Exhibit 3.14 – *Land Use and Land Cover*

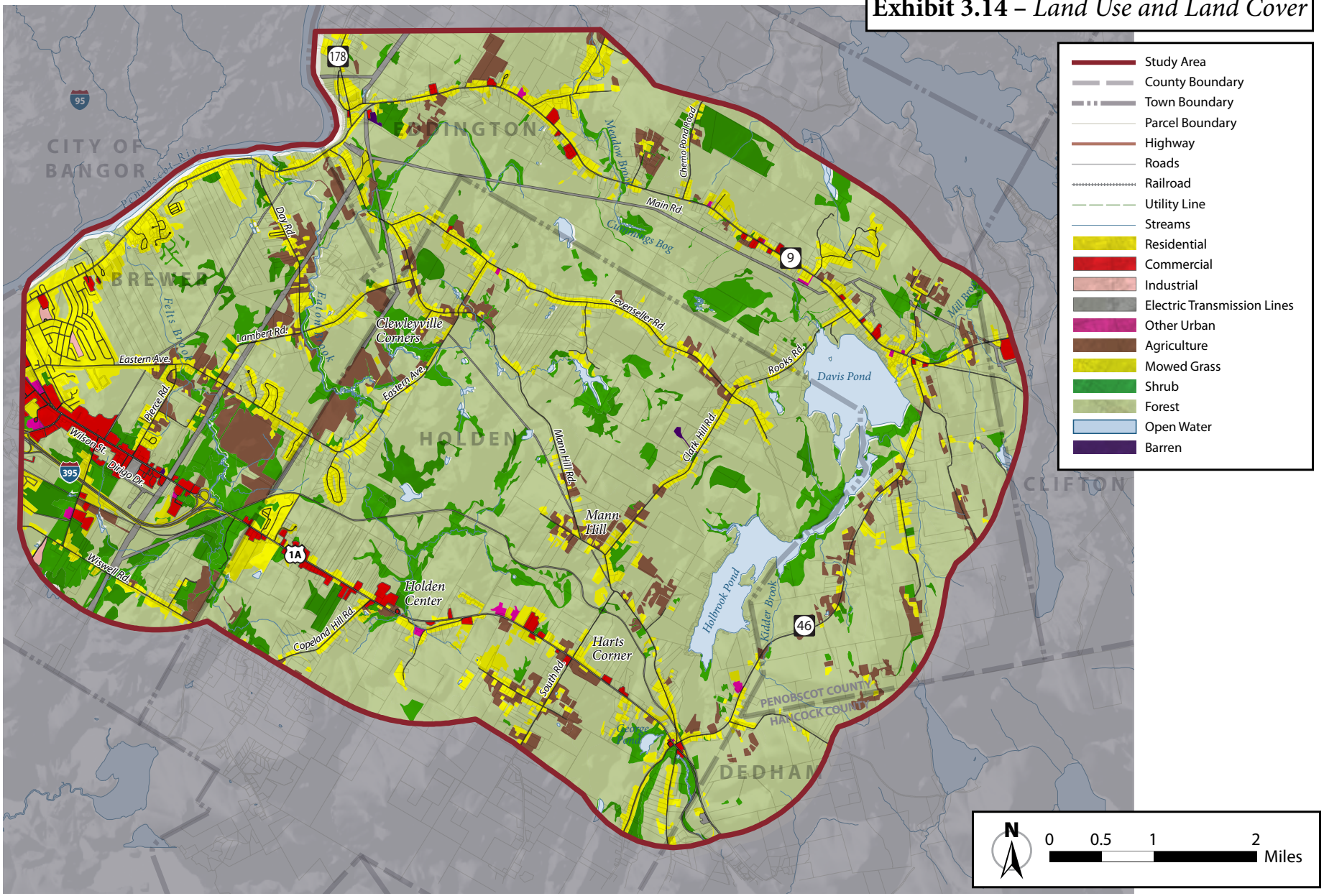


Exhibit 3.15 – *Impacts to Vegetation (acres/percent)*

Alternative	Agricultural	Grassland/ Mowed Grass	Shrub/ Dense Shrub	Deciduous Forest	Coniferous Forest	Mixed Forest	Total
No-Build							
2B-2/the Preferred Alternative	14	6	11	63	0[1]	8	102 (0.4%)
5A2B-2	15	7	29	69	0[1]	16	136 (0.5%)
5B2B-2	20	6	18	57	0	1	102 (0.4%)

Note: *[1] Impact less than a half-acre.*

bittersweet, Japanese knotweed, Norway maple, multiflora rose, and Morrow's honeysuckle.

3.1.4 Wildlife Habitats and Wildlife

Approximately 28,538 acres of the study area is wildlife habitat. These areas contain forests, grasslands, wetlands, and agricultural fields.

3.1.4.1 Wildlife Habitat

The State of Maine has identified key components of wildlife habitat in a program called "Beginning with Habitat," which is a habitat-based landscape approach to assessing wildlife and plant conservation needs and opportunities. It is a planning tool developed by state and nongovernmental natural-resource advocacy agencies to incorporate wildlife and wildlife habitat needs into state, municipal, and private development planning efforts. The goal of the program is to maintain sufficient habitat to support native plant and animal species that have much of their life history in Maine. The Beginning with Habitat program provides Maine municipalities with maps and information depicting and describing those habitats of statewide and national significance that are found in their town. The maps provide information to help guide conservation of habitats, which is the basis of habitat coordination and planning used by the MaineDOT. This information promotes conservation by stewardship and is not regulatory. The beginning with Habitat program allowed MaineDOT to minimize impacts to undeveloped habitat blocks.

Undeveloped habitat blocks are defined by the Beginning with Habitat program as blocks of wildlife habitat that are undeveloped, typically not affected by intense human development, more than 100 acres in size, and outside a 500-foot buffer from improved roads. Typically, there are few or no houses, businesses, or other human habitation. Because studies have demonstrated that edge effects are greatest in the first 160 to 650 feet from development, the Beginning with

Habitat buffer absorbs most of the effects on wildlife. Rounded shapes provide more interior habitat with a minimal amount of edge habitat; linear blocks provide more edge habitat.

Undeveloped habitat blocks are both linear and rounded in shape. The buffer considers the edge effect including the modified impact of predators. Edge habitat generally contains more species that could adversely affect interior species. For example, the animals that are attracted by edge are crows, blue jays, deer, and raccoons, among others, which can use a variety of habitats. Many of these animals prey on interior species. Species that require large forested blocks differ from those that require large grassland blocks.

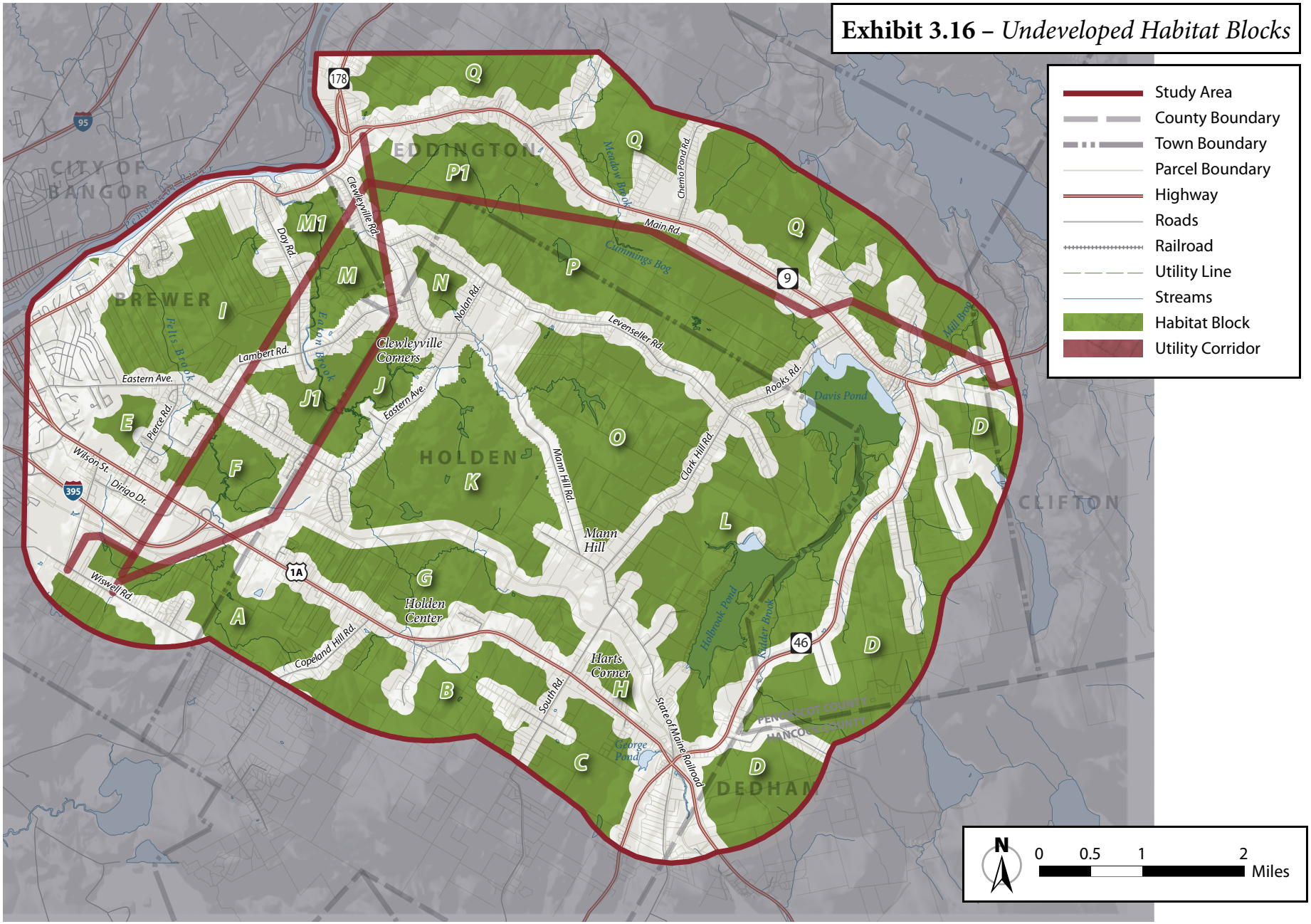
There are 20 blocks of undeveloped habitat in the study area according to the Beginning with Habitat program (exhibit 3.16). The undeveloped habitat blocks were analyzed with the two Bangor Hydro-Electric Company utility easements as features fragmenting habitat. Some of these blocks extend beyond the study area. The total acreage of undeveloped habitat blocks in their entirety is approximately 182,000. The 20 undeveloped habitat blocks range in size from 103 to 108,216 acres (exhibit 3.17). These undeveloped habitat blocks are located between roads that traverse the study area. Approximately 11 percent of the undeveloped habitat blocks are located in the study area; the remainder is portions of blocks that extend beyond the study-area limits.

Utility easements are linear features with vegetation that is periodically mowed, creating discontinuity with the natural vegetation in the area. Utility easements create tracts of edge habitat at the boundary between the vegetation in the easement and natural vegetation. Utility easements can inhibit the movement of small mammals, amphibians, and reptiles. Isolated populations of wildlife species are more vulnerable to crashes in populations from catastrophic events such as fire and disease and are liable to loss of genetic diversity (Strevens, 2007).

The undeveloped habitat blocks contain different habitat types within their boundary. The most abundant habitat cover is deciduous forest and mixed forest (exhibit 3.18 and 3.19).

