4.5 Wetland Resources

This section describes the analysis of potential impacts to wetland resources from the proposed Port MacKenzie Rail Extension. Section 4.1 lists applicable regulations. Section 4.5.1 defines the wetlands study area, Section 4.5.2 describes the methods OEA employed to analyze impacts to wetlands, Section 4.5.3 describes the affected environment (existing conditions), Section 4.5.4 describes potential environmental consequences (impacts), and Section 4.5.5 describes unavoidable environmental consequences of the proposed action to wetlands from the proposed rail line.

4.5.1 Study Area

The Applicant proposed that a 1,000-foot-wide corridor study area for each proposed rail line segment would be adequate to assess potential impacts to wetland functions outside the 200-foot ROW. The USACE agreed to the 1,000-foot-wide corridor with reservations, including the potential that additional wetlands delineation and analysis might be needed if any of the proposed rail line alternatives or their segments were rerouted through areas outside the study area corridor, possibly causing the Applicant time delays and additional costs. OEA determined that the 1,000-foot-wide corridor was acceptable, and used available information on the location and classification of wetlands within 500 feet of the centerline of proposed rail line segments. OEA quantitatively assessed impacts within the rail line footprint; which includes the rail bed, terminal reserve area, access road, and associated facilities; and generally characterized potential impacts to wetlands outside of the rail line footprint.

4.5.2 Analysis Methodology

OEA independently verified information on wetlands within 500 feet of the centerline of the proposed rail segments, based on a 2008 field study that used the USACE delineation manual and assessed wetland functions (HDR, 2008). Unless otherwise noted, this EIS assumes that construction activities would occur within the 200-foot ROW and that construction activities would only impact the area within the rail line footprint, which includes the rail bed, terminal reserve area, access road, and associated facilities. OEA calculated the aerial extent of wetlands that would be directly affected by the proposed project using GIS analysis of delineated wetland areas within the rail line footprint.

OEA used information on wetland functions and values developed using a combination of GIS modeling to assess variables at the watershed level and the application of *A Rapid Procedure for Assessing Wetland Functional Capacity* (Magee and Hollands, 1998; HDR, 2008). OEA used the wetland functional assessment to describe potential impacts to wetland functions that would result from proposed rail line alternatives. OEA compared impacts by alternative and assessed comparisons of wetland functions between the alternatives (low functioning, moderate functioning, and high functioning). Low-functioning wetlands include wetlands assessed with a functional capacity value of 0.33 and lower, moderate-functioning wetlands include wetlands assessed with a functional capacity value above 0.33 and below 0.66, and high-functioning wetlands include wetlands assessed with a functional capacity value of 0.66 or higher. See Appendix C for a more detailed description of analysis methodology.

4.5.3 Affected Environment

Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions (33 C.F.R. § 328.3(b)). By regulatory definition, wetlands support hydrophytic vegetation, show signs of wetland hydrology, and contain hydric soils. Less than 1 percent of the wetlands in the study area did not appear to have surface connections to waterways or other wetlands. These wetlands could be isolated and might not fall under the USACE's jurisdiction.

Appendix C describes wetland communities in the study area. Based on field delineations completed by ARRC and aerial photos, OEA independently verified the wetland community types within the study area. Table 4.5-1 summarizes wetland types within 500 feet of the centerline of the proposed rail line segments. The principle wetland types include:

Table 4.5-1
Summary of Wetland Types within 500 Feet of the Centerline of Proposed Rail Line Segments[a,d]

Wetland Type (NWI Code[c])	Proportion of Wetland Area by Category (percent)[b]	Wetland Area (acres)
Broadleaf Forested Wetlands (PFO1)	6.7	59
Needleleaf Forested Wetlands (PFO4)	91.9	809
Mixed Forested Wetlands (PFO#/#)	1.5	13
Subtotal Forested Wetlands (PFO)	**26.1**	**880**
Broadleaf Scrub/Shrub Wetlands (PSS1)	41.3	823
Needleleaf Scrub/Shrub Wetlands (PSS4)	9.7	193
Mixed and Other Scrub/Shrub Wetlands (PSS#/#)	49.0	975
Subtotal Scrub/Shrub Wetlands (PSS)	**59.1**	**1,991**
Emergent Wetlands (PEM)	**10.9**	**369**
Palustrine Waters (P)	22.2	29
Riverine Waters (R)	27.7	36
Lacustrine Waters (L)	50.1	65
Subtotal Other Wetlands and Waters	**3.8**	**129**
All Wetlands and Waters		***3,369***

[a] Source: HDR 2008.
[b] Proportion of wetland area for broader wetland types (PFO, PSS, PEM, and Other Wetlands and Waters) are in bold. Proportion of wetland areas within each wetland type are listed for Forested Wetlands (PFO1,PFO4, PFO#/#), Scrub/Shrub Wetlands (PSS1, PSS4, PSS#/#), and Other Wetlands and Waters (P, R, L).
[c] National Wetland Inventory (NWI) Codes as defined by Classification of Wetlands and Deepwater Habitats (Cowardin *et al.*, 1979): PFO = Palustrine Forested; PSS = Palustrine Scrub/Shrub; PEM = Palustrine Emergent; P = Palustrine; R = Riverine; L = Lacustrine.
[d] Totals might not equal sums of values due to rounding.

