona, 2008 through 2012. February 29, 2008.

Burr, S.W., J.W. Smith, D. Reiter, P. Jakus, and J. Keith

2008 "Recreational Off-Highway Vehicle Use on Public Lands in Utah." Institute for Outdoor Recreation and Tourism, Department of Environment and Society, College of Natural Resources, Utah State University. Logan, Utah. 101 pp.

Burrowing Owl Conservation Network

n.d. Facts – Burrowing Owl. Earth Island Institute. Available online at: http://www.burrowingowlconservation.org/Facts.html.

Bury, R.B.

1980 What we know and don't know about off-road vehicle impacts on wildlife. Pages 110-123 in Andrews, R. N. L. and P. F. Nowak, editors. *Off-road vehicle use: A management challenge*. USDA Office of Environmental Quality, University of Michigan.

Bury, R.B. and R.A. Luckenbach

2002 Comparison of Desert Tortoise (*Gopherus agassizii*) Populations in an Unused and Off-Road Vehicle Area in the Mojave Desert." *Chelonian Conservation and Biology* 4(2):457–463.

Caldwell, B.

2011 *Glen Canyon National Recreation Area Accessible Shorelines: Addendum to Design for Archaeological Survey*. Northern Arizona University Anthropology Laboratories Report No. 1315-A, submitted to the National Park Service Glen Canyon National Recreation Area under Colorado Plateau Cooperative Ecosystems Studies Unit Agreement No. H1200-09-0005.

California Air Resources Board

2011 Off-Highway Recreational Vehicle Certification Requirements. Website accessed at: http://www.arb.ca.gov/msprog/onroad/cert/rvctp/rvctp.htm. Page updated November 15, 2011.

California Department of Transportation (CALTRANS)

2009 Technical Noise Supplement. November 2009. Available: http://www.dot.ca.gov/hq/env/noise/pub/tens_complete.pdf. Accessed: December 6, 2010. pp 2-19.

Campbell, M. and M. Johns

n.d. Habitat Fragmentation and Birds. NC Wildlife Resources Commission, Division of Conservation Education and Divisions of Wildlife Management. Accessed online at: http://faculty.ncwc.edu/mbrooks/pif/fact%20sheets/fragmentation%20fact%20sheet.htm. Accessed June 16, 2011.

Carey, B.

2013a Personal communication via email with Megan Blue-Sky. The Louis Berger Group. Subject: Glen Canyon Health and Safety Question, September 3, 2013.

2013b Personal communication via email with Megan Blue-Sky, The Louis Berger Group. Subject: Re: Glen Canyon Health and Safety Question, September 4, 2013.

Clites, E.

2011 Paleontological Resources Assessment for ORV Scoping. GLCA Administrative Record File No. 5128.

Cobb, C.

2011 Page-Lake Powell Chamber of Commerce. Personal Communication between Chris Dixon (LBG) and Celia Cobb (Page-Lake Power Chamber of Commerce, Executive Director) on December 21, 2011 regarding major industries and businesses in Page, UT. Conversation via phone call.

Colorado Plateau Land Use History of North America (CP-LUHNA)

n.d. Reintroduction of Native Species. Website. Accessed on March 28, 2012. Accessed at: http://cpluhna.nau.edu/Change/reintroduction.htm.

Consumer Product Safety Commission (CPSC)

2012 ATV-Related Deaths and Injuries for All Ages, 1985-2010. http://www.atvsafety.gov/stats.html. Accessed on August 1, 2012.

2013 2011 Annual Report of ATV-Related Deaths and Injuries. U.S. Consumer Product Safety Commission. February 2013.

Cordell, H.K., C.J. Betz, G. Green, and M. Owens

2005 "Off-Highway Vehicle Recreation in the United States, Regions and States: A National Report from the *National Survey on Recreation and the Environment* (NSRE)." Southern Research Station.

Cordell, H.K., M. Owens, G. Green, C. Betz, M. Fly, B. Stephens, G. Super, and F. Thompson

2004 "Recreation Statistics Update – Trends and Demographics of Off-Road Vehicle Users," Outdoor Recreation for 21st Century America. State College, PA: Venture Publishing Inc. 37 pp.

Cornell Lab of Ornithology

n.d. All About Birds. Bird Guide (Online). Cornell University. Available online at: http://www.allaboutbirds.org/guide/search.

Council on Environmental Quality (CEQ)

1997 Environmental Justice Guidance under the National Environmental Policy Act. Executive Office of the President. Washington, D.C. December 10. Available online at: http://www.epa.gov/compliance/resources/policies/ej/index.html.

Countess Environmental (Countess)

2006 *WRAP Fugitive Dust Handbook*. WGA Contract No. 30204-111.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe

1979 *Classification of Wetlands and Deepwater Habitats of the United States*. Prepared for the U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Cui, Y., E. Mahoney, and T. Herbowicz

2013 Economic Benefits to Local Communities from National Park Visitation, 2011. National Park Service NRR-2013-632.

Dean Runyan Associates

2009 Arizona Travel Impacts, 1998-2008. Prepared for the Arizona Office of Tourism, Phoenix, Arizona. 88 pp.

Divine, A.K., and P.E. Foti

2004 "Learning to Live with Off-Highway Vehicles: Lessons Learned from the Dixie National Forest" Proceedings of the Fourth Social Aspects and Recreation Research Symposium February 4-6, 2004 San Francisco, California. San Francisco State University: Department of Recreation and Leisure Studies. 109 p. http://www.fs.fed.us/psw/programs/recreation/2004_sarr_proceedings.shtml.

Downey, M.

2012 Environmental Protection Assistant, National Park Service, Environmental Quality Division. Personal Communication between Downey and County Motor Vehicle Offices. March 12, 2012.

DOI-BLM-UT-0300-0008-EA

2011 Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road. Grand Staircase Escalante National Monument, Kanab, Utah.

Dregne, H.E.

1983 Soil and soil formation in arid regions. Pages 15-30 in: R. H. Webb and H. G. Wilshire (eds.). Environmental effects of off-road vehicles: Impacts and management in arid regions. Springer-Verlag. New York.

Drost, C. A., R. Platenberg, A. J. Monatesti, and T. Persons.

2008. Reptile and amphibian inventory of Glen Canyon National Recreation Area. U. S. Geological Survey. Flagstaff, AZ.

Dugger, B.D. and K.M. Dugger

2002 Long-billed Curlew (*Numenius americanus*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Accessed online at: http://bna.birds.cornell.edu/bna/species/628.

Durbin, T.D., M.R. Smith, R.D. Wilson, S.H. Rhee

2004 *In-use activity measurements for off-road motorcycles and all-terrain vehicles*. Transportation Research Park D 9 (2004) 209-219. College of Engineering, University of California, Center for Environmental Research and Technology.

Escalante River Watershed Partnership

2011 Escalante River Watershed Restoration, Volume 1, Issue 1. Summer 2011. Accessed online at: http://www.law.utah.edu/wp-content/uploads/GSEP-Newsletter_2011_Final.pdf, on April 8, 2012.

Evans, R.M. and F.L. Knopf

2004 American White Pelican (*Pelecanus erythrorhynchos*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Accessed online at: http://bna.birds.cornell.edu/bna/species/057.

Fairley, H.C.

1985 An Archaeological Survey of the Proposed Marina Development Site at Paiute Farms, Utah. Northern Arizona University Archaeological Report No. 991. May 21, 1985.

Federal Highway Administration (FHWA)

1995 Development of National Reference Energy Mean Emission Levels for the FHWA Traffic Noise Model (FHWA TNM®), Version 1.0. November 1995. FHWA-PD-96-008.

Federal Transit Administration (FTA)

2006 http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf

Frueh, L.M. and Monoghan & Associates

2001 "Status and Summary Report OHV Responsible Riding Campaign." November 15, 2001.

Garfield County, Arizona

2007 Garfield County General Management Plan Resource Management Section. November 8, 2007.

Geib, P.R.

1996 *Glen Canyon Revisited*. University of Utah, Anthropological Papers, Number 119. University of Utah Press, Salt Lake City.

Gillette, D.A., and J. Adams

1983 Accelerated wind erosion and prediction of rates. In Environmental Effects of Off-road Vehicles. Impacts and Management in Arid Regions (R.H. Webb and H.G. Wilshire, ed.). New York: Springer Verlag, pp. 97–109.

Gillette, D. and L. Newcomb

2009 Paleontological Resource Management Plan for Glen Canyon National recreation Area. August 2009.

Gough, G.A., J.R. Sauer, and M. Iliff

1998 *Patuxent Bird Identification Infocenter*. Version 97.1. Patuxent Wildlife Research Center, Laurel, MD. Available online at: http://www.mbr-pwrc.usgs.gov/id/framlst/infocenter.html.

Grambsch, A.

2002 *The Potential Impacts of Climate Change on Transportation.*

Grayson, D.K.

2011 The Great Basin: A Natural Prehistory. University of California Press, Berkeley.

Hammerson, G.A.

2007 *Sauromalus ater*. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4. Available online at: http://www.iucnredlist.org/apps/redlist/details/64054/0. Accessed 2 February 2011.

Havlick

2002 Chapter 4, (Wildlife and Wildlife Habitat, requested missing reference from Glen Canyon NRA).

Hill, M.E. and T. Ayers

2009 Vascular plant inventory of Glen Canyon National Recreation Area. US Dept. of the Interior, National Park Service. Natural Resource Technical Report NPS/SCPN/NRTR – 2009/264.

Hughes, J.M.

1999 Yellow-billed Cuckoo (*Coccyzus americanus*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/418. Accessed. January 6, 2012.

Institute of Water Research (IWR)

2012 "K Factor" [Online] http://www.iwr.msu.edu/rusle/kfactor.htm. Last Accessed: January 20, 2012.