The study area has an abundance of wildlife and a diverse range of habitats for this wildlife. This level of abundance and diversity has been supported by the large areas of forested and undeveloped land and the many riparian and wetlands habitats that link these larger areas. The Felts Brook and Eaton Brook watersheds are well forested and serve as riparian wildlife travel corridors (Beginning with Habitat, 2008). The predominant large-game wildlife species in the study area is the whitetail deer. Less prevalent but not uncommon are the black bear and moose, which most

Exhibit 3.16 – *Undeveloped Habitat Blocks*



Source: *Beginning with Habitat, 2008*

Exhibit 3.17 – *Undeveloped Habitat Block Sizes*

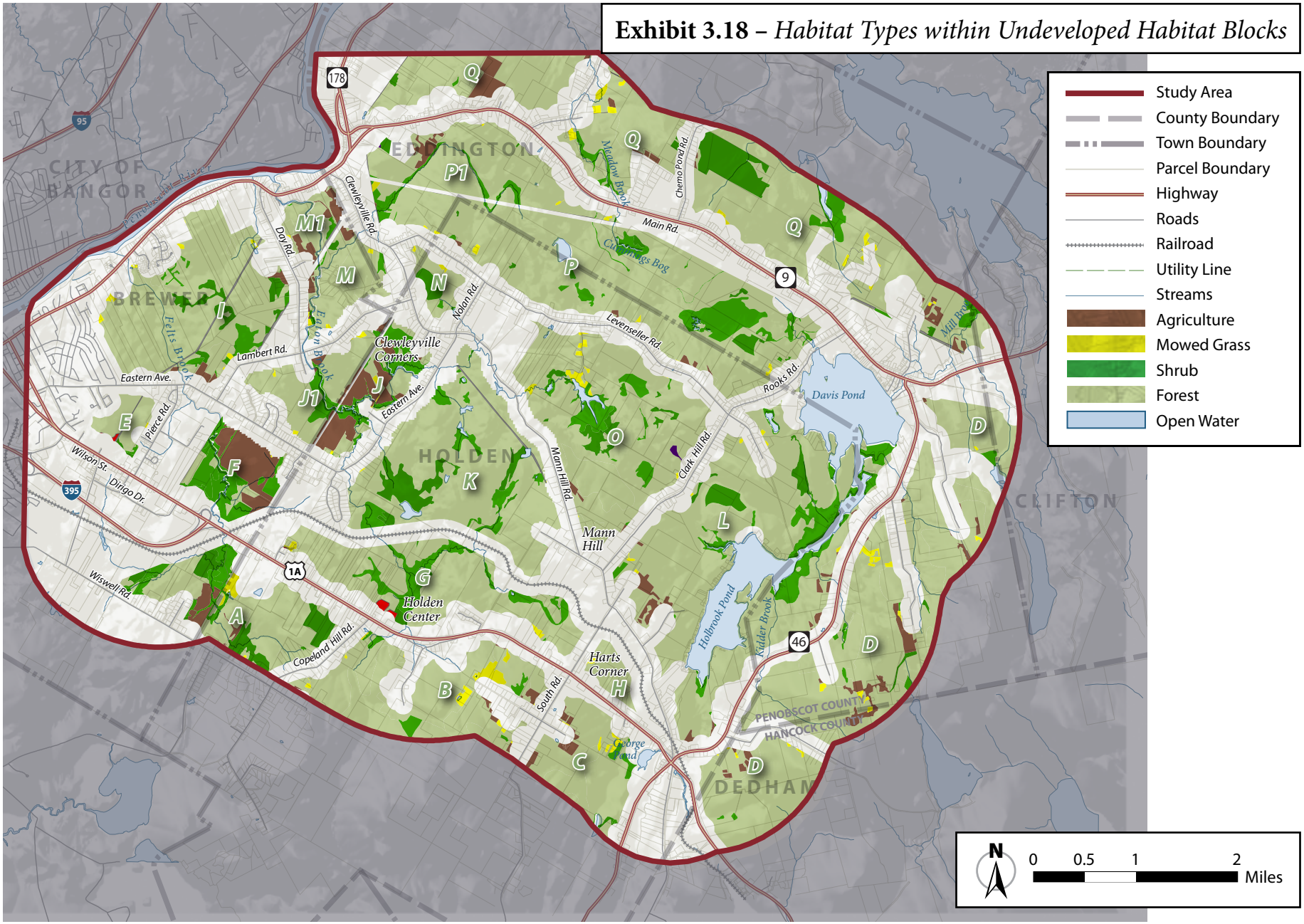
Block	Acres	Acres in Study Area	Percentage of Block in Study Area
A	719	719	100%
B	12,003	888	7.4%
C	1,362	501	36.8%
D	46,895	2,352	5.0%
E	117	117	100%
F	351	351	100%
G	890	890	100%
H	103	103	100%
I	1,194	1,194	100%
J	316	316	100%
J1	304	304	100%
K	1,459	1,459	100%
L	2,900	2,900	100%
M	291	291	100%
M1	157	157	100%
N	115	115	100%
O	1,471	1,471	100%
P	2,010	2,010	100%
P1	626	626	100%
Q	108,216	2,273	2.1%
Total	***181,510***	***19,037***	**-**

often can be seen near isolated bogs and marshes. Other frequently encountered species in the study area include ruffed grouse, snowshoe hare, gray squirrel, woodcock, blue-winged teal, wood duck, Canada goose, beaver, mink, river otter, and muskrat, great blue heron, and a wide variety of passerine bird species.

Some species of wildlife, called "area-sensitive," need large blocks of uninterrupted habitat. They are sensitive to human disturbance and are often preyed upon by species that are found on the edge of two different habitat types (exhibit 3.20). Other wildlife species need access to more than one habitat type to maintain a population. Enough habitat must be available for the minimum number of individuals of a given species to interbreed and maintain a healthy and genetically diverse population. Where habitat has been fragmented into smaller blocks, some animals would need to travel to other nearby habitat blocks to meet their life history requirements. Travel corridors provide habitat connections between fragmented blocks (Maine Audubon Society, 2000).

Power-line corridors can provide important breeding habitat for shrub-land birds. In a naturally forested landscape, power lines may be the only locations where birds that nest in shrub thickets occur. Species such as the common yellowthroat, indigo bunting, mourning warbler, prairie warbler, and chestnut-sided warbler may nest on power lines or gas easements if the landscape is otherwise forested. The vegetation along power lines typically supports a rich diversity of shrub-land birds because these birds depend on low shrub-land and vine tangles (DeGraaf and Yamasaki, 2001). However, these utility corridors likely displaced natural forest or other wildlife habitats and the bird species that depended on these habitats.

Exhibit 3.18 – *Habitat Types within Undeveloped Habitat Blocks*



Source: *Beginning with Habitat, 2008*

Exhibit 3.19 – *Habitat Types and Sizes within Undeveloped Habitat Blocks (acres)*

Habitat Block	Agriculture	Mowed Grass	Shrub	Dense Shrub	Deciduous Forest	Coniferous Forest	Mixed Forest	Open Water	Wetlands[1]
A	42	14	86	122	320	31	102	0.5	87
B	15	24	34	-	226	178	394	1	109
C	23	-	17	4	88	9	347	4	124
D	84	0.5	25	9	1,385	123	698	1	272
E	-	-	2	3	108	-	-		37
F	164	-	147	-	33	-	-	6	93
G	-	4	138	16	394	325	-	0.5	378
H	-	-	-	-	100		-		13
I	19	3	50	68	940	55	37	1	363
J	7	37		-	265	-	-	3	87
J1	108	2	93	-	93	-	-	7	107
K	-	-	104	132	1,187	-	-	25	472
L	49	-	230	72	1,797	-	7	740	1,767
M	11	0.5	6	2	89	23	151	5	147
M1	31	-	4	-	106	13	-	3	27
N	-	2	3	29		-	81		78
O	6	4	113	59	158	-	1,086	20	595
P	9	0.5	222	32	1,715	2	-	23	975
P1	23	-	31	7	562	-	-		97
Q	80	9	102	154	1,705	-	177	13	808

Notes:
[1] Wetlands are found within the other habitat types.

Impacts to wildlife and wildlife habitat result as follows:

- impacts from the roadway footprint, including the required clear zone adjacent to the road
- impacts to the integrity of large undeveloped forested areas
- impacts to animal passage and habitat connectivity
- increased wildlife mortality from vehicle strikes

Exhibit 3.20 – *Area-Sensitive[1] Forest and Grassland Birds Found in the Study Area*

Species	May Occur in Blocks <250 Acres	Occur in Blocks 250-500 Acres	Occur in Blocks 500-1,000 Acres	Occur in Blocks >1,000 Acres
Red-shouldered hawk			X	X
Pileated woodpecker[2]	X	X	X	X
Yellow-billed cuckoo[3]	X	X	X	X
Downy woodpecker[3]		X	X	X
Hairy woodpecker			X	X
Least flycatcher		X	X	X
Great crested flycatcher[2]	X	X	X	X
Tufted titmouse[2]	X	X	X	X
White-breasted nuthatch	X	X	X	X
Brown creeper[2]			X	X
Veery		X	X	X
Hermit thrush			X	X
Wood thrush			X	X
Gray catbird[3]	X	X	X	X
Red-eyed vireo[2]	X	X	X	X
Northern parula				X
Black-throated blue warbler				X
Black-throated green warbler[2]			X	X
Black-and-white warbler			X	X
American redstart		X	X	X
Ovenbird			X	X
Northern waterthrush			X	X
Canada warbler				X
Scarlet tanager		X	X	X
Rose-breasted grosbeak[2]	X	X	X	X

Note:
[1]Bird species that are uncommon in smaller forests or grasslands.
[2]Some studies did not classify these species as area-sensitive.
[3]Some studies classified these species as area-sensitive, but most did not. These are more likely not area-sensitive.
Source: *Maine Audubon Society, 2000.*

The No-Build Alternative would not result in additional impacts to wildlife and wildlife habitat.

The build alternatives would impact wildlife through the conversion of wildlife habitat to transportation use and the fragmentation of habitat into habitat blocks of smaller size. The build alternatives would impact 88 to 121 acres of wildlife habitat through conversion to transportation use (exhibit 3.15).

The build alternatives would be controlled-access highways with fencing along the limits of the land to be acquired and used for right-of-way. The build alternatives would impact wildlife through restricting their movement and degrading the habitat adjacent to the proposed rights-of-way of the build alternatives. Fencing along the rights-of-way of the build alternatives would reduce wildlife highway mortality but would not eliminate it.

Undeveloped habitat blocks consist of various habitat types that are home to species less tolerant or intolerant of disturbance and those that would use a mixture of habitats. These areas are larger than 100 acres in size and serve as habitat for animals that require a variety of habitat types during their lifespan. Animal passage and habitat connectivity within an undeveloped habitat block would be impacted by the placement of a build alternative.

The build alternatives would impact wildlife habitat through fragmentation, which is the subdivision of larger continuous tracts of habitat into smaller tracts. Fragmentation of habitat is detrimental to wildlife that requires large areas of undeveloped habitat, and it increases the potential for wildlife highway mortality.

Impacts to undeveloped habitat blocks more than 100 acres in size were evaluated. Because an undeveloped habitat block is defined as 500 feet from a public road or development, direct impacts include areas converted to and within 500 feet of transportation use. The Bangor Hydro-Electric Company utility easements were considered as features that fragment habitat but were not buffered by 500 feet because most of the two easements are vegetated with trees, shrubs, and grass that is mowed occasionally.

Impacts are considered minor when the reduction in areas is in a narrow or otherwise lower value portion of undeveloped habitat block. Impacts are considered moderate when the existing undeveloped habitat block is reduced in area but remains larger than 100 acres and is not bisected. Severe impacts occur when the existing undeveloped habitat block is bisected into smaller habitat areas with one or more remnants smaller than 100 acres in size (exhibit 3.21).

Although the build alternatives were designed to minimize impacts to undeveloped habitat blocks, they would fragment habitat into smaller tracts (exhibit 3.16). The impacts range from minor to severe. The coniferous and mixed forest areas provide some winter

Exhibit 3.21 – *Impacts to Undeveloped Habitat with Utility Easements as Fragmenting Features (acres)*

Alternative	A	F	I	J	M	M1	N	P	P1	Q	Total
	720	349	1,194	316	291	157	115	2,011	626	108,216	
No-Build											
Total impact											
Remnants after impact											
2B-2/the Preferred Alternative											
Total impact		148		316	2		115	62	183	3	829
Remnants after impact		203			289			141 1,808	443	108,213	
5A2B-2											
Total impact	130	69		316	2		115	62	183	3	880
Remnants after impact	590	280			289			141 1,808	443	108,213	
5B2B-2											
Total impact		134	58			47			270	3	512
Remnants after impact		102 116	1,136			110			158 198	108,213	

thermal cover for wildlife that would be reduced by the build alternatives. The diversity and quality of habitat adjacent to the right-of-way for the build alternatives would be reduced through the traffic operation and maintenance activities.

The build alternatives would have two wildlife passage structures, large enough to pass moose, on both sides of Eaton Brook.