- Forested wetlands: Forested wetlands are one of the predominant wetland types within the study area. Forested wetlands include broadleaf, needleleaf, and mixed broadleaf/needleleaf forest communities. Forested wetlands function to increase nutrient export, modify stream flow, and contribute to the diversity and abundance of wetland fauna. Needleleaf forested wetland communities also have high functional capacities for improving water quality.

- Scrub/shrub wetlands: Scrub/shrub wetlands also dominate the study area and include broadleaf, needleleaf, and mixed shrub communities. Like forested wetlands, scrub/shrub wetlands also function to increase nutrient export and modify stream flow. Scrub/shrub wetland communities also have high functional capacities for improving water quality and contributing to the abundance and diversity of wetland fauna because of the abundance of browse and nesting habitat. Seasonally flooded broadleaf scrub/shrub communities adjacent to streams have a high functional capacity for contributing to the food chain by exporting nutrients downstream.
- Emergent wetlands: Emergent wetlands are less common within the study area. Emergent wetlands are dominated by graminoid species – sedges and grasses. They can also contain scattered shrubs. Emergent wetlands can be associated with a stream function to buffer floodwaters, moderate stream flow, contribute to the food chain through nutrient export, and, in some cases, provide habitat for juvenile fish, waterfowl, and other wildlife.
- Other wetlands and waters: Other wetlands and water habitats in the study area include ponds (with and without aquatic bed vegetation such as lilypads, horsetails, and pondweed), lakes (waterbodies larger than 20 acres), and perennial and intermittent streams. Open water wetlands, lakes, and ponds are highly valued for their functions to improve water quality, buffer storm and floodwaters, and provide valued habitat for a variety of wildlife. Streams and riverine communities are considered sensitive habitats due to their high value for fish habitat and sensitivity to disturbance (Hall *et al.*, 1994).

4.5.3.1 Unique or Sensitive Wetlands

The 2008 field delineation identified the Goose Creek Fen within the study area. Goose Creek Fen is a floating mat fen system located on either side of Goose Creek along the Big Lake Segment. Approximately 18 acres of the fen is within the study area. Fens are peat wetlands fed by a combination of precipitation, groundwater, and surface water (Gore, 1983). Fens typically have a higher potential of hydrogen (pH) and greater nutrient content than bogs and support more diverse plant communities that provide habitat for a number of aquatic and terrestrial organisms. Where they are connected to surface water systems, fens help to maintain the quality of stream water and provide valuable wildlife habitat. Because of their unique features, fens are important ecological features. Unlike many freshwater wetlands, floating mat wetlands adjacent to streams are renewed by fresh water inputs and are not degenerated into acidic muskegs with low wildlife productivity (Bedford and Godwin, 2003). Goose Creek Fen receives overbank flooding from Goose Creek and provides the high-value function of moderating stream flows during periods of high water. These floating wetlands provide high-value rearing habitat for anadromous fish species because they protect fish from predators and keep them warm during winter. These wetlands also function to export carbon into the food chain through the decaying plant matter that makes up the floating mat. A high carbon-export function is highly valued, because it helps support the food chain locally and in downstream habitats.

There are 11,250 acres of wetland mitigation bank lands throughout the MSB (MSB, 2007). The MSB has identified mitigation bank lands for preservation (through conservation easements or other tools) to offset potential development throughout the MSB (Figure 4.5-1). "Wetland Functional Assessment and Wetland Delineation: Big Lake South Bank Plan Su-Knik Wetland Mitigation Bank" (Herrera Environmental Consultants, 2008) describes a portion of these