Iverson, R.M.

1980 Processes of Accelerated Pluvial Erosion on Desert Hillslopes by Vehicular Traffic. *Earth Surface Processes*. 5:4, pp. 369-88.

Iverson, R.M., B. S. Hinckley, R.H. Webb, and B. Hallet

1981 Physical effects of vehicular disturbance on desert landscapes. *Science*, Vol. 212, May 22, 1981, p. 915-917.

Jennings, J.D.

1966 *Glen Canyon: A Summary*. University of Utah, Anthropological Papers, Number 81 (Glen Canyon Series Number 31). University of Utah Press, Salt Lake City.

Joslin, G. and H.Youmans, coordinators

1999 Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307 pp.

Keith, J. E., S.W. Burr, J. Gale, P.l Jakus, R. Krannich, D. Reiter, and D.Tarboton

2008 Utah's Public Lands Socioeconomic Baseline Study: Summary Report. A report for the Utah Governor's Public Lands Policy Coordination Office. Utah State University. December.

Keller, B.J. and L.C. Bender

2007 Bighorn Sheep Response to Road-Related Disturbances in Rocky Mountain National Park, Colorado. *The Journal of Wildlife Management* 71(7): 2329-2337. September 2007.

Lacey, C.A., J.R. Lacey, P.K. Fay, J.M. Storey, and D.L. Zamora

1997 Controlling knapweed on Montana rangeland. Circular 311. Montana State University Extension Service, Bozeman, Montana.

Landres, Peter, Chris Barns, John G. Dennis, Tim Devine, Paul Geissler, Curtis S. McCasland, Linda Merigliano, Justin Seastrand, Ralph Swain

2008 Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System. United States Department of Agriculture, Forest Service. General Technical Report RMRS-GTR-212. July 2008.

Last, M.P.

2009 Intraspecific phylogeography of *Cycladenia humilis* (Apocynaceae). Unpublished master's thesis. BYU. Provo, Utah.

Lathrop, E.W. and P.G. Rowlands

1983 Plant ecology in deserts: an overview. Pages 114-152 In: R. H. Webb and H.G. Wilshire (eds.), Environmental effects of off- road vehicles: Impacts and management in arid regions. Springer-Verlag. New York.

Latimer, P.

2005 Native Plants of Arizona 2005. *Rubus neomexicanus*. Accessed at: http://jan.ucc.nau.edu/~plants-c/bio414/species%20pages/rubus%20neomexicanus.htm.

Lemos, P., and J.F. Lutz

1957 Soil Crusting and Some Factors Affecting It. *Soil Science Society of America Proceedings* 21:485-491.

Lewis, M.S. and R. Paige

2006 "Selected Results From a 2006 Survey of Registered Off-Highway Vehicle (OHV) Owners in Montana." RMU Research Summary No. 21. Montana Fish, Wildlife & Parks. July 2006.

Liestman, T.

1986 Five Sites Near the Lone Rock Development in Glen Canyon National Recreation Area. DOI-NPS, Midwest Archaeological Center, Lincoln, Nebraska.

Lovich, J.E. and D. Bainbridge

1999 Anthropogenic Degradation of the Southern California Desert Ecosystem and Prospects for Natural Recovery and Restoration. *Environmental Management* Vol. 24, No. 3, pp 309-326.

Luckenbach, R.A. and R.B. Bury

1983 Effects of Off-Road Vehicles on the Biota of the Algondones Dunes, Imperial County, California. *The Journal of Applied Ecology* 20(1):265-286.

Madsen, J.

1995 Impacts of Disturbance on Migratory Waterfowl. *Ibis*, 137: S67–S74.

Maxell, B. and G. Hokit

1999 Amphibians and Reptiles. *In* Effects of Recreation on Rocky MountainWildlife: A Review for Montana, coord. G. Joslin and J. Youmans 2: 1-29. Montana Chapter of the Wildlife Society, Committee on Effects of Recreation on Wildlife. Cited by Allison Clark in *Effects of Roads and Off-Road Vehicles on Reptile Populations*, Road RIPorter 10(2), Summer Solstice 2005. Accessed online at http://www.wildlandscpr.org/biblio-notes/effects-roads-and-off-road-vehicles-reptile-populations on 15 December 2010.

McCune, B., and J.A. Antos

1982 Epiphyte Communities of the Swan Valley, Montana. *The Bryologist* 85: 1-12.

McVay, A., and A. Racki

2008 "Recreational Trails in Arizona." Chapter 4 – Arizona 2008 SCORP: 81-95 pp.

Meaney, C.A., M. Reed-Eckert, and G.P. Beauvais

2006 Kit Fox (*Vulpes macrotis*): a technical conservation assessment. Prepared for USDA Forest Service, Rocky Mountain Region. Available online at: http://www.fs.fed.us/r2/projects/scp/assessments/kitfox.pdf. Accessed 2 February 2011.

Medin, D. E.

1986 Grazing and passerine breeding birds in a Great Basin low-shrub desert. *Western North American Naturalist*, *46*(3), 567-572.

Meltzer, D.J.

2009 *First Peoples in a New World: Colonizing Ice Age America*. University of California Press, Berkeley and Los Angeles.

Monz, C., Y-F. Leung, H. Bauman, and C. Ingle

2003 Phase 1 Project Report, National Park Service Coastal Visitor Impact Monitoring.

Munger, J.C. and A.A. Ames

1998 Impacts of Off-Highway Motorized Vehicles on Sensitive Reptile Species in Owyhee County, Idaho. Department of Biology, Boise State University, Boise, ID. June 1998.

Natural Resources Conservation Service (NRCS)

2010 Web Soil Survey for Glen Canyon National Recreation Area. Survey Area Data: Version 1, Oct 7, 2010. Report generated on December 29, 2010.

2011 National Cooperative Soil Surveys. Glen Canyon National Recreation Area and San Juan County, Utah, Navajo Indian Reservation, UT. [Online] http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Last Accessed: December 14, 2011.

NatureServe Explorer (NatureServe)

2009 NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. Available on line at http://www.natureserve.org/explorer. Last updated October 2009. Accessed February 4, 2010.

2010 NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available online at: http://www.natureserve.org/explorer. Accessed January 25, 2011.

National Park Service (NPS)

n.d.a Annotated Checklist of the Birds of Glen Canyon National Recreation Area. Available online at: http://www.nps.gov/glca/naturescience/upload/Annotated%20Bird%20Checklist.pdf.

n.d.b Checklist of Mammals Found in Glen Canyon National Recreation Area. Available online at: http://www.nps.gov/glca/naturescience/upload/MammalChecklist.pdf.

n.d.c Checklist of Reptiles Found in Glen Canyon National Recreation Area. Available online at: http://www.nps.gov/glca/naturescience/upload/ReptileChecklist.pdf.

n.d.d Fish Checklist. Available online at: http://www.nps.gov/glca/naturescience/upload/FishChecklist.pdf.

n.d.e Checklist of Amphibians Found in Glen Canyon National Recreation Area. Available online at: http://www.nps.gov/glca/naturescience/upload/AmphibianChecklist.pdf.

n.d.f Glen Canyon National Recreation Area Expanded Zebra Mussel Action Plan. Glen Canyon National Recreation Area, Arizona and Utah. Accessed online at: http://www.nps.gov/glca/parknews/upload/Expanded%20Action%20Plan.pdf, on April 8, 2012.

n.d.g Tamarisk Leaf Beetle. Glen Canyon National Recreation Area. Accessed online at: http://www.nps.gov/glca/naturescience/tamarisk-leaf-beetle.htm, on April 8, 2012.

n.d.h Hite Webpage. Accessed online at: http://www.nps.gov/glca/planyourvisit/hite.htm.

1979 *Proposed General Management Plan*. July 1979, reprinted August 1991. Glen Canyon Recreation Area / Arizona-Utah.

1980 Wilderness Recommendation – Glen Canyon National Recreation Area, Arizona/Utah. September 1980.

1981 *Lone Rock Beach Development Concept Plan and Environmental Assessment*.

1984 *Park Road Standards*. July 9, 1984.

1986 Glen Canyon National Recreation Area in cooperation with Navajo Nation. Paiute Farms/San Juan Marina. Final Development Concept Plan and Environmental Assessment. May 1986.

1987a *Glen Canyon National Recreation Area, Arizona/Utah: Water Resources Management Plan and Environmental Assessment*. Page, AZ: Glen Canyon National Recreation Area.

1987b *Final Resource Management Plan, Cultural Component, Glen Canyon National Recreation Area*. April 1987. Glen Canyon National Recreation Area. National Park Service – Rocky Mountain Region.

1988 *Environmental Assessment and Management/Development Concept Plans for Lake Powell's Accessible Shorelines*. April 1988. Glen Canyon National Recreation Area. National Park Service – Rocky Mountain Region.

1989 Memorandum, (Recreational road system section).

1991a *Natural Resource Management Guidelines*, NPS DO-77. U.S. Government Printing Office, Washington, D.C. http://www.nature.nps.gov/rm77/.

1991b *Reference Manual 77: Natural Resource Management*. U.S. Department of the Interior, National Park Service. Washington, D.C.

1993 Environmental Assessment for *Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan*.

1995 *Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan*.

1996a Strategic Plan to Protect Water Quality.

1996b *Glen Canyon National Recreational Area Archaeological Resources Protection Plan*. August 1996. Glen Canyon National Recreation Area. National Park Service – Rocky Mountain Region.

1998 Director's Order 28 – *Cultural Resources Management Guideline*. National Park Service, Washington, D.C. Located at: http://www.cr.nps.gov/history/online_books/nps28/28contents.htm Accessed on December 30, 2011.