3.1.4.2 Regulated Wildlife Habitat and Significant Habitats Protected under the NRPA

The Maine NRPA, administered by the MDEP, provides protection for certain natural resources, including significant wildlife habitats (38 MRSA 480B). Under the NRPA, habitats defined as "significant" and subject to protection include the following:

- habitat for federal- or state-listed endangered or threatened animal species
- high- and moderate-value deer-wintering areas and travel corridors

- critical spawning and nursery areas for Atlantic sea-run salmon, as defined by the Maine Atlantic Salmon Commission (MASC)

The following are further defined in Chapter 335 rules in 06 Code of Maine Rule 96:

- high- and moderate-value waterfowl and wading-bird habitats, including nesting and feeding areas
- shorebird nesting, feeding, and staging areas
- seabird nesting islands
- significant vernal pools

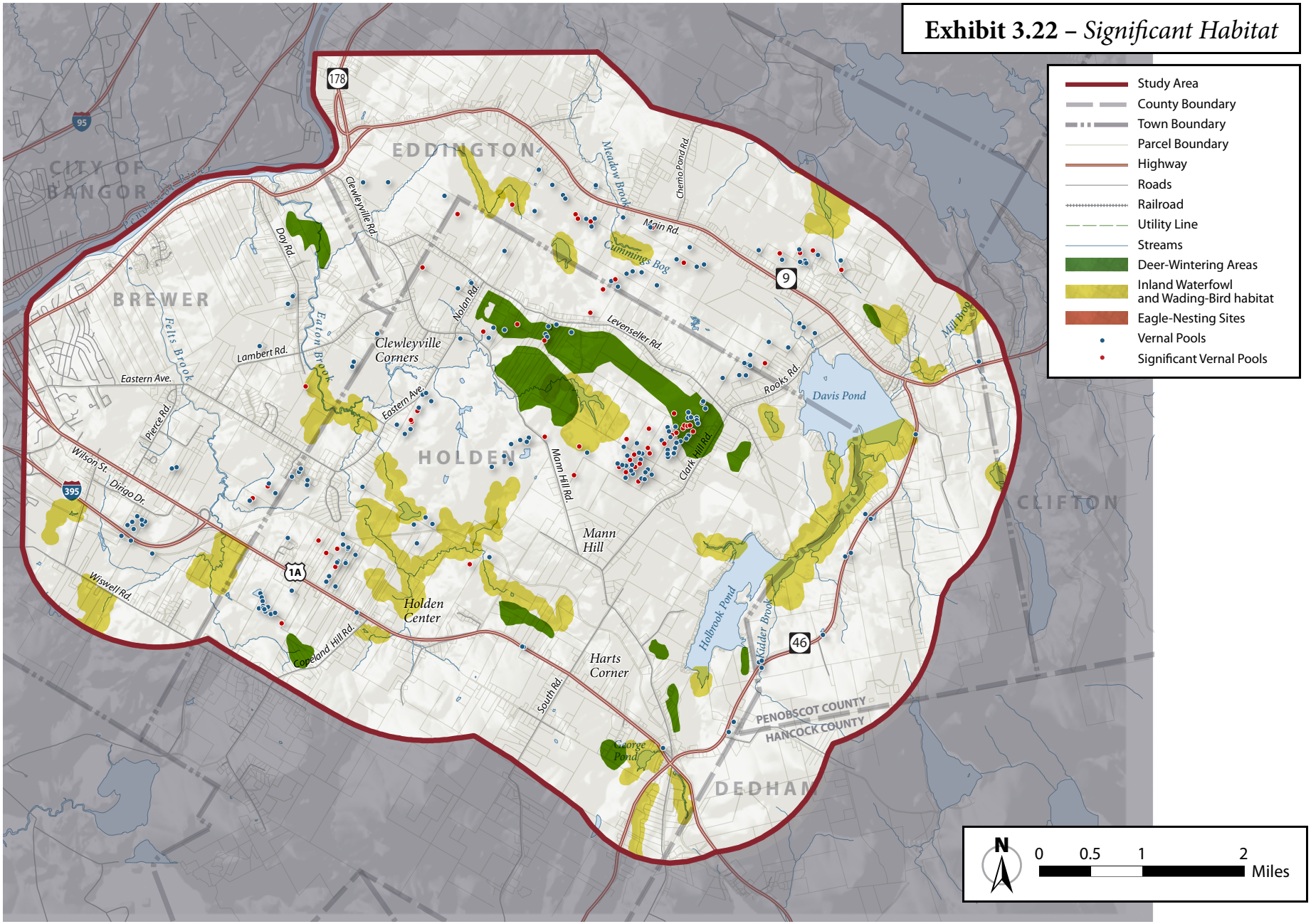
Under the NPRA, the Maine Department of Inland Fisheries and Wildlife (MDIFW) is responsible for defining the high- and moderate-value deer-wintering areas; waterfowl and wading-bird habitats; shorebird nesting, feeding, and staging areas; and seabird nesting islands.

The MDIFW was consulted regarding the presence of significant habitat areas in the study area. Deer-wintering areas and waterfowl and wading-bird habitats are present in the study area (exhibit 3.22). The MDIFW is responsible for identifying and mapping these significant wildlife habitat areas.

Deer-Wintering Areas. An area is considered a high- or moderate-value deer-wintering area (DWA) when:

- snow depth exceeds 12 inches in the open and in hardwoods
- deer sinking depth exceeds eight inches in the open and in hardwoods
- average daily temperature is below 32 degrees F, provided that:
  - » deer use is documented during a minimum of two years in the most recent 10-year period at the time of designation, including a ground survey
  - » the area excludes nonforested wetlands, agriculture, development, clearcuts, hardwood-forest types, and forest stands dominated by Eastern larch
  - » the area – through a combination of intensity of deer use, quality of softwood shelter, and area size – is rated high or moderate

Eleven DWAs totaling 1,051 acres exist in the study area (exhibit 3.22). DWAs, or deer "yards," are critical to the survival of deer over the winter months. The MDIFW identifies and defines DWAs as stands of mature conifers with a tree height greater than 30 feet and crown closure greater than 60 percent (Beginning with Habitat, 2008).



Note: *Only vernal pools near the corridors for alternatives were identified.*

Impacts to DWAs result from the following:

- conversion of one habitat type to another non-compatible use
- disturbance caused by development such as the introduction of a new roadway facility into or adjacent to a resource

The No-Build Alternative, Alternative 2B-2/the Preferred Alternative, and Alternative 5A2B-2 would not impact DWAs.

Alternative 5B2B-2 would impact three acres (0.3 percent) of DWAs (exhibit 3.23).

High- and Moderate-Value Inland Waterfowl and Wading-Bird Habitat. Waterfowl and wading birds are a diverse group of species that make considerable but not exclusive use of inland and coastal wetlands. The high- and moderate-value inland waterfowl and wading-bird significant habitat areas are used by waterfowl, members of the family *Anatidae* including brant, wild ducks, geese, swans, and wading birds such as herons, glossy ibis, bitterns, rails, coots, and common moorhens.

Approximately 2,877 acres of IWWH are in the study area: along Felts Brook, Eaton Brook, and the Thoroughfare between Holbrook Pond and Davis Pond (exhibit 3.22) (MDIFW, MGIS, 2009). These areas are classified as significant wildlife habitat by the MDIFW.

Waterfowl use portions of the study area for feeding and staging areas; organisms on which they feed use the habitat for food supplies. These habitats are highly productive and are recognized as a valued resource. Impacts to IWWH result from the following:

- filling
- conversion of one habitat type to another
- disturbance caused by the introduction of a new highway into or adjacent to the habitat

Exhibit 3.23 – *Impacts to State-Regulated Wildlife Habitat*

Alternatives	DWA	IWWH
No-Build		
2B-2/the Preferred Alternative		9 acres (0.3%) along Eaton Brook and its tributaries
5A2B-2		20 acres (0.7%) along Felts Brook near the proposed interchange and 9 acres (0.3%) along Eaton Brook
5B2B-2	3 acres (0.3%) along a tributary to Eaton Brook	3 acres (0.1%) along a tributary to Eaton Brook

The No-Build Alternative would not impact IWWH.

The build alternatives would impact three to 29 acres (0.1 and one percent respectively) of IWWH (exhibit 3.23).

Vernal Pools. According to the MDEP, vernal pools or "spring pools" are shallow depressions that usually contain water for only part of the year. It is a natural, temporary, or semipermanent body of water occurring in a shallow depression that typically fills during the spring or fall and may be dry during the summer. Vernal pools are defined as temporary pools that serve as reproductive habitat for amphibians such as spotted salamanders, blue-spotted salamanders, and wood frogs.

Beginning on September 1, 2007, significant vernal pool habitat is protected by law under the NRPA (section 3.1.2.2) (MDEP, 2010).

The No-Build Alternative would not impact vernal pools. The build alternatives would impact one non-significant vernal pool and its upland dispersal habitat (exhibit 3.9). The build alternatives may impact upland dispersal habitat from vernal pools not within the alignments of a build alternative.

Essential Habitat. Essential habitat consists of "areas currently or historically providing physical or biological features essential to the conservation of an endangered or threatened species in Maine and which may require special management consideration" (MDIFW, 2008). If an area is designated as essential habitat, the Maine Endangered Species Act (Maine ESA) requires that no state agency or municipal government shall permit, license, fund, or carry out projects that would significantly alter the habitat or violate protection guidelines adopted for the habitat (MDIFW, 2008). If a project takes place partly or wholly within an essential habitat, it must be evaluated by the MDIFW before state and/or municipal permits can be approved or project activities can commence. Identification of essential habitat is based on species observations and confirmed habitat use. The No-Build Alternative and the build alternatives would not impact essential habitat.

3.1.5 Endangered, Threatened, and Other Protected Species

There are species in the state that receive state and federal protection to help repair previous damage to populations and attempt to return a species population to self-sustaining levels. Other species receive state protection if the limits of their distribution ranges are in Maine or if populations can exist only in a specific but uncommon habitat in Maine.

The Federal ESA, as amended (16 USC 1531 et seq.), provides protection for those species that are listed as endangered or threatened under the ESA. Section 7 of the ESA requires that the USFWS and the NMFS work with the federal action agencies to achieve conservation and recovery of listed species.

"Critical habitat" is a term defined and used in the ESA to designate a specific geographic area(s) that is essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat

may include an area that is not currently occupied by the species but would be needed for its recovery.

3.1.5.1 Federal Endangered and Threatened Species

According to the NMFS, there are species of diadromous fish in the study area of which two are endangered, two are candidate species, and one is a species of concern. The Atlantic salmon and the shortnose sturgeon are listed as endangered on the Federal Endangered List; the alewife and blueback herring are candidate species; and rainbow smelt is a species of concern for Maine (Maine Department of Marine Resources, 2008, ; NOAA, 2012).

According to the USFWS, the Red knot bird is listed as a candidate species, the Atlantic salmon is listed as endangered, and the Canada Lynx is listed as threatened for Penobscot County (USFWS, 2012).

The No-Build Alternative would not impact known federal, listed or proposed, endangered and threatened species.

The build alternatives may affect Atlantic salmon and its designated critical habitat through the road-stream crossing and channelization of streams. The road-stream crossings may affect Atlantic salmon during their eggs and larvae stages. Construction of the road-stream crossings increases sediments that could affect migrating adult salmon.

The build alternatives would not impact other known federal, listed or proposed, endangered and threatened species.

3.1.5.2 State Endangered and Threatened Species

Three bird species are listed as threatened and four bird species are listed as endangered in Maine that occur in the study area (MDIFW, 2008). The barrow's goldeneye, upland sandpiper, and common moorhen are listed as threatened and the least bittern, black tern, peregrine falcon, and sedge wren are listed as endangered.

There are no essential habitats that were identified for the listed species that occur in the study area (section 3.1.4.2).

The No-Build Alternative and the build alternatives would not impact known state, listed or proposed, endangered and threatened species.

3.1.5.3 Other Protected Species

The Bald and Golden Eagle Protection Act (16 USC 668-668c), enacted in 1940, protects the bald and golden eagle. The Act prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald and golden eagles, including their parts, nests, or eggs. The Act defines take as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect,

molest, or disturb." Bald eagles occur within the study area.

In addition to immediate impacts, this definition of take covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present if, on the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits and causes injury, death, or nest abandonment (USFWS, 2009).

The MDIFW documented two nesting sites for the bald eagle (*Haliaeetus leucocephalus*) along the east bank of the Penobscot River and Eaton Brook in the study area (exhibit 3.22) . These two nests are alternate nest sites within the breeding territory of a single pair of bald eagles.

The Maine Natural Areas Program (MNAP) documented one rare plant species, water stargrass, in the study area (MNAP, 2008). In Maine, this species requires lakes with relatively clear water and has been documented in Davis Pond in Eddington. There is good probability that water stargrass also occurs in Holbrook Pond and the connecting water between Holbrook Pond and Davis Pond (MNAP, 2008).

The No-Build Alternative would not impact known federal or state, other, listed or proposed protected species.

The build alternatives would not impact known federal or state, other listed or proposed protected species, other than Atlantic salmon.

3.2 Atmospheric Environment

3.2.1 Climate Change

Greenhouse gases (GHGs) are chemical compounds found in the Earth's atmosphere that allow sunlight to freely enter the atmosphere. When sunlight strikes the Earth's surface, some of it is radiated back toward space as infrared radiation (i.e., heat); GHGs absorb this heat and trap it in the atmosphere. Some of the GHGs occur naturally (i.e., water vapor, carbon dioxide, methane, and nitrous oxide); however, human industrial processes are the main source (i.e., carbon dioxide). Carbon dioxide has increased from a preindustrial (early 18th century) level of 280 parts per million (ppm) to the current level of 380 ppm, increasing the temperature of the Earth. Unless steps are taken to lessen further releases of GHGs, these levels are projected to increase to 450 ppm by 2025, 550 ppm by 2050, and more than 600 ppm in the second half of the 21st century (Solomon et al., 2007). If no action is taken, the Intergovernmental Panel on Climate Change (IPCC) identifies the following as likely consequences:

- an increase in the incidence and severity of extreme weather events such as storms, droughts, floods, and heat waves
- a rise in the global sea level, including stresses on estuaries, bays, and wetlands
- changes in precipitation rates that will impact water supplies and food production
- shifts in and/or expansion of certain disease and pest vectors
- further stress on already vulnerable species and ecosystems

For the past century, the *rate* of warming in Maine has been increasing. All three of Maine's climate divisions are warmer today than 30 years ago. There are measurable changes in seasonal variation and in patterns of precipitation, with particular impacts on groundwater that can reasonably be associated with climate change (MDEP, 2004). Maine's social and economic well-being depends on the health and productivity of Maine's forests, fields, lakes, rivers, and the marine waters of the GOM. The diversity of these natural systems and the plants and animals within them result from the wide range of geologic, topographic, and climatic conditions present in the state. Although many states have a wide variety of environments, few have anything approaching Maine's range of climates in close proximity. Maine's unique diversity of climates means that change will not be uniform across the state (University of Maine, 2009).