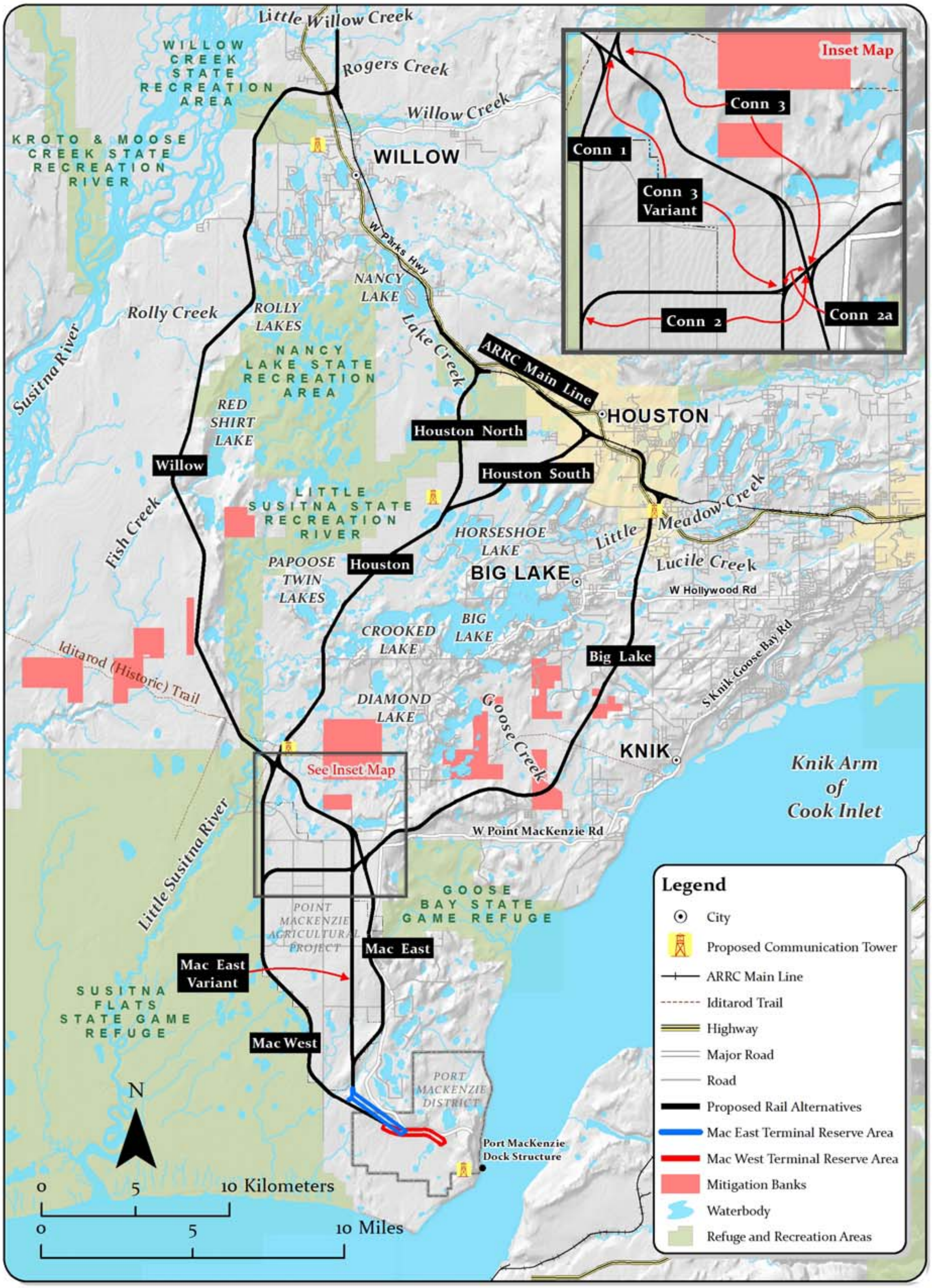

Figure 4.5-1. Mitigation Banks near the Proposed Port MacKenzie Rail Extension

mitigation bank lands. The mitigation bank areas are important to wetlands management in the MSB. They are ecologically valuable lands that protect and support fish and wildlife habitat and provide water recharge and filtering areas important for human uses (MSB, 2007). The Su-Knick Mitigation Bank consists of multiple parcels in 3 separate geographic units that total approximately 2,039 acres of upland and wetland. The Goose Creek and Threemile Creek geographic units would be within the Big Lake Segment ROW. The total area of the Goose Creek geographic unit is 837 acres, 18 acres of which would be within the Big Lake Segment ROW. The total area of the Threemile Creek geographic unit is 320 acres, 7 acres of which would be within the Big Lake Segment ROW. According to the MSB report identifying the bank lands, most of the wetlands within the Goose Creek and Threemile Creek geographic units are riverine wetlands (Herrera Environmental Consultants, 2008). The report categorizes forested, scrub/shrub, and emergent wetlands as riverine wetlands for purposes of assessing their function for the mitigation bank report. These wetlands provide highly valued functions for flood water retention, nutrient export, and as plant and animal habitat support (Herrera Environmental Consultants, 2008). It should also be noted that Goose Creek Fen is within the Goose Creek geographic unit.

4.5.3.2 Wetland Functions and Values

Wetland functions are the chemical, physical, and biological processes or attributes that contribute to the self-maintenance of a wetland and determine the ecological significance of wetland properties (HDR, 2008). Wetlands serve specific functions for the environment, such as controlling erosion, or supplying humans a benefit, such as providing recreation areas. Wetland functions (and values) for study area wetlands that were identified and evaluated include storm and flood water storage (flood control), stream flow moderation (maintaining aquatic habitat and aesthetic appreciation opportunities), groundwater recharge/discharge (replenishing water supplies), sediment removal and nutrient cycling (water quality protection and nutrient export), and contributions to the abundance and diversity of wetland vegetation and wildlife (maintaining aquatic habitat and fish and wildlife harvest opportunities) (USEPA, 2001; HDR, 2008).

Wetlands in the study area are very highly functional because they are predominantly intact, undisturbed systems (Herrera Environmental Consultants, 2008). The primary factors influencing the performance of wetland functions in the study area are climatic conditions, quantity and quality of water entering and leaving the wetland, and disturbances or alterations in the wetland or the surrounding ecosystem (HDR, 2008). An assessment of the functional capacity of wetlands in the study area by the Applicant and reviewed by OEA indicates (HDR, 2008):

- Wetlands without an outlet tend to have a high functional capacity to store storm and flood water.
- All wetlands have a high functional capacity to modify water quality.
- Wetlands without an outlet tend to have a low functional capacity to modify stream flow.
- Wetlands with an outlet tend to have a high functional capacity to export detritus.
- Wetlands have a moderately high functional capacity to contribute to the abundance and diversity of wetland fauna.