1999a *Grazing Management Plan*. Glen Canyon National Recreation Area. August 1999

1999b *Director's Order 41: Wilderness Preservation and Management*. July/August 1999. Available: http://home.nps.gov/applications/npspolicy/DOrders.cfm.

2000 Director's Order 47 - *Soundscape Preservation and Noise Management*.

2001 *Director's Order 12: Conservation Planning, Environmental Impact Analysis and Decision-making Handbook*. National Park Service, Washington D.C. Located at http://www.nps.gov/application s/npspolicy/DOrders.cfm.

2002a Director's Order 77-1: *Wetland Protection*.

2002b Amendment to the Glen Canyon National Recreation Area Archeological Resources Protection Plan, August 1996. January 24, 2002.

2003 Director's Order 77-2: *Floodplain Management*.

2004a Mexican Spotted Owl Inventory in Canyonlands National Park, 2002-2003. General Technical Report SEUG-002-2003. National Park Service, Southeast Utah Group Resource Management Division. January 2004. Accessed online at: http://www.nps.gov/cany/naturescience/upload/SpottedOwl2003.pdf. Accessed January 9, 2012.

2004b *Draft Ruins Preservation Plan, Glen Canyon National Recreation Area*. Glen Canyon National Recreation Area. Glen Canyon National Recreation Area. National Park Service – Rocky Mountain Region.

2005 Acoustic and Soundscape Studies in National Parks. Draft. Natural Sounds Program, NPS, Fort Collins, CO.

2006a NPS *Management Policies 2006*. U.S. Department of the Interior, National Park Service. Washington, D.C.

2006b *Uplake Development Concept Plan / Environmental Assessment*. Glen Canyon National Recreation Area.

2006c Glen Canyon National Recreation Area. *Finding of No Significant Impact (FONSI) and Errata - Uplake Development Concept Plan/Environmental Assessment*. December 2006.

2006d Glen Canyon National Recreation Area. Lees Ferry Area Improvements Final Environmental Assessment/Assessment of Effect. August 2006.

2007a Checklist of Birds Found in Glen Canyon National Recreation Area. October 2007. Available online at: http://www.nps.gov/glca/naturescience/upload/bird%20checklist%20pages%20in%20order.pdf.

2007b Glen Canyon National Recreation Area – Animals. Last updated 16 August 2007. Available online at: http://www.nps.gov/glca/naturescience/animals.htm.

2007c Glen Canyon National Recreation Area – Eagles. Last updated 15 August 2007. Available online at: http://www.nps.gov/glca/naturescience/eagles.htm.

2007d Glen Canyon National Recreation Area – Nature & Science. Last updated 17 August 2007. Available online at: http://www.nps.gov/glca/naturescience/index.htm.

2007e *Strategic Plan for Glen Canyon NRA and Rainbow Bridge NM FY2008 – FY2012*.

2007f Glen Canyon National Recreation Area Visitor Study. Spring and Summer 2007. University of Idaho. Park Studies Unit: Visitor Services Project. Report 186.

2007g "Frequently Asked Questions." General Management Plan / Wilderness Study / Environmental Impact Statement, Sleeping Bear Dunes National Lakeshore. August 22, 2007. Located at: http://www.nps.gov/slbe/parkmgmt/upload/gmpfaq082207to020106.pdf.

2007h Glen Canyon National Recreation Area – Updated Recommended OHV Interim Management Plan at Lone Rock Beach OHV Use Area.

2007i Glen Canyon National Recreation Area – Updated Recommended OHV Interim Management Plan at Glen Canyon Accessible Shorelines.

2008a Glen Canyon National Recreation Area – Amphibians. Last updated 1 October 2008. Available online at: http://www.nps.gov/glca/naturescience/amphibians.htm.

2008b Glen Canyon National Recreation Area – Birds. Last updated 1 October 2008. Available online at: http://www.nps.gov/glca/naturescience/birds.htm.

2008c Glen Canyon National Recreation Area – Reptiles. Last updated 1 October 2008. Available online at: http://www.nps.gov/glca/naturescience/reptiles.htm.

2008d Glen Canyon National Recreation Area – Mammals. Last updated 1 October 2008. Available online at: http://www.nps.gov/glca/naturescience/mammals.htm.

2008e Glen Canyon National Recreation Area. 2008 Uplake Development Concept Plan/Environmental Assessment. October 2008.

2008f Programmatic Agreement Among the National Park Service (U.S. Department of the Interior) the Advisory Council on Historic Preservation and National Conference of State Historic Preservation Officers for Compliance with Section 106 of the National Historic Preservation Act. Accessed at: http://www.ncshpo.org/members/NPSPA2008.pdf.

2008g Memorandum to file. Subject: Determination regarding continuing the prohibition of use of any off-highway vehicle (OHV), all terrain vehicle (ATV), or similar vehicle on park roads. Superintendent, Southeast Utah Group.

2009a *Interim Guidance. Considering Climate Change in National Park Service NEPA Analysis*. November 2009.

2009b Vascular Plant Inventory of Glen Canyon National Recreation Area. Natural Resource Technical Report NPS/SCPN/NRTR – 2009/264. November 2009.

2009c Glen Canyon National Recreation Area. *Finding of No Significant Impact (FONSI) and Errata - Uplake Development Concept Plan/Environmental Assessment*. January 2009.

2009d *Tamarisk* Beetle (Diorhabda spp.) found along Colorado River within Grand Canyon National Park. Available online at: http://www.nps.gov.grca/parknews/tamarisk-beetle.htm, on April 8, 2012.

2010a *Soundscapes Management Plan*. Zion National Park. September 2010. Available: http://www.nps.gov/zion/parkmgmt/upload/ZNP-Soundscape-Plan_Sep_2010.pdf.

2010b NPS: Nature and Science, Natural Sounds, Understanding Sound. Last updated October 13, 2009. Available: http://www.nature.nps.gov/naturalsounds/understanding/. Accessed: December 5, 2010.

2011a Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-Making. Effective Date: 10/5/2011.

2011b Glen Canyon National Recreational Area – Reptiles. Available online at: http://www.nps.gov/glca/naturescience/reptiles.htm. Last updated 30 January 2011. Accessed 2 February 2011.

2011c *Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road*. October 3, 2011.

2011d National Park Service Public Use Statistics Office website. Located at: http://www.nature.nps.gov/stats/index.cfm Accessed on December 8, 2010.

2011e *Guidance for Non-Impairment Determination and the NPS NEPA Process*. October 31, 2011.

2012a Public Use Statistics Office Vehicles Counts 2002-2011. Accessed from http://www.nature.nps.gov/stats/park.cfm?parkid=475 on January 5, 2012.

2012b Glen Canyon NRA ORV Use.

2012c Comments on 2nd internal draft ORV EIS.

2013a Superintendent's Compendium of Designations, Closures, Permit Requirements and Other Restrictions Imposed Under Discretionary Authority. Glen Canyon National Recreation Area and Rainbow Bridge National Monument. April 24, 2013. Page, AZ.

2013b Rare Plants – Glen Canyon. Website Last Updated: 06/11/2013. Accessed at: http://www.nps.gov/glca/naturescience/rareplants.htm.

National Park Service (NPS) and Navajo Nation Division of Economic Development

2002 *Antelope Point Marina & resort Development Project Environmental Assessment*. March 2002.

NPS Public Use Statistics Office

2010 Glen Canyon NRA January 2010 Visitation Report by Area. Accessed online, January 29, 2010. Available: http://www.nature.nps.gov/stats/park.cfm?parkid=496.

2012 NPS Statistics for Glen Canyon National Recreation Area, Visitation and Traffic Counts Reports. Accessed January 3, 2012. Available: http://www.nature.nps.gov/stats/park.cfm.

Nealon, G.

2013 Observations of Waterbirds and Raptors along the Colorado River Between Glen Canyon Dam and Lees Ferry During the Summer of 2013. Resource Management Division, Glen Canyon National Recreation Area. pp. 14.

Neff, J.C., R.L. Reynolds, J. Belnap, and P. Lamothe

2005 Multi-decadal impacts of grazing on soil physical and biogeochemical properties in southeast Utah. *Ecological Applications* 15: 87-95.

New Mexico Energy, Minerals and Natural Resources Department (EMNRD) and New Mexico Department of Game and Fish, with New Mexico Department of Agriculture, Range Improvement Task Force, and New Mexico Tourism Department

2008 New Mexico Energy, Minerals and Natural Resources Department (EMNRD) and New Mexico Department of Game and Fish, with New Mexico Department of Agriculture, Range Improvement Task Force, and New Mexico Tourism Department. Off-Road Vehicle Recreation in New Mexico. The Senate Joint Memorial 40 Report. December 2008. Available online at: http://www.emnrd.state.nm.us/main/sjm40/SJM40report-01-07-09.pdf. Accessed 25 May 2011.

Office of Management and Budget (OMB)

2010 Table 10.1: GDP Deflators Used in Historical Tables. Accessed online, February 5, 2010. Available: http://www.whitehouse.gov/omb/rewrite/budget/fy2008/hist.html.

Otto, D.

2008 The Economic Impact of Off-Highway Vehicles in Iowa. Prepared for the Iowa Off-Highway Vehicle Association, Strategic Economics Group, Des Moines, Iowa. 24 pp.

Ouren, D.S., C. Haas, C.P. Melcher, S.C. Stewart, P.D. Ponds, N.R. Sexton, L. Burris, T. Fancher, and Z.H. Bowen

2007 Environmental Effects of Off-Highway Vehicles on Bureau of Land Management Lands: A Literature Synthesis, Annotated Bibliographies, Extensive Bibliographies, and Internet Resources. Open-File Report 2007-1353. USDOI-USGS.

Parker, P.L.

1993 Traditional Cultural Properties: What You Do and How We Think. *CRM*, Volume 16, pp: 2-6. U.S. Department of the Interior, National Park Service, Washington, D.C.