Reducing human and ecosystem vulnerability to harm and increasing resilience in the face of change is both an economic and a moral imperative. A 2003 Maine law (i.e., PL 237) required the MDEP to develop and submit a Climate Action Plan (CAP) for Maine. The goals of the CAP are to reduce GHG emissions to 1990 levels by ten percent below those levels by 2020, and by a sufficient amount to avert the threat of global warming over the longer term, which could be as much as 75 percent. The law directed the MDEP to undertake "Lead by Example" initiatives, including conducting emissions inventories for state facilities and programs; obtaining voluntary carbon-reduction agreements with private-sector businesses and non-profit organizations; participating in a regional GHG registry; and establishing an annual statewide GHG emissions inventory (MDEP, 2004).

The No-Build Alternative would impact climate change. As traffic congestion increases, CO_2 emissions and fuel consumption increase. Traffic congestion often is categorized by the LOS it provides to travelers. By 2035, it is expected that the roadways would decline from levels of C, D, and E to levels of D, E, and F (section 1.3.3).

The build alternatives would result in a slight improvement in the LOS and the v/c ratios over the

No-Build Alternative (exhibit 3.24). The build alternatives would lower greenhouse gas emissions by approximately 14 percent over the No-Build Alternative.

CO_2 emissions can be lowered by improving traffic operations, particularly by reducing traffic congestion (Barth and Boriboonsomin, 2008). The build alternatives would improve regional mobility and traffic congestion in the study area by reducing the number of vehicles that use existing roadways.

Traveling at a steady-state speed would lower emissions and fuel consumption compared to a stop-and-go driving pattern. By decreasing stop-and-go driving from congested traffic, CO_2 emissions can be reduced. The build alternatives would decrease the stop-and-go driving by reducing traffic congestion on Routes 1A, 9, and 46.

When traffic congestion lowers the average vehicle speed to less than 45 mph, there is a net negative impact on CO_2 emissions. Vehicles spend more time on the road, which results in higher CO_2 emissions. Conversely, if moderate congestion lowers average speeds from a free-flow speed of about 65 mph to 45 to 50 mph, it actually lowers CO_2 emissions. Extremely high speeds of more than 65 mph can increase CO_2 emissions. If high speeds can be controlled, there would be not only direct safety benefits but also indirect benefits of CO_2 reduction. The build alternatives' posted speed limits are between 45 and 55 mph, which is an ideal speed for reducing CO_2 emissions.

Exhibit 3.24 – *Impacts to Greenhouse Gas Emissions (MtCO2e)*

Alternative	Greenhouse Gas Emission	Change from No-Build
No-Build	102.81	-
2B-2/the Preferred Alternative, 5A2B-2, 5B2B-2	88.24	14.57

Overall, small changes in traffic speed can have significant impacts on CO_2 emissions. Several methods to reduce CO_2 by improving traffic operations (with emphasis on freeway operations) include (1) congestion-mitigation strategies that reduce severe congestion such that higher average traffic speeds are achieved (e.g., ramp metering and incident management); (2) speed-management techniques that can reduce excessive speeds to more moderate speeds of approximately 45 to 55 mph (e.g., enforcement and active accelerator pedal); and (3) traffic-flow-smoothing techniques that can reduce the number of acceleration and deceleration events (e.g., variable speed limits).

According to the Council on Environmental Quality (CEQ), if a proposed activity is subject to GHG emissions accounting requirements — such as Clean Air Act (CAA) reporting requirements that apply to stationary sources that directly emit 25,000 metric tons or more of CO_2 equivalent annually — the agency should disclose this information for consideration by decision makers and the public. The build alternatives

would emit less than 25,000 metric tons of CO_2 equivalent annually (CEQ, 2010); therefore, the No-Build Alternative and the build alternatives would not significantly impact climate change.

3.2.2 Air Quality

The study area is in a portion of Penobscot County that is classified by the USEPA as an Attainment Area for ozone, pursuant to the CAA amendments of 1990 (USEPA, 2008).

Vehicles emit primarily carbon monoxide (CO), hydrocarbons (also known as volatile organic compounds, or VOCs), oxides of nitrogen (NO_x), and, to a much lesser extent, respirable particulate matter (PM_{10}) and ($PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb). To determine compliance with the National Ambient Air Quality Standards (NAAQS), the MDEP Bureau of Air Quality Control conducts long-term air-quality monitoring. The MDEP operates several continuous monitoring sites that measure ambient concentrations of criteria pollutants.

The MDEP ozone-monitoring station nearest to the study area is at the summit of Rider Bluff in Penobscot County. At this location, there were no exceedances of the federal 8-hour ozone standard of 0.075 ppm during the 2009–2011 monitoring period (i.e., the most recent complete years for which data are available). The fourth maximum measured hourly ozone concentration in 2009 was 0.057 ppm, in 2010 was 0.059 ppm, and in 2011 was 0.055 ppm; all were below the 8-hour standard (USEPA, 2011).

The MDEP particulate matter $PM_{2.5}$ monitoring station nearest to the study area is at Pump Station-Washington Street in Bangor. At this location, there were no exceedances of the federal $PM_{2.5}$ standard of 35 $\mu g/m^3$ for the 24-hour average and 15 $\mu g/m^3$ for the annual average during the 2009–2011 monitoring period (i.e., the most recent complete years for which data are available). The maximum measured 24-hour $PM_{2.5}$ concentration was 23 $\mu g/m^3$ in 2010 and the maximum measured annual $PM_{2.5}$ concentration was 7.8 $\mu g/m^3$ in 2011; the maximum measured annual $PM_{2.5}$ that are below the NAAQS standards (USEPA, 2011a).

The region in which the study area is located is an attainment area for CO. The MDEP CO monitoring station nearest the study area is in Hancock County, approximately 25 miles southeast of the study area. There were no exceedances of the state and federal CO standards of 35 ppm for the 1-hour average and 9 ppm for the 8-hour average at this station during the 2009–2011 monitoring period (USEPA, 2011).

In accordance with FHWA TA6640.8A, Chapter V, Section G.8 (b), the air-quality analysis consists of two components: (1) a qualitative evaluation of the impact of the build alternatives on regional emissions (i.e., a

mesoscale assessment); and (2) a qualitative assessment of potential changes in CO concentrations (i.e., a microscale assessment).

3.2.2.1 Mesoscale Assessment

The No-Build Alternative would not worsen air quality in the near future. Over time, air quality would worsen as congestion increases on Routes 1A, 9, and 46.

The build alternatives would result in a reduction in vehicle idling time because the new highway would remove traffic congestion from Routes 1A and 46. The build alternatives would result in emission reductions compared to the No-Build Alternative, thereby providing an air-quality benefit.

3.2.2.2 Microscale Assessment

The potential impacts of the build alternatives on CO concentrations were assessed. The USEPA conformity regulations at 40 CFR 93.116 require that a project neither create or contribute to a new violation of the NAAQS nor worsen existing violations of the NAAQS.

Under the No-Build Alternative, growth in traffic due to normal population growth would result in increased vehicle emissions. The growth in traffic would be offset somewhat by a decrease in motor-vehicle emission factors as older and more polluting vehicles in the nation's fleet are replaced with new vehicles that have lower emission rates.

The build alternatives would introduce traffic into an area where there is comparatively little traffic, causing a slight increase in CO concentrations. However, this would be offset somewhat by an increase in travel speeds with the build alternatives and is not anticipated to lead to violations of the CO standards.

With the build alternatives, traffic would be routed away from Route 1A and traffic idling time would decrease. Therefore, CO concentrations would be reduced from their future No-Build Alternative levels, and violations of the 1-hour and 8-hour CO standards are not anticipated.

3.2.2.3 Mobile Source Air Toxics Analysis

In addition to the criteria air pollutants for which there are NAAQS, the USEPA regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries).

Mobile source air toxics (MSATs) are a subset of the 188 air toxics defined by the CAA. The MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel

evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics result from engine wear or impurities in oil or gasoline.

In March 2001, the USEPA issued the Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources (66 FR 17229, March 29, 2001). This rule was issued under the authority in Section 202 of the CAA. In its rule, the USEPA examined the impacts of existing and newly promulgated mobile source control programs. Based on FHWA projections for 2000 to 2020, these programs would reduce on-highway emissions of four MSATs — benzene, formaldehyde, 1,3-butadiene, and acetaldehyde — by 57 to 65 percent and would reduce on-highway diesel PM emissions by 87 percent. These reductions would occur despite projections that the overall nationwide vehicle miles travelled (VMT) would increase by 64 percent during that timeframe. As a result, the USEPA concluded that no further motor-vehicle emissions standards or fuel standards were necessary to further control MSATs. The USEPA is preparing another rule under authority of CAA Section 202(l) that would address these issues and could make adjustments to the full 21 and the primary 6 MSATs.

This EIS includes a basic analysis of the likely MSAT emission impacts of these alternatives because the analysis of MSATs is an emerging science — that is, the available technical tools are not sufficient to predict the study-specific health impacts of the emission changes associated with the build alternatives. Evaluating the environmental and health impacts from MSATs on a proposed highway would involve several key elements: emissions modeling; dispersion modeling to estimate ambient concentrations resulting from the estimated emissions; exposure modeling to estimate human exposure to the estimated concentrations; and the final determination of health impacts based on the estimated exposure. Each step is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this study. Because of the uncertainties, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be made at the study level.

The amount of MSAT emitted would be proportional to the VMT, assuming that other variables such as fleet mix are the same for each alternative. The VMT estimated for the build alternatives is slightly higher than the No-Build Alternative because the additional capacity increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network. The increase in VMT would lead to higher MSAT emissions for the preferred action alternative along the highway corridor, along with a

corresponding decrease in MSAT emissions along the parallel routes. The emissions increase is offset somewhat by lower MSAT emission rates due to increased speeds; according to the USEPA's MOBILE6.2 model (USEPA, 2011b), emissions of all of the priority MSAT except for diesel PM decrease as speed increases. The extent to which these speed-related emission decreases would offset VMT-related emissions increases cannot be reliably projected due to the inherent deficiencies of technical models.

Because the estimated VMT under each of the alternatives is nearly the same, it is expected that there would be no appreciable difference in overall MSAT emissions among the various alternatives. Also, regardless of the alternative chosen, emissions would likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSAT emissions by 72 percent between 1999 and 2050. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the USEPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases.

The build alternatives traffic volume is less than 10,000 vehicles per day and the vehicle speed would increase for the No-Build Alternative. The vehicle mix would not change. Vehicle emissions would decrease for the build alternatives compared to the No-Build Alternative. With an overall decrease in vehicle emissions, the build alternatives would see decrease in MSAT emissions.

3.2.2.4 $PM_{2.5}$ Hot-Spot Screening Analysis

The analysis consists of answering questions in the process, progressing through Levels 1-3 screening. Each level evaluates study-specific information to determine if the next level of screening is required or if the study qualifies or is disqualified from Hot-Spot Analysis. The study was disqualified from a Hot-Spot Analysis in Level 2 of the screening process because the maximum predicted total traffic volume is fewer than 10,000 vehicles per day. It was determined that the build alternatives would not result in an air-quality impact and that the study meets the CAA's requirements without further PM Hot-Spot Analysis.