- Riverine waters and wetlands with outlets have higher functional capacity to perform groundwater discharge and lower functional capacities to perform groundwater recharge.
- Wetlands performing moderate to high stream flow moderation functions were rare compared to other functions.

4.5.4 Environmental Consequences

This section describes the results of OEA's analysis of potential impacts to wetlands (as defined above) within the rail line footprint of the proposed rail line segments. On average, approximately 28 percent of the area within the rail line footprint would be considered wetlands, according to the USACE established criteria for determining wetlands (Environmental Laboratory, 1987; USACE, 2007). Rail line construction would directly affect wetlands within the rail line footprint and could also affect wetlands within 500 feet on either side of the rail line centerline. Rail line construction would require clearing, excavation, and placement of fill material in wetlands. The placement of fill would cause a permanent loss of wetland functions within the fill area and could result in additional impacts to adjacent wetland areas inside and outside the rail line footprint. Because many wetland functions depend on the size of the wetland or the contiguous nature of the wetland with other habitats, clearing and filling a wetland could lower the ability of adjacent wetlands to perform functions that depend on size or an unfragmented connection to a waterbody. The extent of impacts into the adjacent wetland both inside and outside the rail line footprint would depend on the immediate area surrounding the impact, such as adjacent waterbodies, size of contiguous wetland being fragmented, and sensitivity of the wetland type to fragmentation. Appendix C includes detailed wetlands data for each rail line segment.

4.5.4.1 Proposed Action

Common Impacts

Construction would take place within the 200-foot ROW. There would be impacts to wetlands from excavation and direct placement of fill into wetlands for construction of the rail line, access road, and other associated facilities within the rail line footprint. ARRC would place associated facilities inside the 200-foot ROW where possible. During final design and permitting, ARRC could need to construct outside the ROW for work spaces, borrow areas, and associated facilities. These areas would be identified by the Applicant during final design and permitting, and the Applicant would avoid wetland areas as much as practicable. If a wetland is used as a borrow area, excavation of the wetland would not eliminate the waterbody, but would convert it to a different type of waterbody (See Section 4.2.4.1 for additional borrow area impacts). Wetland areas adjacent to the rail line ROW could also be affected through fragmentation. Wetland hydrology, vegetative cover, habitat, and other functions would be altered or diminished by the effects of the rail bed and rail line operation. The following sections describe construction impacts within the rail line footprint that would be common to all rail line segments, and potential impacts to wetlands outside the rail line footprint. Although common to all alternative segments, potential impacts outside the rail line footprint would depend on the size and type of wetland being crossed in any given location.

Construction

Wetlands would be both excavated and filled within the footprints of the rail bed and access road. Construction activities resulting in the direct loss of wetlands, through excavation or fill placement, would predominantly affect the most common wetland types within the area – forested and scrub/shrub. Loss or alteration of wetlands also could eliminate or reduce adjacent wetland function. Filling or draining wetlands would prevent surface water storage and reduce wetland water quality enhancement functions, while accelerating the flow of water downstream, thereby increasing the potential for flooding. Construction activities would affect wetland functions and values, both short and long term.

Loss of Fish, Wildlife, and Plant Habitats

Fill placed in wetlands would result in permanent direct loss of habitat. Changing the hydrologic regime of wetlands by fragmenting the connection between larger wetland areas also could result in impacts to the ability of adjacent wetlands to support a high diversity of wetland fauna. For example, culverts could drain permanently flooded areas that provide valuable habitat for waterfowl. When floods or other high-water events occur, culverts could sink into the underlying peat, or rise up and become perched and, over time, could prevent the movement of water from one side of the rail bed to the other. In this way, wetlands on one side of the rail bed might be drained, changing the hydrology of the wetland system. A change in the hydrology of the system could result in impacts to wetlands adjacent to the rail bed, and could reach outside the extent of the rail line footprint. Where the rail bed embankment would fragment or interrupt contiguous emergent and scrub/shrub communities, the ability of the wetland to provide wildlife habitat also would be affected. Channel modifications that change instream water temperatures could diminish habitat suitability for fish and wildlife (USEPA, 1993). During construction, fugitive dust generated by excavation and grading would cause short-term, local increases in levels of air-borne particulates. Loose soil blowing from haul-truck beds and traffic in vehicle access and construction staging areas could generate fugitive dust. Dust deposited in wetlands could affect plant growth by changing soil productivity and permeability and reducing water quality, which could result in reduced wetland plant diversity next to haul roadways.

Degradation of Water Quality

Reduction in total wetland area and alteration of wetland hydrology would reduce the capacity of regional wetlands to improve water quality. For example, changing the natural sheet flow of a contiguous wetland to channelized flow through culverts could reduce the residence time of water within the wetland and would lower the capability of the wetland to improve water quality. Removal of wetland and riparian vegetation during rail line construction activities would expose mineral soils to erosion and cause increased sediment loading to wetlands (Childers and Gosselink, 1990). High sediment loads entering wetlands through channels and drainage ditches can smother aquatic vegetation and benthic invertebrates, fill in riffles and pools, and increase water turbidity (USEPA, 1993). Borrow areas established next to wetlands could also degrade water quality through sedimentation and increased turbidity in the wetlands (Irwin, 1992). Silts and fines precipitate from still waters, leading to sedimentation, which reduces water storage capacity, smothers vegetation, and reduces oxygen concentrations, which ultimately affects wetland richness, diversity, and productivity.