Parker, P.L. and T.F. King

1999 *Guidelines for Evaluating and Documenting Traditional Cultural Properties*. National Register Bulletin 38. U.S. Department of the Interior, National Park Service, Washington, D.C.

Parris, K.M., and A. Schneider

2009 Impacts of traffic noise and traffic volume on birds of roadside habitats. *Ecology and Society* 14.1: 29.

Payne, G.F., J.W. Foster, and W.C. Leininger

1983 Vehicle impacts on Northern Great Plains range vegetation. *J. of Range Manage*. 36(3): 327-331.

Poulin, R.L., D. Todd, E.A. Haug, B.A. Millsap, and M.S. Martell

2011 Burrowing Owl (*Athene cunicularia*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/061. Accessed. January 6, 2012.

Radle, A.L.

2007 The Effect of Noise On Wildlife: A Literature Review. *University of Oregon*. pp. 16. Available online at: http://interact.uoregon.edu/medialit/wfae/library/articles/radle_effect_noise_wildlife.pdf.

Reed, P., and G. Haas

1989 Off Highway Vehicles in Colorado: Estimated Recreational Use and Expenditures. Colorado State University, Fort Collins, Colorado. 15 pp.

Reid, M.

2004 Paiute ATV Trail Economic Outcomes Max Reid, Public Service Staff, Fishlake National Forest. 3 pp.

Richardson, C.T. and C.K. Miller

1997 Recommendations for Protecting Raptors from Human Disturbance: A Review. *Wildlife Society Bulletin* 25(3): 634-638. Autumn 1997.

Riffell, S.K., K.J. Gutzwiller, and S.H. Anderson

1996 Does Repeated Human Intrusion Cause Cumulative Declines in Avian Richness and Abundance? *Ecological Applications* 6(20):492-505.

Rooney, T.P.

2005 Distribution of ecologically-invasive plants along off-road vehicle trails in the Chequamegon-Nicolet National Forest, Wisconsin. *The Michigan Botanist* 44:178- 182.

Rosen, P.C. and C.H. Lowe

1994 Highway Mortality of Snakes in the Sonoran Desert of southern Arizona. *Biological Conservation* 68:143-148.

Rosentreter, R., M. Bowker, and J. Belnap

2007 A Field Guide to Biological Soil Crusts of Western U.S. Drylands. US Government Printing Office, Denver, CO.

Roth, D.

2001 Species Account for *Astragalus cutleri*. Navajo Natural Heritage Program. Window Rock, AZ.

2009 Copper Canyon Milk-vetch (*Astragalus cutleri*) – Status and Monitoring Report 2009. Navajo Natural Heritage Program, Department of Fish & Wildlife, Window Rock, Arizona.

The Royal Society for the Protection of Birds (RSPB)

2009 Bird guide: Golden eagle. Last published 23 October 2009. Available online at: http://www.rspb.org.uk/wildlife/birdguide/name/g/goldeneagle/threatsand_conservation_action.aspx.

Rudolph, D.C.

2000 An Overview of the Impact of Roads on Amphibians and Reptiles. Pages 143-159 *in* T.A. Messmer and B. West eds. Wildlife and Highways: Seeking Solutions to an Ecological and Socio-Economic Dilemma. Cited by Allison Clark in *Effects of Roads and Off-Road Vehicles on Reptile Populations*, Road RIPorter 10(2), Summer Solstice 2005. Accessed online at http://www.wildlandscpr.org/biblio-notes/effects-roads-and-off-road-vehicles-reptile-populations on 15 December 2010.

Sampson, M. P.

2007 "The Effects of Off-Highway Vehicles on Archaeological Sites and Selected Natural Resources of Red Rock Canyon State Park." California State Parks.

2009 The Effects of Off-Highway Vehicles on the Cultural Resources of Red Rock Canyon State Park, California. In *Proceedings of the Society for California Archaeology*, Vol. 21, pp. 190-201.

San Diego Natural History Museum (SDNHM)

n.d. Field Guide – *Sauromalus ater*, Common Chuckwalla. Available online at: http://www.sdnhm.org/fieldguide/herps/saur-ate.html.

Santucci, V.L.

1998 The Yellowstone Paleontological Survey, published in electronic format by Yellowstone Center for Resources, National Park Service [http://www2.nature.nps.gov/grd/geology/paleo/surveys/yell_survey/index.htm].

Santucci, V., J. Kenworthy and A. Mims

2009 Monitoring In Situ Paleontological Resources. Geological Monitoring. Rob Young and Lisa Norby (eds.) The Geological Society of America. 2009.

Schiffman, L.

2005 Archaeology, Off-road vehicles, and the BLM. Archaeology Institute of America. [Online] http://archaeology.org/online/features/southwest/ [Last Accessed: November 26, 2008].

Schmidt, W.

1989 Plant dispersal by motor cars. *Vegetation* 80: 147–152.

Schneider, I. and T. Schoenecker

2006 All-Terrain Vehicles in Minnesota: Economic Impact and Consumer Profile. University of Minnesota Tourism Center, Saint-Paul, Minnesota. 9 pp.

Schubert, D.J. and J. Smith

2000 "The Impacts of Off-Road Vehicle Noise on Wildlife." *The Road-RI Porter* 5(1):12-14. January/February 2000. Available online at: http://www.wildlandscpr.org/files/uploads/RIPorter/rr_v5-1.pdf.

Shields, M.

2002 Brown Pelican (*Pelecanus occidentalis*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Accessed from the Birds of North America Online at: http://bna.birds.cornell.edu/bna/species/609. Accessed March 22, 2012.

Shipman, P.

1981 Spatial distribution of fossils in sediments, in Shipman, P., Life History of a Fossil, an introduction to taphonomy and paleoecology: Cambridge, Harvard University Press, pp 65–98.

Singer, F.J., V.C. Bleich, and M.A. Gudorf

2000 Restoration of bighorn sheep metapopulations in and near western national parks. *Restoration Ecology* 8:14-24.

Smiley, F.F., M.M. Vance, W.D. Bryce, G.M. Hayes

2010 *Glen Canyon National Recreation Area Grazing Allotments: Design for Archaeological Survey Part I.* Northern Arizona University, Archaeological Report 1325 submitted to the National Park Service Glen Canyon National Recreation Area under Colorado Plateau Cooperative Ecosystems Studies Unit Agreement No. H1200-09-0005.

Sowl, K. and R. Poetter

2004 Impact Analysis of Off-Road Vehicle Use for Subsistence Purposes on Refuge Lands and Resources Adjacent to the King Cove Access Project. Izembek National Wildlife Refuge. April 16, 2004. Available online at: http://izembek.fws.gov/pdf/impanalysis.pdf.

Spangler, J.D.

2006 Site Condition and Vandalism Assessment of Archaeological Sites, Lower and Middle Arch Canyon. Colorado Plateau Archaeological Alliance, Ogden, Utah.

Spence, J.R.

n.d. Inventory and Assessment of Natural Resources at the Lone Rock OHV Area, Glen Canyon NRA. Unpublished document on file at park.

1994 Characterization and Possible Origins of Isolated Douglas Fir Stands on the Colorado Plateau. Presented in Proceedings of the Workshop Climate Change in the Four Corners and Adjacent Regions: Implications for Environmental Restoration and Land Use Planning, September 12-14, 1994. Campbell College Center, Mesa State College, Grand Junction, Colorado.

1995 A survey and classification of the riparian vegetation in side canyons around Lake Powell, Glen Canyon NRA. Unpublished report, Resource Management Division, Glen Canyon NRA. 89pp.

1998 1994-1997 Lake Powell Winter Aquatic Bird Surveys, Glen Canyon National Recreation Area, Utah and Arizona. Unpublished report, Resource Management Division, Glen Canyon National Recreation Area. 39 pp.

2002 Inventory and Assessment of Natural Resources at the Lone Rock OHV Area, Glen Canyon NRA. Unpublished document on file at park.

2012a Special-Status Species and Communities of Glen Canyon National Recreation Area. National Park Service, Science & Resource Management Division, Glen Canyon National Recreation Area, Page, Arizona. January 4, 2012.

2012b Personal communication via email with Julia Yuan and Lia Jenkins, The Louis Berger Group, Inc., regarding special-status species within Glen Canyon, including a table indicating species to be analyzed in chapter 4. February 10, 2012.

Spence, J.R. and B.R. Bobowski

2003 1994-1997 Water Bird Surveys of Lake Powell, A Large Oligotrophic Reservoir on the Colorado River, Utah and Arizona. *Western Birds* 34:133 – 148.

Spence, J.R., C.T. LaRue, and J.D. Grahame

2011 Birds of Glen Canyon National Recreation Area, Utah and Arizona. *Monographs of the Western North American Naturalist* 5:20-70.

Sprinkel, D.A., T.C. Chidsey, P.B. Anderson

2000 Geology of Utah's Parks and Monuments. *Utah Geological Association Publication* 28. Salt Lake City, Utah. pp 300-335.

State Journal-Register

2010 Street-legal golf carts, ATVs in works in Williamsville. http://www.sj-r.com/top-stories/x1173970403/Street-legal-golf-carts-ATVs-in-works-in-Williamsville. Accessed August 1, 2012.

Stolen, E.D.

2003 The Effects of Vehicle Passage on Foraging Behavior of Wading Birds. *Waterbirds* 26(4): 429-436, 2003.

Stynes, D.J.

2000 Economic Impacts of Michigan Spending on ORV Trail Riding Trips. East Lansing, MI: Department of Park, Recreation and Tourism Resources, Michigan State University.

2011 Economic Benefits to Local Communities from National Park Visitation and Payroll, 2009. Department of Community, Agriculture, Recreation and Resource Studies. Michigan State University. National Park Service Social Science Program. Published: January 2011.