3.2.3 Noise

Fourteen general noise-sensitive areas (NSAs), each encompassing many individual receptors, were identified in the study area (exhibit 3.25), as follows:

- NSAs 1, 2, and 3 represent mixed residential and commercial development along Route 1A

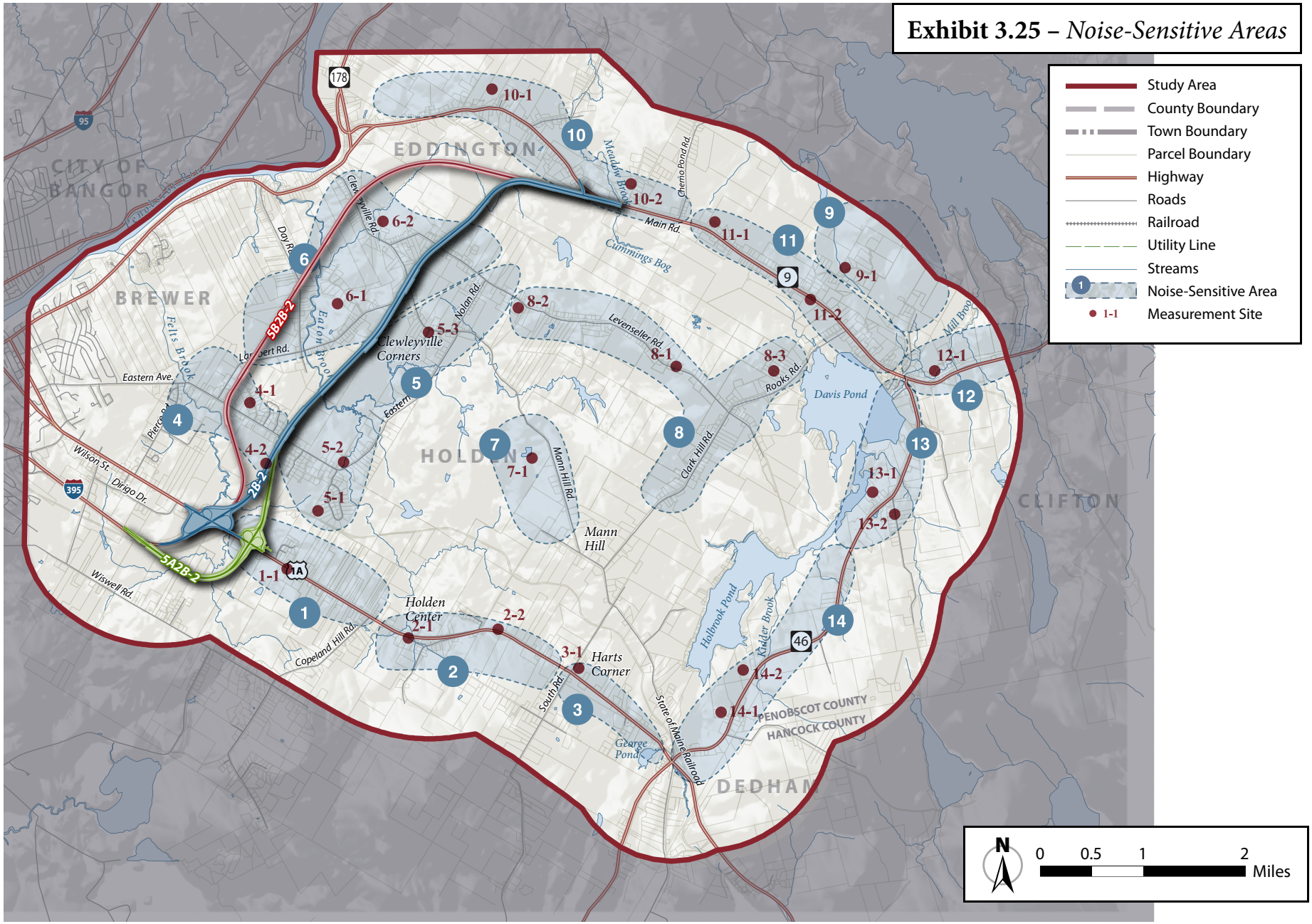


Exhibit 3.25 – *Noise-Sensitive Areas*

from I-395 to Route 46. Measured noise levels in those NSAs were dominated by traffic on Route 1A.

- NSAs 4, 5, and 6 represent residences located along or near Eastern Avenue, Lambert Road, Mann Hill Road, and the western end of Levenseller Road. Noise levels in those three NSAs were influenced primarily by local road traffic, which was very light at most locations. Traffic noise from major highways was noticeable only as distant background noise.
- NSA 7 represents a small rural residential area along Mann Hill Road, a lightly traveled secondary road. Traffic noise from Route 1A was occasionally audible as background noise during the measurement period.
- NSA 8 represents several residential areas and individual residences located along Levenseller Road, Clark Hill Road, and Rooks Road, and three local roads with light and intermittent traffic.
- NSA 9 represents several isolated residences on Stony Ridge Road north of Route 9. One vehicle passed by during the measurement period, and noise from Route 9 traffic was barely audible in the background.
- NSAs 10, 11, and 12 represent mixed residential and commercial development along Route 9 from Route 178 to the town of Clifton to the east. Traffic on Route 9 was the primary source of noise during the measurement periods.
- NSAs 13 and 14 represent residences along Route 46 between Routes 1A and 9. Measured noise levels were influenced primarily by traffic noise from Route 46.

Noise measurements were conducted to determine ambient (i.e., background) noise levels and to validate the FHWA Traffic Noise Model (TNM) at sites influenced by traffic-generated noise. Measurements were taken in accordance with FHWA Report Number FHWA-PD-96-046, *Measurement of Highway Related Noise* (FHWA, 1996). Noise levels are A-weighted hourly equivalent noise levels in decibels (L_{eq} (h) dBA). The hourly L_{eq}, or equivalent sound level, is the level of constant sound that in an hour would contain the same acoustic energy as the time-varying sound (i.e., the fluctuating sound levels of traffic noise are represented in terms of a steady-state noise level of the same energy content). A-weighting simulates the response of the human ear to noise. For sites affected by highway traffic, concurrent counts of automobiles and medium-weight trucks, and heavy trucks were recorded and speed observations were made for model-validation purposes.

Measured noise levels varied considerably in the study area depending on the proximity of sensitive receptors to major roadways. Overall, short-term measurements ranged from 39 to 71 dBA (exhibit 3.26). Along Routes 1A, 9, and 46, traffic was the major source of ambient noise. Noise levels measured at receptors along these roads ranged from 58 to 71 dBA. Along lightly traveled secondary roads, such as Mann Hill Road, Levenseller Road, and Rooks Road, noise levels ranged from 43 to 55 dBA. In the absence of traffic noise from the secondary roads, distant traffic from major roadways could be heard. Background noise levels in remote locations not influenced by highway traffic ranged from 39 to 46 dBA. In these remote locations, noise from distant roadways was occasionally audible.

Noise evaluation of the No-Build Alternative and build alternatives was conducted based on MaineDOT noise policy.

The Noise Abatement Criteria (NAC) for specific land-use activities were used in the evaluation of traffic-noise impacts. These criteria are based on those in Title 23 Code of Federal Regulations, Part 772; U.S. Department of Transportation; the FHWA, Procedures for Abatement of Highway Traffic Noise and Construction Noise, and guidelines for "increase over existing" (IOE) noise levels as set forth in the MaineDOT publication "Highway Traffic Noise Policy". Predicted noise levels were determined using Version 2.5 of the FHWA TNM.

The FHWA and MaineDOT define noise impact based on seven categories of land use (exhibit 3.27). The study area consists of a variety of residential, institutional, commercial, and industrial land uses, the noise analyses considered all Activity Category areas. Individual sites within a given activity category are designated as noise-sensitive receivers.

The noise-level descriptor is the hourly equivalent sound level (Leq(h)). Leq(h) is the steady-state, A-weighted sound level, which contains the same amount of acoustic energy as the actual time-varying A-weighted sound level over a one-hour period.

Exterior receivers evaluated are categorized as Activity Categories B and C, with an applicable noise level of 66 dBA defining an impact. Noise impact is evaluated by comparing the predicted noise levels with existing noise levels. Where the future (year 2035) noise levels are predicted to equal or exceed 66 dBA or where the No-Build Alternative and the build alternatives are predicted to cause a substantial noise increase (i.e., >15 dBA) in the future as compared to existing noise levels, NAC must be considered.

The noise analyses are based on the conceptual design of the build alternatives. As Alternative 2B-2/the Preferred Alternative is developed, details related to the alignment, profile, cross section, drainage features,

right-of-way requirements, and structures are refined, resulting in the final configuration of any noise-abatement features determined to be feasible and reasonable.

The model used to predict worst-case existing and future noise levels and to evaluate noise-abatement options was the FHWA's TNM, Version 2.5. The FHWA TNM predicts noise levels at selected locations based

Exhibit 3.26 – *Noise Measurement Data*

NSA and Measurement Location	Setback from Edge of Near Roadway (ft)	Measured Noise Level Leq(h) (dBA)	Total Hourly Traffic During Measurement Period
1-1 Gravel parking area, Route 1A	70	65.8	1,341
2-1 Gravel parking area at Maine Kitchen Equipment & Supply Co. at 421 Route 1A	72	71.0	1,170
2-2 Holden School, Route 1A	110	64.7	576
3-1 Front yard of residence at 708 Route 1A	50	71.3	1,614
4-1 Shoulder of road in front of residence at 83 Woodridge Road	5	41.2	Background
4-2 On cul-de-sac in front of residence at 76 Brian Drive	95	45.7	Background
5-1 Front yard of residence at 150 Eaton Ridge	80	44.5	Background
5-2 Front yard of residence at 915 Eastern Avenue	60	54.8	84
5-3 Front yard of residence at the corner of Eastern Avenue and Mann Hill Road	66	54.9	Background
6-1 Grassy area next to driveway at 29 Lambert Road	110	47.8	18
6-2 Grassy area next to driveway of residence at 52 Levenseller Road	60	50.4	33
7-1 Front yard of residence at 638 Mann Hill Road	100	50.7	54
8-1 Driveway of residence at 431 Levenseller Road	80	50.5	42
8-2 Front yard of residence at 753 Levenseller Road	90	43.4	36
8-3 Front yard of residence at 183 Rooks Road	80	53.1	75
9-1 Undeveloped homesite along Stony Ridge Road	52	41.1	Background
10-1 Edge of driveway in front of residence at 752 Route 9	98	63.9	381
10-2 Yard next to residence at 990 Route 9	64	63.5	330
11-1 Grassy area next to abandoned commercial property at 1024 Route 9	87	64.7	363
11-2 Backyard of residence at Hope Manor, Route 9	68	62.4	384
12-1 Edge of parking lot of residence at 1499 Route 9	100	63.5	459
13-1 Cleared gravel area along Route 46 south of Hatcase Pond Road	65	61.4	222
13-2 Along Hatcase Pond Road	50	38.8	6
14-1 Next to parking lot in front of Holbrook School Along Route 46	80	58.0	123
14-2 Front yard of residence at 4 Edge of Town Road Along Route 46	95	58.7	81

on traffic data, roadway design, topographic features, and the relationship of the analysis site to the roadway.

The noise levels for receicers for the future year were compared to the absolute NAC levels and to increases over existing-year noise levels using the MaineDOT's NAC to determine noise impacts (exhibit 3.28). An activity meeting either of these criteria is designated as meeting the warrants for consideration of noise abatement. Increases in noise for the future No-Build Alternative as compared to existing conditions are the result of normal traffic growth projected to occur between the present and 2035 and range from 0 to 2 dBA.

Compared to existing noise levels, predicted changes in noise levels resulting from the build alternatives result in either an increase or a decrease of sound levels. These changes reflect traffic growth between the present and 2035 and the redistribution of traffic with the build alternatives. Drawings of the build alternatives noise level and modeling locations are in Appendix D.

Noise from the No-Build Alternative would impact one property in NSA 1. The projected 2035 noise level at the property is 67 dBA; the increase over the existing noise level is 2 dBA.

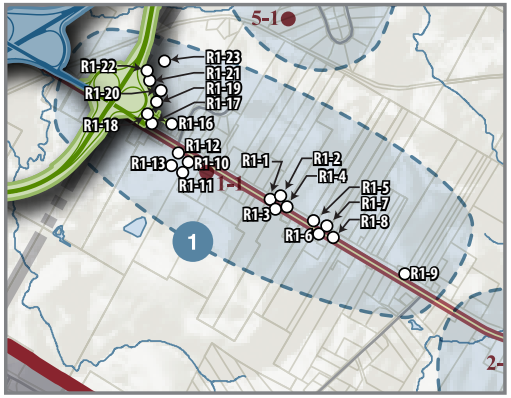
Noise from Alternative 2B-2/the Preferred Alternative would impact fifteen properties: three properties in NSA 4, one property in NSA 5, and eleven properties in NSA 6. The projected 2035 noise levels at the properties range from 44 to 66 dBA; the increase over existing noise levels is 3 to 32 dBA.