Loss of Storm and Flood Water Storage Capacity

Removal of wetland vegetation would reduce the capacity of the wetlands to impede and redistribute storm and floodwaters (USEPA, 2001). Storm and flood water storage capacity is directly related to the size of the wetland and the existence of an outlet for water. Emergent wetlands are especially adept at moderating floodwaters during storm events because of their vegetation composition and deep organic soils. Disturbance or fragmentation of a large undisturbed wetland by reducing its size or creating a water outlet through installation of a culvert would reduce the capacity of the wetland to store floodwaters. Impacts to flood water storage capacity could reach beyond the rail line footprint, depending on the location of fragmentation within the wetland.

Loss of Riparian Zones

Riparian habitats are adjacent to waterbodies and are the transition areas between terrestrial and aquatic ecosystems (NRC, 2002). They provide a mechanism through which energy, materials, and water pass and are significant in ecology, environmental management, and civil engineering because of their role in soil conservation, their biodiversity, and their influence on aquatic ecosystems. Riparian zones act as natural filters, protecting aquatic environments from excessive sedimentation, polluted surface runoff, and erosion (Nakasone *et al*., 2003). They supply shelter and food for many aquatic animals and shade, which is an important part of stream temperature regulation. Research shows riparian zones are instrumental in water quality improvement for both surface runoff and water flowing into streams through subsurface or groundwater flow (Mengis *et al.*, 1999).

The direct loss of wetland vegetation due to construction activities also could affect adjacent riparian vegetation. Depending on the type of crossing proposed at a given location, riparian vegetation could be altered upstream and downstream of the crossing. In some cases, these changes could be outside the rail line footprint. For example, alteration of localized water velocities and flow patterns and impacts to floodplains could alter the mean high water line of the waterbody. This change in water level could cause riparian vegetation to become submerged; in some cases, this would cause a loss of vegetation. Section 4.4 describes impacts to floodplains in more detail.

Loss and Degradation of Hydric Soils

Impacts to wetland soils would result from filling, excavating, or clearing for construction of the rail bed and associated facilities, resulting in the permanent loss of some hydric soils that sustain wetlands. The presence of thick organic mats within wetlands is directly related to the ability of a wetland to provide water quality functions to the surrounding watershed (HDR, 2008). Soil stability depends on vegetative cover, and when vegetation is disturbed, soil can become unstable.

Interruption and Reduction of Natural Hydrologic Functions

Disturbances in wetland hydrology, such as interruption of surface flow or creation of outlets, could create surface impoundments or increase outflow. When the water table of a wetland drops because of decreased inflow or increased outflow, there can be changes in vegetation and degradation of the peat layer, which can ultimately result in degradation of the wetland and reduction or elimination of its functions. Rail bed embankments could fragment normal sheet flow through wetlands, leading to the creation of surface impoundments that would decrease water circulation and lead to water stagnation. Decreased water circulation also results in increased water temperature, lower dissolved oxygen levels, changes in salinity and pH, the prevention of nutrient outflow, and increased sedimentation (USEPA, 1993). Rail beds and road beds could create impoundments even with installation of properly placed and maintained culverts. Once installed, even a properly sized culvert can become an ice trap because its location within an embankment exposes the culvert to maximum cooling conditions (Freitag and McFadden, 1997). This is of special concern in the study area because weather conditions are subject to alternating periods of freeze and thaw, which can cause ice to build up in culverts.

Operation

Most effects to wetlands within the ROW would occur during construction, while some effects would occur during rail line operation. Railroad maintenance would include clearing of vegetation, repairs to the tracks and associated structures (access road, ditches, bridges, and culverts), and cleaning out ditches and culverts. These activities would be infrequent and short in duration.

Maintenance and use of the access road could include the use of sand for increasing traction. Soil stabilizers and chemical agents used along roadways could damage wetland plants (USEPA, 1993). Any toxic substances, such as bridge maintenance materials, that are spilled on the access road could adhere to sediments and could subsequently accumulate in impoundments as a result of decreased water circulation, leading to bioaccumulation of contaminants by wetland biota. Bioaccumulation of toxins occurs at higher trophic levels, which could ultimately cause toxicity.

Storm water discharges from the rail bed and road bed would convey storm water and low concentrations of pollutants to wetlands along the receiving waterways and drainage channels, potentially altering soil chemistry and soil pH and affecting vegetation adjacent to the rail line. Runoff from bridges can increase loadings of hydrocarbons, heavy metals, toxic substances, and deicing chemicals directly into wetlands (USEPA, 1993). Moreover, precipitation runoff could have a similar effect on the pH of wetlands, depending on the parent materials for the rail bed and road bed. The primary pollutants that cause degradation are sediments, nutrients, salts, heavy metals, and selenium. Other impacts could include low dissolved oxygen and pH (USEPA, 1993).