Sucec, R.J.

1996 Ethnographic Resource Inventory and Assessment for the Burr Trail, Capitol Reef National Park, Utah and Glen Canyon National Recreation Area. National Park Service, Rocky Mountain Regional Office, Denver Colorado.

2012 *Cultural Landscapes, Historic/Prehistoric Structures, and Ethnographic Resources for ORV EIS Consideration*. Manuscript on file at LBG office.

2013 Personal Communication on 5th Internal Draft EIS.

Sweatland, B.

2010a Personal communication via email with Lia Peckman. The Louis Berger Group. Subject: Species List for Biological Assessment/ORV EIS, 23 February 2010.

2010b Email message from Brian Sweatland, Chief of Planning and Compliance, to Megan Blue-Sky, Louis Berger Group Environmental Scientist, February 5, 2010, regarding safety within the area.

Sweatland, B. and J. Spence

2009 Literature Review Off-road Vehicles and the Desert Landscapes. Draft copy provided by Glen Canyon National Recreation Area.

Switalski, A. and A. Jones

2010 "Off-Road Vehicle Impacts on Wildlife." *The Road RIPorter* 15.1 Spring Equinox 2010. March 24, 2010. Available online at: http://www.wildlandscpr.org/biblio-notes/off-road-vehicle-impacts-wildlife. Accessed 25 January 2011.

Switalski, T.A. and A. Jones, eds

2008 Best Management Practices for Off-road Vehicle Use on Forestlands: A Guide for Designating and Managing Off-road Vehicle Routes. Prepared by: Wild Utah Project and Wildlands CPR. January 2008.

Taylor, D.M.

1986 Effects of Cattle Grazing on Passerine Birds Nesting in Riparian Habitat. *Journal of Range Management* 39(3):254-258.

Taylor, R. B.

n.d. The effects of off-road vehicles on ecosystems. Retrieved March 27, 2006, from the Texas Parks and Wildlife Department Web site: http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_rp_t3200_1081.pdf

Tesky, J.L.

1994 *Ostrya knowltonii*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Accessed at: http://www.fs.fed.us/database/feis/plants/tree/ostkno/all.html.

Texas Parks and Wildlife Department (TPWD)

2009 Long-billed Curlew (*Numenius americanus*). Last updated 2 June 2009. Available online at: http://www.tpwd.state.tx.us/huntwild/wild/species/curlew/.

The Louis Berger Group

2009 Economic Contribution of Off-Highway Vehicle Recreation in Colorado. The Louis Berger Group, Inc., prepared for the Colorado Off-Highway Vehicle Coalition. 27 pp. Executive summary available online: http://cohvco.org/wp/wp-content/uploads/2009/10/2009-EXEC-SUMMARY.pdf.

Tipps, B.L.

1987 Archaeological Investigations in the Lone Rock and Wahweap Development Areas Glen Canyon National Recreation Area, Near Page, Arizona. Midwest Archaeological Center, Occasional Studies in Archaeology No. 21. USDOI-NPS, Lincoln, Nebraska.

Trombulak, S C. and C.A. Frissell

2000 Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. *Conservation Biology*, 14: pp 18–30.

Tuhy, J.S., and J.A. MacMahon

1988 Vegetation and Relict Communities of Glen Canyon National Recreation Area, Final Report for Contract CX1200-6-B076. The Nature Conservancy and Department of Biology and Ecology Center, Utah State University. Wellsville, UT and Logan, UT.

Tuttle, M. and G. Griggs

1987 Soil Erosion and Management Recommendations at Three State Vehicular Recreation Areas, California. *Environmental Geol Water Sci* 10:2 pp 111-123.

U.S. Census Bureau

2000 Table 1. Land Area, Population, and Density for States and Counties: 1990. Released 1996, Updated 2000. Accessed online, January 27, 2010. Available: http://www.census.gov/population/censusdata/90den_stco.txt.

2008 Annual Estimates of the Population of Metropolitan and Micropolitan Statistical Areas: April 1, 2000 to July 1, 2008 (CBSA-EST2008-01). Accessed online, February 3, 2010. Available: http://www.census.gov/popest/metro/tables/2008/CBSA-EST2008-01.xls.

2010a Arizona Population Estimates, Incorporated Places and Minor Civil Divisions: 2000 to 2008. Accessed online, January 26, 2010. Available: http://www.census.gov/popest/cities/SUB-EST2008-states.html.

2010b Utah Population Estimates, Incorporated Places and Minor Civil Divisions: 2000 to 2008. Accessed online, January 26, 2010. Available: http://www.census.gov/popest/cities/SUB-EST2008-states.html.

2010c County Population, Population Change and Estimated Components of Population Change: April 1, 2000 to July 1, 2008 (CO-EST2008-alldata). Accessed online, January 22, 2010. Available: http://www.census.gov/popest/counties/files/CO-EST2008-ALLDATA.csv.

2010d American Factfinder. Decennial Census. Census 2000 Summary File SF3. United States. Arizona. Coconino County. Utah. Garfield County. Kane County. Iron County. San Juan County. Sevier County. Washington County. Wayne County. P1. Total Population. P3. Race. P7. Hispanic or Latino by Race. P87. Poverty Status in 1999 by Age. Accessed online, January 22, 2010. Available: http://factfinder.census.gov/.

2010e Cumulative Estimates of Resident Population Change for the United States, Regions, States, and Puerto Rico and Region and State Rankings: April 1, 2000 to July 1, 2009. Accessed online, January 25, 2010. Available: http://www.census.gov/popest/states/NST-pop-chg.html.

2010f American Factfinder. Decennial Census. Census 2000 American Indian And Alaska Native Summary File (AIANSF) - Sample Data. United States. Navajo Nation Reservation and Off-Reservation Trust Land, AZ--NM--UT. PCT1. Total Population [1] - Universe: Total population. Accessed online, November 16, 2010. Available: http://factfinder.census.gov/.

2010g Fact Sheet, Page, Arizona, 2000. Accessed online, February 1, 2010. Available: http://factfinder.census.gov.

2011 2006 to 2010 American Community Survey. Population and Labor Force. Accessed December 12, 2011. Available: http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=geo&refresh=t.

U.S. Department of Agriculture (USDA)

n.d. Plants Database. Natural Resources Conservation Service. Available online at: http://plants.usda.gov.

2011 Plant Guide – Navajo Sedge. United States Department of Agriculture, Natural Resources Conservation Service, Idaho. Available online at: ftp://199.141.121.35/ID/programs/plant/sedge_navajo.pdf. Accessed 4 February 2011.

U.S. Department of Interior, Bureau of Land Management (USDOI-BLM)

2011 Programmatic Environmental Assessment for Organized Group Activities along Hole-in-the-Rock Road. Grand Staircase Escalante National Monument, Kanab, Utah.

U.S. Environmental Protection Agency (EPA)

1998 Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses. April. Accessed from: http://www.epa.gov/compliance/resources/policies/ej/index.html on Aug. 25, 2011.

U.S. Fish and Wildlife Service (USFWS)

1985 Brady Pincushion Cactus (*Pediocactus bradyi*) Recovery Plan. USFWS, Albuquerque, NM.

1987 Navajo Sedge (*Carex speculcola*) Recovery Plan. USFWS, Albuquerque, New Mexico.

1995 Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*). Volume I. USFWS, Southwestern Region. December 1995.

1996 Recovery Plan for the California Condor. USFWS, Pacific Region. April 1996.

2000 Jones' Cycladenia. Arizona Ecological Services Field Office. June 2000. Available online at: http://www.fws.gov/southwest/es/arizona/Jones.htm.

2002a Final Recovery Plan, Southwestern Willow Flycatcher (*Empidonax traillii extimus*). August 2002. Prepared by Southwestern Willow Flycatcher Recovery Team, Technical Subgroup. For Region 2, USFWS, Albuquerque, NM.

2002b Brady Pincushion Cactus (*Pediocactus bradyi*). Arizona Ecological Services Field Office. September 2002. Available online at: http://www.fws.gov/southwest/es/arizona/Documents/Redbook/BradyPincushionRB.pdf.

2004 Final Designation of Critical Habitat for the Mexican Spotted Owl. Federal Register, August 31, 2004, 50 CFR 17.

2008 Recovery Outline for the Jones Cycladenia (*Cycladenia humilis* var. *jonesii*). December 2008.

2011 Peninsular bighorn sheep (*Ovis canadensis nelsoni*). 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California. April 21, 2011.

U.S. Geological Service (USGS)

2003 *Xantusia vigilis*, Desert Night Lizard. Western Ecological Research Center, USGS. Available online at: http://www.werc.usgs.gov/fieldguide/xavi.htm.

University of Idaho

2008 *Glen canyon National Recreation Area Visitor Study, Spring and Summer 2007*. Park Studies Unit. Visitor Services Project. Report 186.

Utah Department of Natural Resources (DNR), Division of Wildlife Resources

n.d.a Wildlife Fact Sheet. Wildlife Notebook Series No. 9. Division of Wildlife Resources. Available online at: http://wildlife.utah.gov/publications/notebook.php.

n.d.b Species profile. State of Utah Natural Resources, Division of Wildlife Resources. Accessed online at http://dwrcdc.nr.utah.gov/rsgis2/.

n.d.c Bald Eagle. Species profile. State of Utah Natural Resources, Division of Wildlife Resources. Accessed online at http://dwrcdc.nr.utah.gov/rsgis2/Search/Display.asp?FlNm=halileuc, on February 13, 2012.

n.d.d American White Pelican. Species profile. State of Utah Natural Resources, Division of Wildlife Resources. Accessed online at http://dwrcdc.nr.utah.gov/rsgis2/Search/Display.asp?FlNm=peleeryt, on February 14, 2012.

n.d.e Great Blue Heron. Species profile. State of Utah Natural Resources, Division of Wildlife Resources. Accessed online at: http://dwrcdc.nr.utah.gov/rsgis2/Search/Display.asp?FlNm=ardehero, on February 14, 2012.