Noise from Alternative 5A2B-2 would impact sixteen properties: one property in NSA 1, three properties in NSA 4, one property in NSA 5, and eleven properties in NSA 6. The projected 2035 noise levels at

Exhibit 3.27 – *Noise Abatement Criteria*

Activity Category	Leq(h) (dBA)	Description of Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Residential
C	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools , television studios, trails, and trail crossings
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	–	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	–	Undeveloped lands that are not permitted

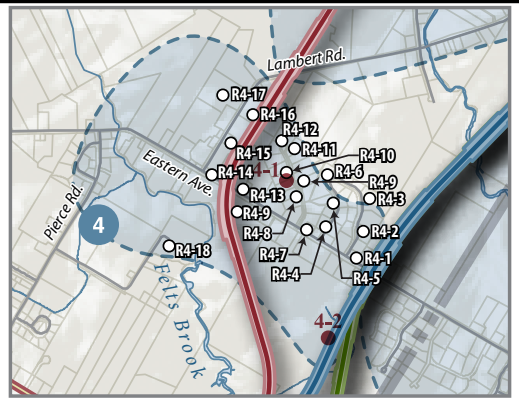
Exhibit 3.28 – *Summary of Predicted Noise Levels*



Site	Existing	No-Build		2B-2/the Preferred Alternative		5A2B-2		5B2B-2	
	Leq	Leq	IOE	Leq	IOE	Leq	IOE	Leq	IOE
Predicted Noise Levels Leq (dBA) NSA 1									
R1-16	56	58	2			56	0		
R1-17	65	67	2			62	-3		
R1-18	61	63	2			60	-1		
R1-19	53	56	2			56	3		
R1-20	50	52	2			53	3		
R1-21	49	51	2			60	11		
R1-22	48	50	2			62	15		
R1-23	45	47	2			55	10		

Notes:
Values calculated to tenth of a dBA and then rounded for presentation purposes.
Leq(h) = Hourly equivalent noise level
dBA = Decibels on the A-weighted scale
IOE = Increase over existing
= Impacts based on noise level of 66 dBA or greater; values > 66 dBA shown for existing conditions and No-Build Alternative for informational purposes.
= Impact based on noise level exceeding existing level by 15 dBA or more.

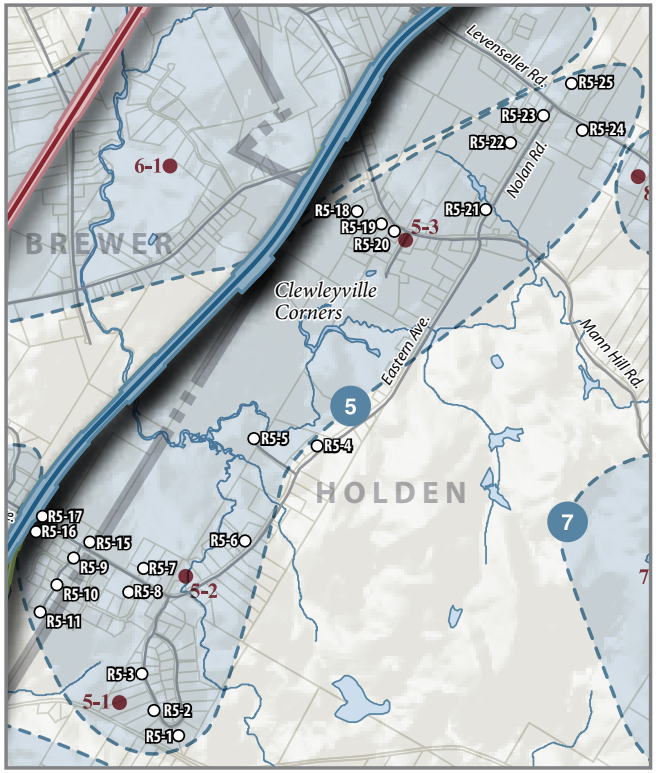
Exhibit 3.28 – *Summary of Predicted Noise Levels (continued)*



	Site	Existing	No-Build		2B-2/the Preferred Alternative		5A2B-2		5B2B-2	
		Leq	Leq	IOE	Leq	IOE	Leq	IOE	Leq	IOE
Predicted Noise Levels Leq (dBA) NSA 4										
	R4-1	42	43	1	57	15	57	15		
	R4-2	37	39	2	55	18	55	18		
	R4-3	34	36	2	51	17	51	17		
	R4-4	38	39	1	48	10	48	10		
	R4-5	36	38	2	46	10	46	10		
	R4-6	35	37	2	44	8	44	8		
	R4-7	46	47	1	49	3	49	3		
	R4-8	35	37	2					48	13
	R4-9	34	36	2					47	13
	R4-10	34	36	2					50	16
	R4-11	34	36	2					51	17
	R4-12	33	35	2					54	20
	R4-13	42	43	1					57	15
	R4-14	47	48	1					58	12
	R4-15	38	39	2					62	25
	R4-16	36	38	2					68	32
	R4-17	34	36	2					56	22
	R4-18	34	36	2					47	13
	R4-19	41	42	1					58	17

Notes:
Values calculated to tenth of a dBA and then rounded for presentation purposes.
Leq(h) = Hourly equivalent noise level
dBA = Decibels on the A-weighted scale
IOE = Increase over existing
= Impacts based on noise level of 66 dBA or greater; values > 66 dBA shown for existing conditions and No-Build Alternative for informational purposes.
= Impact based on noise level exceeding existing level by 15 dBA or more.

Exhibit 3.28 – *Summary of Predicted Noise Levels (continued)*

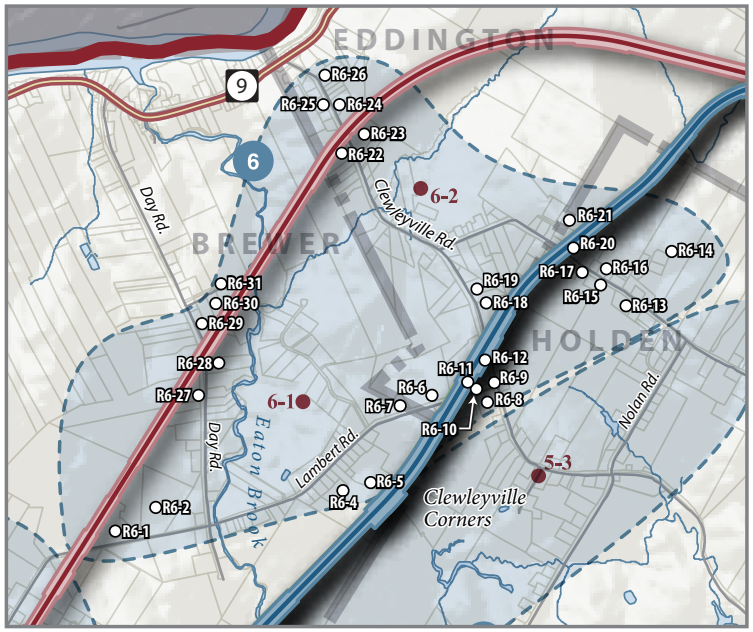


	Site	Existing	No-Build		2B-2/the Preferred Alternative		5A2B-2		5B2B-2	
		Leq	Leq	IOE	Leq	IOE	Leq	IOE	Leq	IOE
Predicted Noise Levels Leq (dBA) NSA 5										
	R5-16	45	46	1	58	14	58	14		
	R5-17	44	45	1	59	16	59	16		

Notes:

Values calculated to tenth of a dBA and then rounded for presentation purposes.
Leq(h) = Hourly equivalent noise level
dBA = Decibels on the A-weighted scale
IOE = Increase over existing
= Impacts based on noise level of 66 dBA or greater; values > 66 dBA shown for existing conditions and No-Build Alternative for informational purposes.
= Impact based on noise level exceeding existing level by 15 dBA or more.

Exhibit 3.28 – *Summary of Predicted Noise Levels (continued)*



Site	Existing	No-Build		2B-2/the Preferred Alternative		5A2B-2		5B2B-2	
	Leq	Leq	IOE	Leq	IOE	Leq	IOE	Leq	IOE
Predicted Noise Levels Leq (dBA) NSA 6									
R6-1	33	36	2					54	21
R6-2	32	34	2					49	17
R6-4	33	35	2	53	20	53	20		
R6-5	32	34	2	58	27	58	27		
R6-6	35	37	2	58	24	58	24		
R6-7	35	37	2	51	17	51	17		
R6-8	39	41	2	54	15	54	15		
R6-9	45	47	2	56	10	56	10		
R6-10	42	44	2	58	16	58	16		
R6-11	34	36	2	66	32	66	32		
R6-12	43	45	2	61	18	61	18		
R6-13	41	42	2	45	5	45	5		
R6-14	33	35	2	45	11	45	11		
R6-15	45	47	2	50	5	50	5		
R6-16	41	43	2	50	9	50	9		
R6-17	48	49	2	53	6	53	6		
R6-18	38	40	2	60	22	60	22		
R6-19	41	43	2	55	14	55	14		
R6-20	42	44	2	61	20	61	20		
R6-21	34	36	2	64	30	64	30		
R6-22	39	41	2					59	20
R6-23	35	37	2					57	22
R6-24	42	43	2					59	18

Notes:

Values calculated to tenth of a dBA and then rounded for presentation purposes.
Leq(h) = Hourly equivalent noise level
dBA = Decibels on the A-weighted scale
IOE = Increase over existing
= Impacts based on noise level of 66 dBA or greater; values > 66 dBA shown for existing conditions and No-Build Alternative for informational purposes.
= Impact based on noise level exceeding existing level by 15 dBA or more.

Exhibit 3.28 – *Summary of Predicted Noise Levels (continued)*

	Site	Existing	No-Build		2B-2/the Preferred Alternative		5A2B-2		5B2B-2	
		Leq	Leq	IOE	Leq	IOE	Leq	IOE	Leq	IOE
	R6-25	44	46	2					56	12
	R6-26	40	42	2					50	10
	R6-27	30	33	2					56	26
	R6-28	30	32	2					55	26
	R6-29	29	32	2					63	34
	R6-30	29	32	2					64	34
	R6-31	29	32	2					60	31

Notes:
Values calculated to tenth of a dBA and then rounded for presentation purposes.
Leq(h) = Hourly equivalent noise level
dBA = Decibels on the A-weighted scale
IOE = Increase over existing
= Impacts based on noise level of 66 dBA or greater; values > 66 dBA shown for existing conditions and No-Build Alternative for informational purposes.
= Impact based on noise level exceeding existing level by 15 dBA or more.

the properties range from 44 to 66 dBA; the increase over existing noise levels is 3 to 32 dBA.

Noise from Alternative 5B2B-2 would impact eighteen properties: eight properties in NSA 4 and ten properties in NSA 6. The projected 2035 noise levels at the properties range from 47 to 68 dBA; the increase over existing noise levels is 10 to 34 dBA.

Noise abatement was considered for the impacted properties. In evaluating potential abatement measures, noise walls were modeled using the FHWA TNM and results compared to the MaineDOT criteria for feasibility and reasonableness. For a barrier to be feasible under the MaineDOT noise policy, it must provide at least 7 dBA of reduction (i.e., insertion loss). If a barrier is determined to be feasible, it is evaluated for reasonableness. To be reasonable, the MaineDOT requires that the barrier cost not exceed $31,000 per benefited residence, based on a barrier cost of $31 per square foot. A benefited residence is one that receives an insertion loss of 7 dBA or greater.

Barriers were determined to be feasible for impacted receptors in the NSAs (exhibit 3.29). However, no barrier evaluated was determined to be reasonable because all options considered exceeded the $31,000 per benefited residence criteria. Sixteen barrier analysis sites were identified along the three build alternatives.

Five of these analysis sites included only one impacted receptor. Mitigation is most effective when receptors are in proximity to each other in small communities or in residential subdivisions. Receptors along the build alternatives are not clustered but rather are isolated, making abatement inefficient. Mitigation results indicate that mitigation in the vicinity of the three build alternatives would not be reasonable due to high cost/benefited receptors. Barrier costs ranged from $194,968 to $1,043,724 per benefited receptor.

Although no reasonable barriers appear likely, certain techniques can sometimes be used as part of the highway's design that has the potential for somewhat reducing noise levels. Such techniques have variable effectiveness based on the relationship of the receptor to the roadway. Examples of such techniques are as follows:

- additional berming at the top of cut slopes, assuming right-of-way requirements permit
- use of glare screen or Jersey barrier on fill sections in lieu of guardrail

3.3 Transportation Environment

3.3.1 Transportation Facilities and Systems

The major roads in the study area are I-395, Route 1A, Route 46, and Route 9. I-395, Route 1A, and Route 9 are designated as part of the NHS.

I-395 is a principal arterial highway between I-95 in Bangor and Route 1A in the study area. I-395 is a controlled-access highway with two eastbound and two westbound lanes separated by an approximate 50-foot grass median. I-395 connects to Route 1A with a partial cloverleaf interchange. It has a posted speed limit of 55 mph and has a paved shoulder approximately 10 feet wide.