Fugitive dust generated by vehicles using the access road could affect wetlands next to the access road by covering vegetation with fine dust particles and inhibiting photosynthesis. Train operation could produce fugitive dust. Fugitive dust settling in wetlands along the rail line could affect soil pH, surface hydrology, and sheet flow (DNRP, 2004).

Sparks from rail line operation and maintenance have not been a common cause of fires, but could increase the potential for fires. Fires caused by operation could impact wetlands outside the rail line footprint. However, the increased risk of fire in these areas from rail line operation would be low, and wide-ranging changes in fire management for the area surrounding the rail line would be unlikely.

Impacts by Segment and Segment Combination

Wetlands would be permanently removed or altered through direct excavation and filling for the rail line and associated facilities. The intensity of impact would depend on the size of the area to be excavated and filled during rail line construction and operation. Overall, wetlands along all the rail line segments are high functioning for 5 out of 8 functions analyzed for the project. All segments are relatively low functioning for groundwater recharge. Wetlands along all segments are moderate functioning for streamflow moderation and storm and flood water storage. This section describes the wetland types and areas within the rail line footprint for rail line segments and segment combinations. This section also compares general wetland function between segments and segment combinations where there would be notable differences. Appendix C and the alternative-level discussion include additional detail regarding wetland functions. Impacts outside of the rail line footprint cannot be quantitatively assessed, and would depend on the type of wetland crossed, the type and size of drainage structures, value of nearby waterbodies and habitat, and proposed avoidance, minimization, and mitigation measures (see Chapter 19). When possible, these impacts are discussed in general terms.

Southern Segments and Segment Combinations

Wetland communities within the rail line footprint of the southern segments and segment combinations would be directly affected through the loss of 94 to 218 acres (depending on segment or segment combination) of wetlands and waters through excavation, filling, or related construction activities (Figure 4.5-2 and Table 4.5-2). Impacts described for all southern segments and segment combinations include impacts from the terminal reserve areas, which are included in the rail line footprint. Impacts from construction activities would be permanent and would eliminate or limit most wetland functions. In general, the southern segments and segment combinations have a higher proportion of lower functioning wetlands within the rail line footprint than the northern segments and segment combinations.

Most of the affected wetlands would be scrub/shrub and forested communities common in the region (Hall *et al.*, 1994). Most forested wetlands along the southern segments and segment combinations are comprised of needleleaf communities. In some locations, the direct loss of wetlands to construction activities would eliminate adjacent riparian zones. All 6 southern segments and segment combinations (Mac West-Connector 1, Mac West-Connector 2, Mac East-Connector 3, Mac East, Mac East Variant-Connector 2a, and Mac East Variant-Connector 3 Variant) would include the crossing of streams and skirting of lakes and ponds, which could impact the waterbody and the adjacent riparian wetlands through the placement and operation of drainage structures. The acreages of other wetlands and waters along the southern segments and segment combinations would be relatively minor, with these waters comprising 1 percent or less of the study area. Table 4.5-2 details the acreages of wetlands and waters the 6 southern segments and segment combinations could impact.