2009 Utah Pronghorn Statewide Management Plan. Approved January 8, 2009

2011 Utah Sensitive Species List. March 29, 2011. State of Utah Department of Natural Resources, Division of Wildlife Resources. Available online at: http://dwrcdc.nr.utah.gov/ucdc/ViewReports/SSLAppendices20110329.pdf. Accessed February 13, 2012.

Utah Governor's Office of Planning and Budget

2008 Baseline Projections. Accessed online, February 2, 2010. Available: http://www.governor.utah.gov/DEA/ERG/ERG2008/ProjectionSummary.xls.

Utah Native Plant Society (UNPS)

2009 Utah Rare Plant Guide – Species Descriptions. Available online at: http://www.utahrareplants.org/rpg_species.html. Last updated 1 November 2009.

Utah Navajo Industries

1986 Paiute Farms/San Juan Marina Development Concept Plan Environmental Assessment. Final, May 1986.

Utah Office of Tourism

2006 2006 State and County Economic and Travel Indicator Profiles. Utah Governor's Office of Economic Development, Utah Office of Tourism, Salt Lake City, Utah. 112 pp.

Utah State Parks

2004 "Utah State Parks, Health Departments Work to Reduce ATV Injuries and Deaths." May 11, 2004.

Utah State Parks and Recreation

n.d. *Utah Off-Highway Vehicle Program Brochure*.

2012 Email correspondence between Lindsay Gillham and OHVeducation@utah.org. number of registered OHVs in 4 Utah counties. Email on 2/17/2012.

Utah State University Cooperative Extension (Utah State University)

2013 Douglas fir. Accessed at: http://extension.usu.edu/rangeplants/htm/douglas-fir.

Vance, M.M.

2010 *Glen Canyon National Recreation Area Grazing Allotments: Design for Archaeological Survey Part II: Geographical Information Systems Analysis*. Northern Arizona University, Archaeological Report 1325 submitted to the National Park Service Glen Canyon National Recreation Area under Colorado Plateau Cooperative Ecosystems Studies Unit Agreement No. H1200-09-0005.

Vance, M. and C. Downum

2012 Archaeological Inventory of at Least One High-Priority Lake Powell Accessible Shoreline. Phase I Letter report dated January 15, 2012 to Rosemary Sucec, Chief of Cultural Resources, Glen Canyon National Recreation Area. Copy of letter report on file at LBG's Raleigh, North Carolina office.

2013 Archaeological Inventory of at Least One High-Priority Lake Powell Accessible Shoreline, Phase II. Letter report dated March 8, 2013 to Rosemary Sucec, Chief of Cultural Resources, Glen Canyon National Recreation Area. Copy of letter report on file at LBG's Raleigh, North Carolina office.

Vennesland, R.G. and R.W. Butler

2011 Great Blue Heron (Ardea herodias). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Accessed online at: http://bna.birds.cornell.edu/bna/species/025/articles/introduction. Accessed March 21, 2012.

Webb, C.

2011 City of Blanding. Personal Communication between Chris Dixon (LBG) and Chris Webb (City of Blanding, City Manager) on December 27, 2011 regarding major industries and businesses in Blanding, UT. Conversation via phone call. Phone Number: 435-678-2791 ext 302.

Webb R.H.

1982 Off Road Motorcycle Effects on Desert Soils. *Environmental Conservation*, 9:3 pp 197-208.

Webb R.H. and H.G. Wilshire

1983 Environmental Effects of Off-Road Vehicles: Impacts and Management in Arid Regions.

Wiggins, D.A.

2005. Pinyon Jay (*Gymnorhinus cyanocephalus*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/pinyonjay.pdf

Wine, Kori

2011 Town of Hanksville. Personal Communication between Chris Dixon (LBG) and Kori Wine (Town of Hanksvile, Town Clerk) on December 27, 2011 regarding major industries and businesses in Hanksville, UT. Conversation via phone call. Phone Number: 435-542-3451.

Winter, K and L. Hargrove.

2004. Gray Vireo (*Vireo vicinior*). In The Coastal Scrub and Chaparral Bird Conservation Plan: a strategy for protecting and managing coastal scrub and chaparral habitats and associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/htmldocs/scrub.html.

Winward, A.H.

1980 Taxonomy and Ecology of Sagebrush in Oregon. Station Bulletin No. 642, Oregon State University, Corvallis. 15 pp.

Wisconsin Department of Natural Resources

2011 Wisconsin All-Terrain Vehicle Laws.

Wisconsin Department of Transportation

2009 Transportation Synthesis Report: On-Road Operation of ATVs.

Wyle

2011 Lake Meredith National Recreation Area Acoustic Monitoring and Modeling of Off Road Vehicles. Prepared for NPS. February 2011 Draft.

GLOSSARY

accessible shoreline area (or ORV-accessible shoreline area; TBD)—Lake Powell shoreline areas where vehicle access is permitted.

aeolian—Pertain to the winds' ability to shape the surface of the Earth (commonly referred to as “wind erosion”)

aestivate—To pass the summer in a state of torpor; similar to hibernate (in winter).

all-terrain vehicle (ATV)—A nonconventional motor vehicle that is designed primarily for off-road use (falling under the broader term ORV) and that is not registered for interstate travel.

alluvial—A fine-grained fertile soil deposited by water flowing over flood plains or in river beds

alluvium—A deposit of sand, mud, etc., formed by flowing water. The sedimentary matter deposited especially in the valleys of large rivers.

arable—Land that can be or is cultivated. Land that is capable of producing crops; suitable for farming, suited to the plow.

A-weighted decibel—A-weighted decibels, abbreviated dBA, or dBa, or dB(a), are an expression of the relative loudness of sounds in air as perceived by the human ear.

biological crust (biotic crust)—Crust of soil particles bound together by organic material that are formed by living organisms and their by-products.

bovid—An animal related to or belonging to the *Bovidae*, a family of ruminant artiodactyls hollow-horned mammals including sheep, goats, cattle, antelopes, and buffalo.

candidate species—Those species being considered by the U.S. Fish and Wildlife Service for listing as threatened or endangered as published in the Federal Register.

chronometric dating—A dating method that provides an actual age in years for a defined piece of material or event.

clay barren—Areas characterized by bare clay with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the "green" vegetated categories; lichen cover may be extensive.

colluvial—A loose deposit of rock debris accumulated through the action of gravity at the base of a cliff or slope.

conservation agreement—Conservation measures for species that are proposed for listing, are candidates for listing, or are likely to become candidates in the near future.

conventional motor vehicle—Conventional motor vehicles are automobiles (i.e., jeeps, trucks, cars) and other vehicles that are licensed and registered for interstate travel.

coprolite—A stony mass consisting of fossilized fecal matter of animals.

decibel (dBA)—A unit of measure of sound intensity.

designated off-road vehicle (ORV) area—Areas in the recreation area where the public is allowed to leave the designated road and drive to Lake Powell's shoreline to fish, camp, picnic, boat, or engage in other recreational activities.

development concept plan (DCP)—Proposes a range of alternatives to provide for future visitor access at varying Lake Powell water levels and to address changes in visitor services, visitation levels, and visitor expectations. The plans also ensure the protection of park resources and values.

diurnal—Active by day.

endangered species—"…any species (including subspecies or qualifying distinct population segment) that is in danger of extinction throughout all or a significant portion of its range (ESA Section 3(6))." The lead federal agency, U.S. Fish and Wildlife Service, for the listing of a species as endangered is responsible for reviewing the status of the species on a five-year basis.

endemic—Native to or confined to a particular region.

environmental assessment (EA)—A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purposes and need for an action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

environmental impact statement (EIS)—A document prepared to analyze the impacts on the environment of a proposed project or action and released to the public for comment and review. EISs are prepared when there is the potential for major impacts on natural, cultural or socioeconomic resources. An EIS must meet the requirements of National Environmental Policy Act, Council on Environmental Quality, and the directives of the agency responsible for the proposed project or action.

fecundity—The ability to reproduce

finding of no significant impact (FONSI)—A document prepared by a federal agency showing why a proposed action would not have a significant impact on the environment and thus would not require preparation of an environmental impact statement. A FONSI is based on the results of an environmental assessment.

forb—Any herbaceous plant that is not a grass.

full pool—Term used to describe the water level of a reservoir at normal operating conditions.

hanging garden—Spring-fed colonies of plants found clinging to vertical cliff walls.

herbivore—An animal that eats a diet consisting primarily of plant material.

hibernation—An inactive state resembling deep sleep in which certain animals living in cold climates pass the winter. In hibernation, the body temperature is lowered and breathing and heart rates slow down. Hibernation protects the animal from cold and reduces the need to food during the season when food is scarce.

hydrologic cycle—The natural sequence through which water passes into the atmosphere as water vapor, precipitates to earth in liquid or solid form, and ultimately returns to the atmosphere through evaporation.

interfluve—The land area separating adjacent stream valleys.

off-highway vehicle (OHV)—Utah definition of OHV is any snowmobile, all-terrain Type I vehicle, all-terrain Type II vehicle, or motorcycle. Arizona definition of OHV is any vehicle operated on unimproved roads, trails and approved use areas not suitable for conventional two-wheel-drive vehicular travel. Examples include ATVs, trail motorcycles and dirt bikes. It does not apply to pickup trucks, SUVs, cars, and other recreational vehicles.

off-road vehicle (ORV)—A motorized vehicle (ATV or conventional) designed for or capable of cross-country travel on or immediately over natural terrain.

palimpsest— A collection of archaeological artifacts, ecofacts, and material that may not be related - that are together through accident or natural forces rather than human activity.

physical crust (nonbiotic crust)—Soil crusts that are primarily formed by raindrop impact, which breaks down the soil and fixes small-diameter silt and clay particles to the surface, creating strong, dense, soil layers ranging in thickness from 1 millimeter to 3 centimeters.

radiocarbon dating—A dating method that uses the naturally occurring radioisotope carbon-14 (^{14}C) to estimate the age of carbon-bearing materials up to about 58,000 to 62,000 years.

relict plant community—A plant community that once had a wider distribution but now only occurs in a localized area.

riparian—Relating to or living or located on the bank of a natural watercourse (as a river) or sometimes of a lake or a tidewater.