Route 1A is a principal arterial highway connecting the greater Bangor and Brewer area with Ellsworth and the coast at Bar Harbor. West of the I-395 interchange, Route 1A has two eastbound lanes and two westbound lanes. East of the I-395 interchange, Route 1A has one eastbound lane, one westbound lane, and a center turn lane from Brewer to approximately 1.3 miles east of the I-395 interchange. The remainder of Route 1A in the study area and to the coast has one eastbound and one westbound lane with no center turn lane. Access to Route 1A from its adjacent properties is not controlled and is subject to the state's rules on access management. Route 1A in the study area is posted at 35 to 45 mph, depending on location, and has a paved

Exhibit 3.29 – *Summary of Noise Abatement*

Alternatives	Barrier Location	Impacted Receptors	Consideration of Abatement Warranted?	Noise Abatement Feasible?	Noise Abatement Reasonable?	Details of Barrier Systems				
						Length (feet)	Average Height (feet)	Cost ($)	Benefited Residences	Cost per Benefited Residence ($)
NSA - 1										
5A2B-2	Wilson St./I-395 Interchange	1	Yes	Yes	No	1,148	16.4	584,904	3	194,968
NSA - 4										
5B2B-2	Lambert Road West	3	Yes	Yes	No	2,258	11.7	817,116	3	272,372
5B2B-2	Eastern Avenue	5	Yes	Yes	No	3,197	17.4	1,719,122	2	859,561
2B-2/the Preferred Alternative, 5A2B-2	Eastern Avenue West	3	Yes	Yes	No	2,510	18.3	1,424,546	2	712,273
NSA - 5										
2B-2/the Preferred Alternative, 5A2B-2	Eastern Avenue East	2	Yes	Yes	No	1,389	18.6	799,440	2	399,720
NSA - 6										
5B2B-2	Lambert Road East	2	Yes	Yes	No	3,509	20.0	2,087,448	2	1,043,724
5B2B-2	Day Road East	2	Yes	Yes	No	2,784	19.4	1,671,069	2	835,535
5B2B-2	Day Road West	3	Yes	Yes	No	1,591	17.0	837,378	3	279,126
5B2B-2	Mann Hill Road East	2	Yes	Yes	No	1,981	17.6	1,080,924	2	540,462
5B2B-2	Mann Hill Road West	1	Yes	Yes	No	1,509	17.3	810,124	1	810,124
2B-2/the Preferred Alternative, 5A2B-2	Lambert Road South	2	Yes	Yes	No	2,391	20.0	1,482,490	2	741,245
2B-2/the Preferred Alternative, 5A2B-2	Lambert Road North	2	Yes	Yes	No	2,195	20.0	1,361,029	2	680,515
2B-2/the Preferred Alternative, 5A2B-2	Mann Hill Road East	4	Yes	Yes	No	2,595	19.1	1,533,904	4	383,476
2B-2/the Preferred Alternative, 5A2B-2	Mann Hill Road West	1	Yes	Yes	No	1,535	15.2	721,871	2	360,909
2B-2/the Preferred Alternative, 5A2B-2	Levenseller Road East	1	Yes	Yes	No	1,306	17.3	698,743	1	698,743
2B-2/the Preferred Alternative, 5A2B-2	Levenseller Road West	1	Yes	Yes	No	1,479	15.1	690,505	1	690,505

shoulder approximately six feet wide. The land uses adjacent to Route 1A in the study area are primarily commercial and residential with some undeveloped and underdeveloped areas. Over time, the areas adjacent to Route 1A are becoming increasingly more commercial.

Route 46 is a two-lane minor arterial road connecting Route 1A to Route 9. Access to Route 46 from adjacent properties is not controlled and is subject to the state's rules on access management. Portions of Route 46 are steep and exceed the State of Maine's design criteria. Route 46 is posted at 35 or 45 mph and has a gravel shoulder approximately four feet wide. The land cover adjacent to Route 46 is primarily mature forested areas with scattered residences and open areas. Approaching Route 9, the land uses adjacent to Route 46 are primarily residential. Because of the mature forest canopy, considerable portions of Route 46 are shaded, and snow and ice cover does not melt rapidly.

Route 9 is a two-lane principal arterial highway connecting the greater Bangor and Brewer area with Washington County and the Canadian Maritime Provinces to the east. Access to Route 9 from its adjacent properties is not controlled and is subject to the State's rules on access management. Route 9 is posted at 45 or 35 mph, depending on location, and has a paved shoulder approximately eight feet wide. The land uses adjacent to Route 9 in the study area are primarily commercial and residential with some undeveloped and underdeveloped areas. Over time, the areas adjacent to Route 9 are becoming increasingly more developed. To the east of the study area, the land uses and land cover adjacent to Route 9 quickly become less developed and more forested, and the speed limit increases to 55 mph. Most of the land adjacent to Route 9 east of the study area to the Canadian border is undeveloped.

Other important local roads in the study area are Eastern Avenue, Mann Hill Road, Levenseller Road, Lambert Road, and Clark Hill Road. These roadways are two-lane rural roads, without shoulders, that provide local connections between residential areas and major roads.

The intersection of Routes 1A and 46 is a signalized intersection. To the east and west of the intersection, Route 1A has a left turn lane and a through lane. The northbound and southbound lanes of the Route 46 intersection only have one lane for all traffic movements.

The intersection of Routes 46 and 9 is an unsignalized "T" intersection with a stop sign controlling traffic on Route 46. The Route 46 northbound side of the intersection has one lane, from which vehicles can turn left or right. Route 9, westbound and eastbound, has one through lane in each direction.

Brewer is part of the federally designated Metropolitan Planning Organization (MPO) known as the Bangor Area Comprehensive Transportation System (BACTS), which collaborates with the MaineDOT on area transportation projects.

Brewer is served by Bangor's public bus system — the BAT Community Connector — which operates Monday through Saturday (City of Bangor, 2011) generally between 6:30 a.m. and 6:30 p.m. The closest bus station for Holden and Eddington residents is located at the Wal-Mart along Wilson Street (i.e., Route 1A) in Brewer. The BAT Brewer route serves both North and South Brewer with access into greater Bangor and connections to Old Town and Hampden.

The Penquis Community Action Program bus service — the Lynx — is available for residents with special physical and social needs in Penobscot and Piscataquis Counties. This bus service operates Monday through Friday between 8:00 a.m. and 4:30 p.m. and is supported financially through the MaineCare program of the Maine Department of Health and Human Services.

Pedestrians and bicyclists are permitted to use the roads in the study area with the exception of I-395.

Commercial air service is available at the Bangor International Airport, which is owned and operated by the city of Bangor. Although no rail or water transportation is available in Holden and Eddington, both rail and waterborne freight-transportation carriers serve Brewer.

One inactive rail line, the state-owned railroad (or Calais Branch), crosses the study area. It enters the study area from Brewer, crosses I-395, passes under Route 1A and bisects the town of Holden, crosses Route 46 at grade, and passes to the east of the study area. There are no plans to restore rail service in the near future, but the possibility exists in the long term.

The town of Holden has public parking lots available at the public works area, municipal building, Holden Elementary School, and Holbrook School (Town of Holden, 2007).

The No-Build Alternative would not impact the transportation facilities and systems in the study area and region, or pedestrians and bicyclists.

The build alternatives would impact the transportation facilities in the study area by improving consistency in operating speeds and reducing travel time. Alternative 2B-2/the Preferred Alternative and Alternative 5B2B-2 would partially reconstruct the existing I-395 interchange with Route 1A (exhibit 2.12); the extent of reconstruction would be determined during final design of Alternative 2B-2/the Preferred Alternative. Alternative 5A2B-2 would require the realignment of approximately 1.5 miles of I-395 to the east of the existing location, the construction of a new interchange between I-395 and Route 1A, and the removal

of the easternmost portion of I-395 and the existing interchange with Route 1A (exhibit 2.15).

The build alternatives would either bridge over or pass underneath the roads it crosses (exhibits 2.11, 2.14, and 2.16).

The build alternatives would connect to Route 9 at a "T" intersection (exhibit 2.13). Route 9 eastbound would be controlled with a stop sign.

The build alternatives would facilitate the future redesignation of a portion of the NHS in the study area from Water Street in Bangor to the selected alternative.

The No-Build Alternative would not impact pedestrians and bicyclists.

Bicyclists and pedestrians would be allowed to use the build alternatives. The build alternatives would function as an extension of the existing Route 9, or like any other one lane non Interstate controlled access facility in the state. An example where bicyclists and pedestrians are allowed is Route 196 in Topsham. The only locations that the State of Maine prohibits bicyclists or pedestrians without a positive separation between the traffic and the pedestrians are facilities with two lanes or more in each direction that function like interstate facilities. It should be noted that some states allow bicyclists on the interstate system (two lanes or more in each direction) without positive separation. Maine does not allow that.

Bicyclists would have access to the build alternatives without needing to use the interstate system. The state may consider closing the facility to pedestrians because of the long distance without any outlets.

The build alternatives would not impact the bus, air, and rail transportation systems in the study area and region.

3.3.2 System Continuity and Mobility

Poor system continuity was identified as one of the needs for highway improvements in the study area (section 1.3.1). The transitions in travel speed, roadway geometry, and capacity for motorists traveling between I-395 and Route 9 are inconsistent and contribute to safety concerns, delays in passenger and freight movement, and conflicts between local traffic and regional traffic.

Continuity in the transportation system is essential for the safe and efficient movement of vehicles and travel patterns. System continuity can be defined and measured by how often an existing highway transitions from wider, higher-speed segments to narrower, lower-speed segments. System linkage and improved mobility results from smooth interconnections and transitions between regional, high-speed, high-capacity highways. In connecting these types of highways, highway design and design principles attempt to

provide for gradual and consistent transitions in travel speed, roadway geometry, and capacity.

Severe traffic congestion exists on Route 1A and it becomes more noticeable in the approach to I-395. Traffic congestion is most pronounced in the summer months. Motorists can experience considerable delays when attempting to turn left across traffic and onto Route 1A, and many serious crashes have occurred on Route 1A.

The intersection of Routes 1A and 46 is a signalized intersection. It handles traffic traveling to and from the areas of Downeast Maine, the Ellsworth area, and the coast. The MaineDOT has made improvements to this intersection over time to improve safety and capacity. In 2035, this intersection is projected to be overcapacity (i.e., the number of vehicles on the roads that approach the intersection exceed the capacity of the roads) and to operate with considerable delays (i.e., more than 80 seconds per vehicle).

Route 9 in the vicinity of Route 46 is posted at 35 mph and has limited sight distance approaching Route 46 in both directions. The intersection of Routes 46 and 9 is an unsignalized intersection, and traffic on Route 46 is controlled by a stop sign. Trucks experience considerable difficulty when turning from Route 46 onto Route 9 eastbound and from Route 9 westbound onto Route 46. The northbound approach of Route 46 to the intersection with Route 9 operates in an acceptable condition. With increases in the traffic volume, the delays on Route 46 turning onto Route 9 are projected to increase from 6.5 seconds in 1998 to 119.4 seconds in 2035.

The No-Build Alternative would not improve system continuity. Traffic would continue to use existing roads – primarily Route 1A and Route 46 – to travel between I-395 and Route 9. Over time, with increasing traffic congestion, system continuity on existing routes would worsen. The transitions in travel speed, roadway geometry, and capacity would increasingly become more inconsistent for travelers with growth in overall traffic volume and changes in traffic composition with increased truck traffic. Improvement of the intersection of Routes 9 and 46 would improve operational capacity (additional through-lanes and dedicated turn lanes) of the intersection but would not substantially improve overall system continuity or mobility for regional travelers.

The build alternatives would improve system continuity for regional travel between I-395 and Route 9 by providing a new controlled-access highway with improved continuity in speeds and roadway geometry. The proposed highway would carry a similar lane configuration throughout the entire length and would be posted at 55 mph. The proposed highway would bypass portions of Routes 1A and 46 in the study area that lack continuity. Delays at the signalized

intersection of Routes 1A and 46 would be less than 80 seconds for all movements, with the exception of left turns from westbound Route 1A to southbound Route 46, due to reductions in through-traffic along Route 1A. At the intersection of Routes 9 and 46, delay for vehicles from Route 46 northbound to Route 9 in 2035 would decrease to approximately 21.5 seconds.

3.3.3 Existing and Projected Demand

Future traffic volumes for study-area roadways were forecasted to 2035, which was chosen because it represents the future design year for which alternatives are being evaluated. The 2035 traffic-volume projections were derived based on a review of traffic forecasts from the statewide travel-demand model and historical traffic-volume increases.

Future 2035 AADT volumes compared with 1998, 2006, and 2010 AADT (exhibit 1.6) depict travel-demand growth trends in the study area. Volumes are shown for eight roadway segments that form important links in the area transportation network. The three major roadway segments currently used by drivers from I-395 to Route 9 north of the study area (i.e., Route 1A west of Route 46, Route 46 north of Route 1A, and Route 9 east of Route 46) are projected to have the largest percentage increases in AADT in the local transportation network between 2010 and 2035. These same roadway segments would experience substantial growth in the heavy-truck component of the AADT by 2035.

Estimates of roadway performance were developed using the applicable DHV, v/c ratio, and LOS for five major roadway segments within the study area (exhibit 1.8). Traffic volumes along Route 1A are forecasted to exceed roadway capacity by 2035 under the No-Build Alternative condition, with an accompanying LOS of F and reduction in average travel speed. Route 46 performance would fall to LOS D with a marked reduction in average travel speed, and conditions along Route 9 would decrease to LOS E.