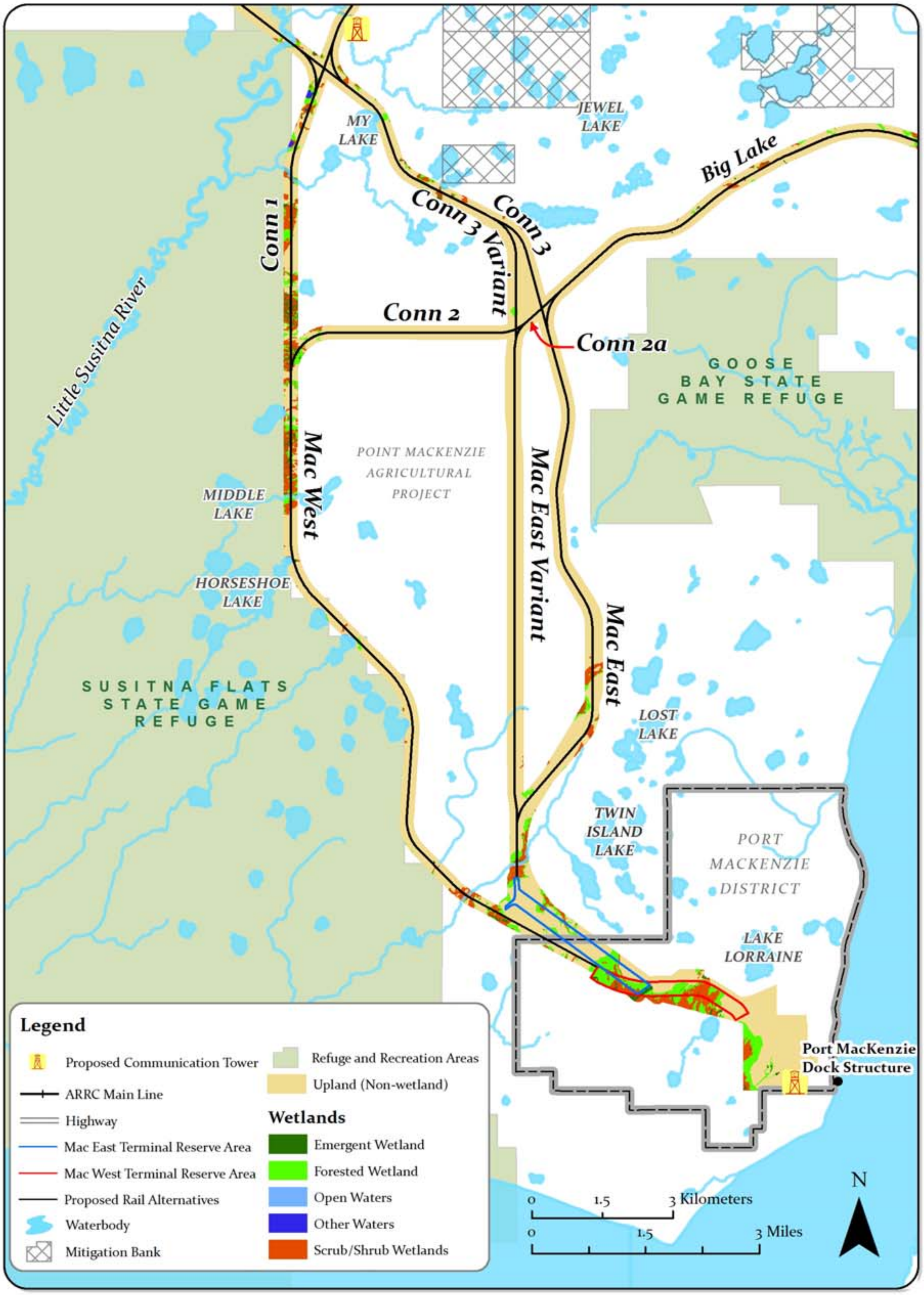

Figure 4.5-2. Mac East, Mac West, Mac East Variant, and Connector Segment Wetlands within the Study Area

Table 4.5-2
Wetlands within the Rail Line Footprint of the Southern Segments and Segment Combinations[a,b]

National Wetlands Inventory Code	Description	Mac West-Connector 1		Mac West-Connector 2		Mac East-Connector 3		Mac East		Mac East Variant-Connector 2a		Mac East Variant-Connector 3 Variant	
		Area (acres)	Wetland Ratio (percent)	Area (acres)	Wetland Ratio (percent)	Area (acres)	Wetland Ratio (percent)	Area (acres)	Wetland Ratio (percent)	Area (acres)	Wetland Ratio (percent)	Area (acres)	Wetland Ratio (percent)
PFO1	Broadleaf Forested Wetlands	24	22.1	24	22.8	23	31.9	23	32.3	23	32.5	23	31.2
PFO4	Needleleaf Forested Wetlands	77	69.9	73	68.9	45	63.4	45	63.0	44	62.6	47	64.2
PFO#/#	Mixed Forested Wetlands	9	8.0	9	8.3	3	4.7	3	4.8	3	4.8	3	4.6
PFO	**Subtotal Forested Wetlands[c]**	**110**	**50.5**	**106**	**53.3**	**72**	**69.8**	**71**	**71.1**	**70**	**74.5**	**73**	**73.7**
PSS1	Broadleaf Scrub/Shrub Wetlands	21	22.4	19	24.0	7	23.5	6	21.8	5	22.7	6	25.0
PSS4	Needleleaf Scrub/Shrub Wetlands	12	12.8	10	13.1	2	6.0	2	6.3	1	3.8	1	3.5
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	60	64.8	50	62.9	21	70.5	20	71.8	17	73.5	18	71.5
PSS	**Subtotal Scrub/Shrub Wetlands**	**92**	**42.3**	**80**	**40.2**	**30**	**29.3**	**28**	**28.4**	**24**	**25.2**	**26**	**25.7**
PEM	**Emergent Wetlands**	**15**	**6.9**	**13**	**6.4**	**1**	**0.8**	**<1**	**0.4**	**<1**	**0.2**	**<1**	**0.5**
P	Palustrine Waters	<1	11.8	0	0	0	0	0	0	0	0	0	0
R	Riverine Waters	<1	39.2	0	0	<1	100.0	<1	100.0	<1	100.0	<1	100.0
L	Lacustrine Waters	<1	49.0	<1	100.0	0	0	0	0	0	0	0	0
	Subtotal Other Wetlands and Waters	**1**	**0.2**	**<1**	**0.1**	**<1**	**0.1**	**<1**	**0.1**	**<1**	**0.1**	**<1**	**0.1**
	All Wetlands and Waters	***218***	***100***	***200***	***100***	***103***	***100***	***100***	***100***	***94***	***100***	***100***	***100***

[a] Source: HDR, 2008; HDR, 2010.
[b] Wetland impacts within the Mac East, Mac East Variant, and Mac West segments include impacts from the terminal reserve areas.
[c] Totals might not equal sums of values due to rounding.