RS 2477 rights-of-way—Section 8 of the Mining Act of 1866 provided: "and be it further enacted, that the right-of-way for the construction of highways over public lands, not reserved for public uses, is hereby granted." The statute was self-enacting; rights being established by "construction" of a "highway" on unreserved public lands, without any form of acknowledgement or action by the Federal government. This section of the statute was later re-codified as Revised Statute 2477

sedentism—A way of life in which people remain settled in one place throughout the year.

spark arrester—A device used to stop or keep sparks from escaping.

special-status species—Plant and animal species federally or state listed as endangered or threatened, or otherwise judged to be in need of protection.

species of concern—Species for which credible scientific evidence exists to substantiate a threat to continued population viability.

street-legal ATV—An ATV that qualifies under the state's motor vehicle and traffic code to be operated on state roads and highways. Dune buggies, sand rails, go-karts, and rock crawlers cannot be licensed as street-legal.

threatened species—Any species that is likely to become endangered within the foreseeable future throughout all or a part of its range, as listed by the USFWS in the Federal Register.

torpor—A state of mental or physical inactivity or insensibility.

unpaved GMP roads—Unpaved GMP roads in Glen Canyon are open to travel by conventional motor vehicles and ATVs that meet the street-legal definition under Utah state motor vehicle and traffic code, currently described at UCA 41-6a-1509, "Street-legal all-terrain vehicle — Operation on highways — Registration and licensing requirements — Equipment requirements."

INDEX

accessible shorelines, 10, 18, 23, 29, 32, 46, 47, 63, 81, 82, 83, 84, 85, 214, 215, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 234, 235, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 262, 263, 265, 267, 268, 270, 272, 273, 282, 283, 286, 287, 289, 290, 291, 292, 293, 294, 297, 298, 300, 301, 305, 307, 308, 315, 321, 327, 333, 340, 343, 344, 346, 347, 348, 349, 350, 351, 352, 353, 355, 358, 359, 361, 362, 363, 364, 365, 366, 368, 374, 375, 378, 380, 383, 384, 385, 388, 390, 391, 392, 393, 394, 395, 397, 398, 399, 400, 402, 403, 404, 406, 408, 409, 413, 414, 421, 427, 433, 439, 446, 447, 448, 449, 456

adaptive management, 451

air quality, 18, 20, 41, 349, 356

alternatives, 1, 2, 5, 8, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 23, 24, 29, 30, 31, 32, 35, 36, 37, 38, 39, 40, 43, 44, 73, 74, 76, 77, 78, 79, 80, 87, 106, 111, 116, 185, 211, 213, 225, 228, 242, 243, 245, 253, 256, 259, 260, 266, 271, 273, 278, 288, 296, 297, 298, 301, 302, 303, 304, 305, 307, 339, 340, 352, 353, 354, 363, 366, 367, 368, 369, 371, 372, 384, 385, 386, 395, 396, 404, 406, 408, 411, 412, 413, 439, 445, 447, 448, 451, 452, 453, 454, 455, 456

ambient sound, 131, 137, 304

American Indian, 15, 19, 23, 183, 186, 187, 188, 222, 354, 355

archeological resources, 14, 19, 28, 31, 83, 91, 172, 174, 180, 183, 220, 354, 355, 356, 358, 359, 360, 362, 363, 364, 365, 366, 367, 368, 372, 446, 447, 448, 449

biological crust, 93, 94, 95, 96, 97, 232, 235

boating, 47, 141, 143, 144, 154, 168, 227, 230, 357, 375

camping, 9, 13, 33, 57, 63, 79, 95, 127, 130, 133, 141, 143, 144, 153, 154, 155, 160, 163, 164, 167, 168, 171, 182, 184, 261, 279, 343, 345, 346, 349, 357, 370, 372, 374, 375, 378, 380, 381, 382

Canyonlands (National Park), 18, 31, 87, 129, 131, 171, 209, 214, 216, 217, 219, 221, 222, 223, 225, 226, 236, 250, 265, 287, 344, 400, 457, 459

Colorado Plateau, 7, 8, 12, 87, 92, 94, 98, 104, 105, 106, 107, 108, 109, 117, 125, 126, 127, 129, 172, 174, 175, 203, 218, 229, 232, 288, 397, 457

Colorado River, 7, 15, 17, 87, 103, 108, 109, 110, 117, 118, 119, 120, 122, 124, 144, 153, 159, 160, 163, 164, 168, 171, 172, 173, 176, 177, 184, 204, 219, 226, 227, 228, 265, 266, 287, 288, 345, 369

consultation, 13, 15, 23, 43, 111, 116, 173, 178, 183, 184, 274, 354, 369, 372, 397, 451, 454, 455, 456, 457, 459

cost, 196, 347, 348, 349, 379, 380

critical habitat, 27, 120, 125, 129, 218, 218, 229, 266, 274, 283, 284, 288, 298

cultural resources, 2, 14, 15, 19, 24, 26, 28, 30, 32, 37, 42, 76, 77, 87, 172, 174, 183, 213, 225, 342, 354, 355, 356, 357, 368, 371, 448, 455, 462, 464, 465

cumulative impacts, 211, 213, 214, 225, 236, 238, 240, 241, 242, 249, 251, 252, 254, 255, 257, 264, 267, 268, 269, 270, 271, 272, 273, 286, 289, 292, 295, 299, 301, 305, 308, 309, 310, 313, 315, 316, 319, 322, 325, 327, 331, 334, 337, 340, 344, 345, 347, 348, 350, 351, 360, 361, 364, 366, 367, 370, 371, 376, 377, 379, 381, 383, 384, 389, 390, 391, 393, 394, 395, 400, 401, 403, 404, 405, 413, 415, 419, 421, 425, 428, 431, 433, 434, 437, 440, 443

dinosaur, 200, 204, 206, 397, 398, 406, 407, 409

education, 11, 17, 24, 39, 40, 41, 42, 46, 58, 64, 68, 77, 199, 201, 239, 240, 242, 252, 253, 254, 255, 256, 268, 269, 270, 271, 272, 292, 294, 296, 297, 300, 362, 379, 380, 387, 391, 396, 401, 403, 464

elements common to all alternatives, 36

enabling legislation, 2, 7, 8, 10, 28, 30, 31, 32, 79, 216, 226, 264, 286

Endangered Species Act, 13, 27, 110, 122, 129, 213, 229, 274, 454

endangered species, 13, 27, 110, 122, 125, 129, 199, 201, 213, 229, 274, 454

environmentally preferable alternative, 35, 79

ethnographic resources, 14, 15, 28, 84, 172, 183, 184, 221, 222, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 446, 447, 448, 449

fishing, 47, 141, 144, 154, 164, 168, 191, 343, 345, 349, 375, 380, 382

four corners, 98, 189

Glen Canyon Dam, 7, 8, 14, 87, 91, 103, 110, 118, 122, 123, 124, 144, 153, 163, 167, 173, 176, 177, 186, 188, 189, 214, 215, 217, 219, 220, 221, 223, 227, 228, 230, 250, 266, 288, 345, 459

GMP roads, 2, 9, 10, 15, 16, 17, 18, 20, 35, 37, 38, 44, 45, 48, 53, 57, 63, 67, 73, 74, 75, 77, 78, 79, 81, 82, 83, 84, 85, 88, 96, 106, 111, 142, 144, 154, 159, 164, 171, 172, 179, 182, 183, 209, 212, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 235, 237, 239, 241, 242, 244, 249, 252, 253, 254, 255, 256, 257, 258, 263, 267, 269, 271, 272, 273, 284, 285, 291, 294, 298, 299, 301, 304, 305, 307, 308, 315, 316, 321, 327, 333, 339, 340, 343, 346, 348, 349, 351, 352, 353, 355, 357, 359, 360, 361, 363, 365, 367, 368, 369, 370, 371, 375, 376, 379, 380, 382, 384, 385, 388, 389, 390, 392, 394, 395, 396, 399, 401, 402, 403, 405, 406, 408, 409, 412, 413, 414, 421, 427, 433, 434, 439, 445, 446, 447, 448

health and safety, 16, 30, 37, 77, 84, 87, 197, 222, 386, 388, 389, 390, 391, 392, 393, 394, 395, 396, 446, 447, 448, 464

hiking, 141, 143, 156, 159, 164, 199, 227, 230, 266, 288, 343, 346, 348, 357, 380

impairment, 26, 32

Lake Powell, 7, 8, 9, 14, 15, 17, 22, 29, 32, 36, 46, 47, 87, 88, 91, 94, 103, 107, 108, 109, 110, 113, 116, 118, 119, 121, 122, 123, 124, 129, 132, 133, 140, 141, 143, 144, 153, 154, 160, 163, 164, 167, 168, 172, 173, 181, 184, 186, 188, 189, 200, 201, 203, 204, 205, 206, 209, 222, 225, 227, 230, 231, 234, 245, 248, 250, 259, 262, 263, 265, 266, 273, 282, 284, 285, 287, 288, 295, 309, 343, 346, 349, 357, 362, 365, 366, 375, 382, 396, 397, 398, 409, 414, 446, 447, 448, 449, 461