The No-Build Alternative would not improve regional mobility, traffic congestion, or safety in the study area. Over time, with increasing traffic volumes, roadway performance would continue to decline in terms of LOS and travel speeds. Increases in heavy-truck traffic, especially along Route 46 between Routes 1A and 9, would further exacerbate capacity and safety issues.

With the build alternatives, roadway-system performance would improve in comparison to the No-Build Alternative (exhibit 3.30). In 2035, the new two-lane highway would carry approximately 20 percent (i.e., 7,745 AADT) of the total traffic through the study area and a majority of the traffic destined between I-395 and Route 9, thereby reducing traffic volumes and increasing mobility and safety on Routes 1A and

Exhibit 3.30 – *Changes in Traffic Volumes*

Location	No-Build Alternative		Build Alternatives		Change in 2035 AADT No-Build v. Build	% Change in 2035 AADT No-Build v. Build
Total AADT	**2010**	**2035**	**2010**	**2035**		
Route 1A east of I-395	22,236	33,070	20,754	26,410	-6,660	-20.1
Route 1A west of Route 46	16,976	30,600	15,494	23,940	-6,660	-21.8
Route 1A east of Route 46	12,116	18,870	12,116	18,870	0	0.0
Route 46 south of Route 1A	2,021	3,130	2,021	3,130	0	0.0
Route 46 north of Route 1A	3,058	8,570	1,576	1,910	-6,660	-77.7
Route 9 east of Route 178	7,156	8,730	6,071	7,645	-1,085	-12.4
Route 9 west of Route 46	5,129	5,410	6,611	12,070	6,660	123.1
Route 9 east of Route 46	5,830	10,940	5,830	10,940	0	0.0
Truck AADT	**1998**	**2035**	**2035**			
Route 1A east of I-395	1,569	2,449	1,439		-1,010	-41.2
Route 1A west of Route 46	1,569	2,449	1,439		-1,010	-41.2
Route 1A east of Route 46	1,569	2,449	1,439		-1,010	-41.2
Route 46 south of Route 1A	265	281	281		0	0.0
Route 46 north of Route 1A	604	1,167	157		-1,010	-86.5
Route 9 east of Route 178	569	662	447		-215	-32.5
Route 9 west of Route 46	604	1,167	2,177		1,010	86.5
Route 9 east of Route 46	879	1,535	1,535		0	0.0

46. The study area would experience reductions of regional-through heavy-truck traffic on Routes 1A and 46 because those trips would use the proposed highway, whereas heavy-truck traffic along Route 9 west of Route 46 would increase over the No-Build Alternative.

Improvements in LOS, or no further decrease in LOS, would occur on each of the key roadway segments in the study area with implementation of a build alternative (exhibit 3.31).

3.3.4 Crash Reductions

Locations in the study area exhibit higher crash rates than other locations in Maine with similar roadway and traffic characteristics. Of the major roads in the study area, the section of Route 1A between Parkway South and I-395 and the intersection of Route 9

Exhibit 3.31 – *Changes in DHV, v/c Ratio, Travel Speed, and LOS*

Year	DHV	v/c Ratio	Average Travel Speed (mph)	LOS Rural Two-Lane Road
Route 1A east of I-395				
2035 No Build	3,269	1.12	varies	F
2035 Build	2,612	0.9	28	E
Route 1A east of Route 46				
2035 No Build	2,123	0.72	37.5	E
2035 Build	2,123	0.72	37.5	E
Route 46 between Route 1A and Route 9				
2035 No Build	1,006	0.4	40.8	D
2035 Build	346	0.15	45	C
Route 9 east of Route 178				
2035 No Build	873	0.36	39.5	E
2035 Build	764	0.32	40.3	D
Route 9 east of Route 46				
2035 No Build	1,267	0.46	39.3	E
2035 Build	1,267	0.46	39.3	E

(known locally as North Main Street) and Riverside Drive are the sites of six HCLs (exhibit 1.5).

To evaluate the potential improvement in safety, the No-Build Alternative and the build alternatives were evaluated using the FHWA Interactive Highway Safety Design Model (IHSDM) (FHWA, 2010). IHSDM is a suite of software analysis tools for evaluating the safety and operational effects of highway design. The model is intended to predict the functionality of proposed or existing roadway designs by applying chosen design guidelines and generalized data to predict performance of the design. Although based on engineering design and roadway-environment conditions, estimates from IHSDM are expected values from a statistical sense (i.e., they represent the estimated average performance among a large number of sites with similar characteristics). Actual performance or experiences associated with the roadway may vary over time; therefore, IHSDM estimates are intended to be only one of many inputs into the decision-making process (FHWA, 2003).

Estimates of crashes for the No-Build Alternative and the build alternatives were developed using engineering alignments and the Crash Prediction Module of the IHSDM model. Crash types estimated were Fatal/Serious Injury, Injury, and Property Damage Only (PDO). The Fatal/Serious Injury crashes generally involve either a fatality, disabling injury, or long-term incapacitation. An Injury crash typically involves an injury with a short- to medium-term recovery period. PDO crashes involve no injuries and typically involve only damage to vehicles or other property.

The build alternatives have a lower crash potential than the No-Build Alternative. Alternative 2B-2/the Preferred Alternative would have the lowest number of potential crashes across all three crash types. The major factor providing an advantage to the build alternatives concerning potential crash events is the

Exhibit 3.32 – *Crash Estimates and 2035 Annual Costs*

Alternative	Number of fatal/serious injury crashes	Cost for fatal/serious injury crash ($3,493,128 per)	Number of injury crashes	Cost for injury crash ($83,546 per)	Number of PDO crashes	Cost for PDO crash ($9,410 per)	Total Crash Costs	Crash Cost Savings over No-Build
No-Build	5.14	$17,954,678	9.38	$783,661	19.85	$186,789	$18,925,128	0
2B-2/the Preferred Alternative	3.75	$13,099,230	6.85	$572,290	14.50	$136,445	$13,807,965	$5,117,163
5A2B-2	4.14	$14,461,550	7.56	$631,608	16.00	$150,560	$15,243,718	$3,681,410
5B2B-2	4.02	$14,042,375	7.33	$612,392	15.52	$146,043	$14,800,810	$4,124,318

Note: *Crash output obtained using: Interactive Highway Safety Design Model (IHSDM), FHWA, 2010 Release.*
Crash cost estimates derived from: Crash Cost Estimates by Maximum Police-Reported Injury Severity Within Selected Crash Geometries. FHWA October 2005. Publication No. FHWA HRT-05-051

controlled-access design. By reducing the number of crossroads and driveway-access points, fewer vehicle-conflict points exist with the build alternatives in comparison to the No-Build Alternative. The improved horizontal and vertical grades (i.e., fewer sharp turns and hills than the No-Build Alternative) of the build alternatives contribute to reduced crash potential.

To estimate the potential costs associated with the range and number of predicted crashes, mean-cost data were derived as composite results from the FHWA's *Crash Cost Estimates by Maximum Police-Reported Injury Severity within Selected Crash Geometries* (FHWA, 2005) using undefined crash-geometry estimates. Mean-cost data used were comprehensive estimates, including costs for medical treatment, emergency services, property damage, lost productivity, and adverse effects on quality of life. The crash costs were adjusted to 2011 value using the Consumer Price Index (CPI) for capital-cost components (i.e., medical treatment, emergency services, property damage, and lost productivity) and the Employment Cost Index for quality-of-life effects.

With Alternative 2B-2/the Preferred Alternative, modeled crash costs would provide an approximate 28 percent savings in comparison to the No-Build Alternative. Cost savings of 20 to 22 percent would be realized with Alternatives 5A2B-2 and 5B2B-2 over the No-Build Alternative (exhibit 3.32).

3.3.5 Mobility Benefits

To illustrate the mobility benefits of implementation of a build alternative, VHT and VMT changes were monetized and compared to the No-Build Alternative. VHT and VMT were derived from the shift of traffic from Route 1A and Route 46 to the build alternatives and Route 9.

Exhibit 3.33 – *Changes in VMT and Vehicle Operating Costs*

Alternative	AADT	Length (miles)	Vehicle Miles Traveled	Vehicle Operating Costs per Mile	Vehicle Operating Costs	Operating Cost Savings over No-Build
Passenger Vehicle[1]						
No-Build	6,520	10.2	23,582,579	0.1774	$4,183,550	$0
2B-2/the Preferred Alternative	6,520	6.1	22,189,907	0.1774	$3,936,490	$247,060
5A2B-2	6,520	7.3	25,114,518	0.1774	$4,455,316	-$271,766
5B2B-2	6,520	7.0	24,394,971	0.1774	$4,327,668	-$144,118
Freight Truck[2]						
No-Build	1,225	10.2	4,430,776	0.65	$2,880,004	$0
2B-2/the Preferred Alternative	1,225	6.1	4,169,116	0.65	$2,709,925	$170,079
5A2B-2	1,225	7.3	4,718,602	0.65	$3,067,091	-$187,087
5B2B-2	1,225	7.0	4,583,411	0.65	$2,979,217	-$99,213

Notes:

[1] Passenger vehicle-operating costs derived from "Behind the Numbers–Your Driving Costs, 2011 Edition". American Automobile Association (AAA).

[2] Freight-truck operating costs derived from: "An Analysis of the Operational Costs of Trucking: 2011 Update". American Transportation Research Institute.

Monetized benefits for VMT were calculated using only typical variable vehicle-operating costs (i.e., fuel and oil, repair and maintenance, and tires) for passenger vehicles and freight trucks. For passenger vehicles, the average variable operating cost per mile of $0.1774 (a composite value considering costs of small, medium, and large size automobiles) was based on American Automobile Association (AAA) data for 2011. Freight-truck per-mile variable costs of $0.65 were developed using 2010 data from the American Transportation Research Institute (ATRI).

Net present-value cost savings for passenger-vehicle drivers and freight-truck drivers would be approximately six percent with Alternative 2B-2/the Preferred Alternative, whereas drivers with Alternatives 5A2B-2 and 5B2B-2 would spend an additional four percent to seven percent, in comparison to the No-Build Alternative, to travel between I-395 and Route 9. The differences in costs are directly attributable to the length of the build alternatives (exhibit 3.33).

Monetized benefits for VHT were calculated using variable vehicle-operating costs, fixed vehicle-operating costs (i.e., vehicle financing, insurance, taxes, license and registration, and depreciation), and operator-based costs (i.e., value of personal time, considering wages, benefits, and trip purpose).

Using USDOT guidance on the *Valuation of Travel Time in Economic Analysis* (USDOT, 2003), values

Exhibit 3.34 – *Changes in VHT and Vehicle Operating Costs*

Alternative	AADT	Length (miles)	Miles Traveled	Vehicle Hours Traveled	Travel Time Savings over No-Build (Hours Traveled)	Vehicle Total Costs per Hour	Total Vehicle Travel Time Cost Savings over No-Build
Passenger Vehicle[1]							
No-Build	6,520	10.2	23,582,579	524,058	0		
2B-2/the Preferred Alternative	6,520	6.1	22,189,907	438,246	85,812	$21.45	$1,840,667
5A2B-2	6,520	7.3	25,114,518	491,421	32,637	$21.45	$700,064
5B2B-2	6,520	7.0	24,394,971	478,338	45,720	$21.45	$980,694
Freight Truck[2]							
No-Build	1,225	10.2	4,430,776	98,462	0		
2B-2/the Preferred Alternative	1,225	6.1	4,169,116	82,339	16,123	$59.61	$961,092
5A2B-2	1,225	7.3	4,718,602	92,330	6,132	$59.61	$365,529
5B2B-2	1,225	7.0	4,583,411	89,872	8,590	$59.61	$512,050

Notes:

[1] Passenger-vehicle operating costs derived from "Behind the Numbers–Your Driving Costs, 2011 Edition", American Automobile Association, and FHWA "Revised Guidance on the Valuation of Travel Time in Economic Analysis", February 11, 2003.

[2] Freight-truck operating costs derived from "An Analysis of the Operational Costs of Trucking: 2011 Update". American Transportation Research Institute.

of operator-based costs for passenger vehicles were adjusted to 2011 dollars and estimated to be $20.45 an hour for each "all-purpose" automobile (i.e., a weighted average of business automobile and passenger automobile travelers). Total vehicle operating costs (variable and fixed) were estimated to be $1.00 per hour based on AAA data, resulting in a total VHT value of $21.45 for passenger vehicles.

The value of travel time for freight trucks was based on adjusted 2010 average marginal-cost data for truck operations from the ATRI, resulting in a total VHT value of $59.61 per hour for heavy trucks.

Using VHT as a comparative criterion that considers both the alternative length and travel speed, each build alternative would provide cost savings over the No-Build Alternative. VHT savings with the build alternatives for both passenger and freight trucks range from six percent to 16 percent. VHT and monetized savings are highest with Alternative 2B-2/the Preferred Alternative, whereas savings with Alternative 5A2B-2 are approximately 11 percent less and with Alternative 5B2B-2 are approximately 40 percent less (exhibit 3.34).