Lone Rock Beach, 8, 9, 10, 15, 18, 23, 29, 32, 35, 39, 44, 46, 47, 48, 53, 57, 58, 63, 64, 67, 68, 77, 78, 79, 81, 82, 83, 84, 85, 95, 106, 110, 121, 132, 143, 144, 154, 155, 178, 180, 183, 199, 201, 212, 214, 215, 216, 217, 218, 219, 220, 222, 223, 225, 226, 233, 237, 238, 239, 240, 241, 245, 247, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 261, 262, 264, 265, 267, 268, 270, 271, 273, 279, 280, 281, 282, 284, 286, 287, 289, 290, 292, 296, 297, 299, 300, 301, 305, 307, 315, 321, 327, 333, 339, 340, 341, 342, 343, 344, 345, 347, 349, 350, 352, 353, 355, 358, 360, 361, 362, 363, 364, 365, 366, 367, 368, 374, 377, 378, 379, 380, 381, 382, 383, 384, 385, 387, 388, 390, 391, 392, 393, 394, 395, 396, 397, 398, 400, 401, 403, 404, 406, 408, 413, 414, 421, 427, 433, 439, 446, 447, 448, 449

management action, 1, 13, 14, 21, 29, 30, 31, 35, 36, 37, 40, 41, 43, 47, 63, 73, 77, 79, 82, 87, 122, 197, 212, 228, 235, 248, 259, 260, 263, 274, 275, 282, 301, 305, 307, 343, 354, 359, 375, 388, 399, 411, 413, 451

management zone (zoning), 28, 36, 75, 87, 88, 91, 265, 287, 340, 341, 353, 360

Mexican spotted owl, 13, 112, 120, 129, 218, 229, 266, 276, 280, 283, 284, 286, 288, 291, 294, 295, 297, 298

mitigation, 239, 240, 241, 242, 252, 253, 254, 255, 256, 266, 286, 288, 302, 304, 316, 334, 340, 354, 356, 359, 361, 363, 364, 365, 366, 367, 371, 391, 392, 393, 395, 396, 401, 402, 403, 404, 412, 415, 427, 428, 439, 447, 448, 451

monitoring, 17, 18, 24, 40, 41, 42, 43, 58, 64, 68, 76, 77, 78, 79, 125, 132, 133, 199, 201, 302, 303, 304, 308, 362, 365, 366, 391, 396, 410, 412

National Register of Historic Places, 14, 15, 19, 26, 42, 43, 84, 159, 173, 178, 180, 181, 182, 183, 18, 213, 354, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 369, 371, 372

Native American, 31, 173, 174, 175, 176, 177, 183, 355, 369, 455, 460

Navajo Nation, 7, 9, 15, 30, 87, 125, 160, 163, 176, 183, 184, 205, 225, 455, 458, 460

noise, 13, 24, 39, 57, 63, 67, 82, 83, 85, 107, 109, 119, 120, 121, 130, 131, 139, 140, 218, 229, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 278, 279, 280, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 300, 301, 303, 304, 305, 306, 307, 308, 309, 315, 321, 327, 333, 339, 340, 341, 342, 343, 344, 346, 347, 348, 349, 350, 351, 352, 411, 412, 413, 414, 415, 421, 427, 428, 433, 439, 440, 445, 446, 447, 448

off-highway vehicle (OHV), 1, 2, 5, 6, 10, 14, 18, 32, 35, 36, 38, 39, 40, 43, 44, 45, 46, 47, 48, 53, 57, 63, 67, 73, 76, 77, 78, 79, 81, 82, 83, 84, 85, 144, 145, 225, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 244, 245, 247, 249, 251, 252, 253, 254, 255, 256, 258, 259, 261, 262, 264, 265, 268, 269, 270, 271, 272, 273, 279, 281, 282, 285, 287, 292, 293, 294, 296, 299, 300, 301, 302, 303, 304, 305, 307, 308, 316, 321, 322, 327, 333, 334, 339, 340, 341, 342, 343, 344, 345, 347, 348, 349, 350, 351, 352, 353, 354, 358, 359, 360, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 374, 375, 376, 377, 378, 379, 380, 381, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 402, 403, 405, 408, 409, 412, 413, 415, 421, 427, 433, 439, 445, 446, 447, 448

Orange Cliffs, 31, 44, 45, 48, 53, 57, 67, 91, 92, 93, 104, 112, 113, 114, 115, 118, 120, 122, 124, 125, 126, 127, 128, 129, 142, 143, 163, 164, 168, 169, 171, 172, 178, 200, 209, 214, 216, 217, 218, 219, 221, 222, 223, 225, 226, 229, 235, 236, 237, 239, 242, 249, 250, 252, 253, 256, 263, 265, 267, 269, 272, 273, 283, 284, 287, 291, 294, 301, 302, 305, 308, 321, 340, 343, 344, 348, 351, 352, 353, 359, 363, 367, 369, 375, 380, 384, 388, 390, 392, 395, 399, 400, 401, 402, 405, 413, 427, 439, 447

Play Area, 10, 15, 18, 23, 32, 35, 39, 44, 46, 47, 53, 57, 58, 63, 64, 67, 68, 74, 78, 79, 81, 82, 83, 84, 85, 95, 106, 110, 121, 132, 144, 154, 178, 180, 183, 199, 201, 212, 214, 215, 216, 217, 219, 220, 222, 223, 226, 233, 234, 237, 238, 239, 240, 241, 245, 247, 250, 251, 252, 253, 254, 256, 257, 259, 261, 262, 265, 267, 268, 270, 271, 273, 279, 281, 282, 287, 290, 292, 297, 300, 301, 307, 315, 321, 327, 333, 339, 340, 341, 342, 343, 344, 345, 347, 349, 350, 352, 353, 355, 358, 361, 362, 363, 365, 366, 368, 374, 377, 378, 379, 380, 381, 382, 383, 384, 385, 387, 388, 390, 391, 392, 393, 394, 395, 396, 398, 400, 401, 403, 404, 406, 408, 413, 414, 421, 427, 433, 439, 446, 447, 448, 449

preferred alternative, 18, 30, 35, 79, 80, 227, 228

purpose and need, 11

restoration, 41, 42, 91, 230, 239, 241, 242, 245, 252, 254, 255, 256, 265, 287, 302, 303, 356, 360, 361, 365, 367, 368

safety, 6, 8, 9, 10, 16, 20, 24, 29, 33, 39, 41, 44, 48, 57, 58, 64, 67, 68, 74, 76, 77, 197, 213, 235, 248, 263, 265, 282, 287, 347, 359, 362, 366, 379, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 454, 460

San Juan River, 92, 97, 108, 109, 118, 120, 125, 160, 176, 226

scoping, 10, 11, 36, 38, 74, 75, 342, 412, 451, 452, 453, 454, 456

soils, 12, 17, 18, 41, 42, 76, 81, 87, 93, 94, 95, 96, 97, 98, 99, 103, 105, 106, 125, 126, 127, 128, 144, 159, 164, 171, 182, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 253, 254, 255, 256, 258, 259, 260, 264, 267, 272, 273, 278, 279, 285, 291, 294, 356, 357, 360, 361, 363, 364, 397, 399, 446, 447, 448, 449

soundscapes, 13, 76, 130, 132, 306, 310, 311, 313, 315, 317, 321, 323, 327, 329, 333, 335, 339, 341, 343, 344, 345, 449, 303, 307, 308, 309, 311, 313, 317, 319, 323, 325, 329, 331, 335, 337, 339, 340, 341, 445

terminology, 2, 130, 142

threatened species, 27, 120, 129, 213

U.S. Fish and Wildlife Service (USFWS), 13, 22, 110, 111, 116, 118, 119, 120, 121, 122, 124, 125, 129, 199, 229, 260, 266, 274, 288, 454, 459, 463

vegetation, 12, 17, 19, 21, 22, 24, 25, 27, 28, 40, 41, 42, 76, 79, 81, 82, 87, 93, 94, 95, 96, 97, 98, 101, 103, 104, 105, 106, 108, 109, 112, 113, 117, 118, 120, 124, 130, 131, 133, 144, 215, 232, 234, 237, 239, 240, 242, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 261, 264, 265, 266, 267, 272, 273, 274, 279, 281, 283, 285, 287, 288, 289, 290, 291, 294, 302, 360, 361, 362, 364, 365, 367, 368, 397, 411, 446, 447, 448, 449, 464, 465

visitation, 8, 23, 42, 83, 84, 140, 141, 143, 154, 160, 167, 168, 189, 195, 197, 225, 240, 242, 255, 256, 341, 343, 346, 349, 351, 352, 353, 367, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 402, 404

visitor experience, 11, 31, 41, 77, 83, 130, 167, 226, 303, 341, 342, 343, 344, 346, 347, 349, 352, 353, 410, 411, 448

water resources, 17, 88, 91, 230, 266, 286, 288

wilderness, 7, 8, 11, 17, 24, 27, 29, 32, 75, 76, 85, 87, 91, 129, 142, 144, 156, 209, 224, 263, 268, 269, 343, 344, 410, 411, 412, 413, 414, 415, 417, 419, 421, 423, 425, 427, 428, 429, 431, 433, 435, 437, 439, 440, 441, 443, 445, 446, 447, 448, 449, 452, 453, 456, 457, 458, 461, 463

wildlife, 12, 13, 24, 25, 27, 41, 76, 82, 87, 96, 98, 106, 109, 111, 117, 119, 120, 121, 123, 130, 199, 216, 229, 231, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 278, 279, 280, 281, 282, 284, 285, 286, 287, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 306, 307, 308, 315, 321, 322, 333, 339, 341, 356, 446, 447, 448, 449, 460, 461, 464, 465