Mac West-Connector 1 Segment Combination

This segment combination would have the potential to affect the largest wetland and water acreages near the southern terminus of the proposed rail line (218 acres within the rail line footprint). The Mac West-Connector 1 Segment Combination would affect a higher proportion and acreage of needleleaf forested wetlands, emergent wetlands, palustrine waters, and lacustrine waters than other southern segments and segment combinations (Table 4.5-2). The Mac West-Connector 1 Segment Combination would cross 3 large areas of patterned forested, scrub/shrub, and emergent bog. Patterned bogs have a high functional value for contribution to abundance and diversity of wetland fauna due to the diversity of summer and winter browse vegetation, nesting habitat for song birds, and cover for other small mammals in the scrub/shrub areas, combined with ease of movement through the emergent areas (HDR, 2008). Fragmentation of these patterned bogs by construction of the rail bed could lower the ability of adjacent wetlands to provide wildlife habitat.

Mac West-Connector 2 Segment Combination

Construction of this segment combination would impact about 200 acres of wetlands and waters within the rail line footprint (Figure 4.5-2 and Table 4.5-2). The Mac West-Connector 2 Segment Combination would cross predominantly mixed scrub/shrub and needleleaf forested wetlands. The Mac West-Connector 2 Segment Combination would have large areas of patterned bog within the rail line footprint that would be fragmented by construction of the rail line. Fragmentation of these patterned bogs could lower the adjacent wetland’s ability to perform certain functions outside the rail line footprint.

Mac East-Connector 3 Segment Combination

This segment combination would impact about 103 acres of wetlands and waters within the rail line footprint. The Mac East-Connector 3 Segment Combination would affect a higher proportion of forested wetlands, although the overall acreage would be significantly less than that of the Mac West-Connector 1 Segment Combination. Construction of the Connector 3 Segment, while only impacting 3 acres of wetlands and waters overall, would impact wetlands adjacent to My Lake; these impacts could lower the ability of adjacent wetlands to provide wildlife habitat by fragmenting the wetlands adjacent to the lake.

Mac East Segment

By itself, the Mac East Segment is very similar to the Mac East-Connector 3 Segment Combination because the Connector 3 Segment contributes only approximately 3 acres of wetlands and waters to the total. The Mac East Segment would impact 100 acres of wetlands and waters within the rail line footprint. These wetlands are predominantly forested wetlands (71 percent), and mostly needleleaf forested wetland communities.

Mac East Variant-Connector 2a Segment Combination

This segment combination has the potential to affect the least acres of wetlands and water (94 acres within the rail line footprint). The Mac East Variant-Connector 2a Segment Combination would affect a higher proportion of forested wetlands, although the overall acreage would still be significantly less than that of the Mac West-Connector 1 Segment Combination.

Mac East Variant-Connector 3 Variant Segment Combination

This segment combination has the potential to affect one of the lowest acres of wetlands and waters (100 acres within the rail line footprint and terminal reserve area). The Mac East Variant-Connector 3 Variant Segment Combination would affect a higher proportion of forested wetlands, although the overall acreage would still be about half that of the Mac West-Connector 1 Segment Combination. Construction of the Connector 3 Variant Segment, while only impacting approximately 3 acres of wetlands and waters overall, would impact wetlands adjacent to My Lake; these impacts could lower the ability of adjacent wetlands to provide wildlife habitat by fragmenting the wetlands adjacent to the lake.

Northern Segments and Segment Combinations

Construction of the northern segments and segment combinations (Willow, Big Lake, Houston-Houston North, and Houston-Houston South) would affect 38 to 101 acres of wetland communities and waters within the rail line footprint (depending on segment and segment combination) through excavation, filling, or other construction activities, including the development of the rail line, sidings, a power line, a buried communications cable, and an access road (Figures 4.5-3 and 4.5-4, and Table 4.5-3). Impacts from construction activities would be permanent and would eliminate or limit most wetland functions within the rail line footprint.

Most of the affected wetlands would be broadleaf and mixed scrub/shrub wetland communities, which comprise from about 60 to 80 percent of the wetland habitats in the study area. Scrub/shrub wetlands are a predominant feature of the landscape in Southcentral Alaska (Hall *et al.*, 1994). Forested wetlands along the northern segments and segment combinations consist completely of needleleaf communities (Table 4.5-3). Overall, the northern segments and segment combinations have a slightly higher proportion of high-functioning wetlands than the southern segments and segment combinations for all 8 wetland functions. In some locations, the direct loss of wetlands to construction activities would eliminate adjacent riparian zones. Construction of each of the northern segments and segment combinations would include the crossing of streams and skirting of lakes and ponds, which could affect the waterbodies and the adjacent riparian wetlands through the placement of the drainage structure. The acreages of these other wetlands and waters that the northern segments and segment combinations would affect would be relatively minor, because they comprise no more than 3 acres of the study area. Table 4.5-3 details the acreages of wetlands and waters the 4 northern segments and segment combinations would affect.

Willow Segment

This segment has the potential to affect the smallest acres of wetlands and waters (38 acres) along any of the northern segments and segment combinations. Of the 38 acres of potentially affected wetlands and waters, 55 percent are comprised of scrub/shrub wetlands, predominantly broadleaf wetland communities (Figure 4.5-3 and Table 4.5-3). The Willow Segment would also affect a larger proportion of riverine waters than the other northern segments and segment

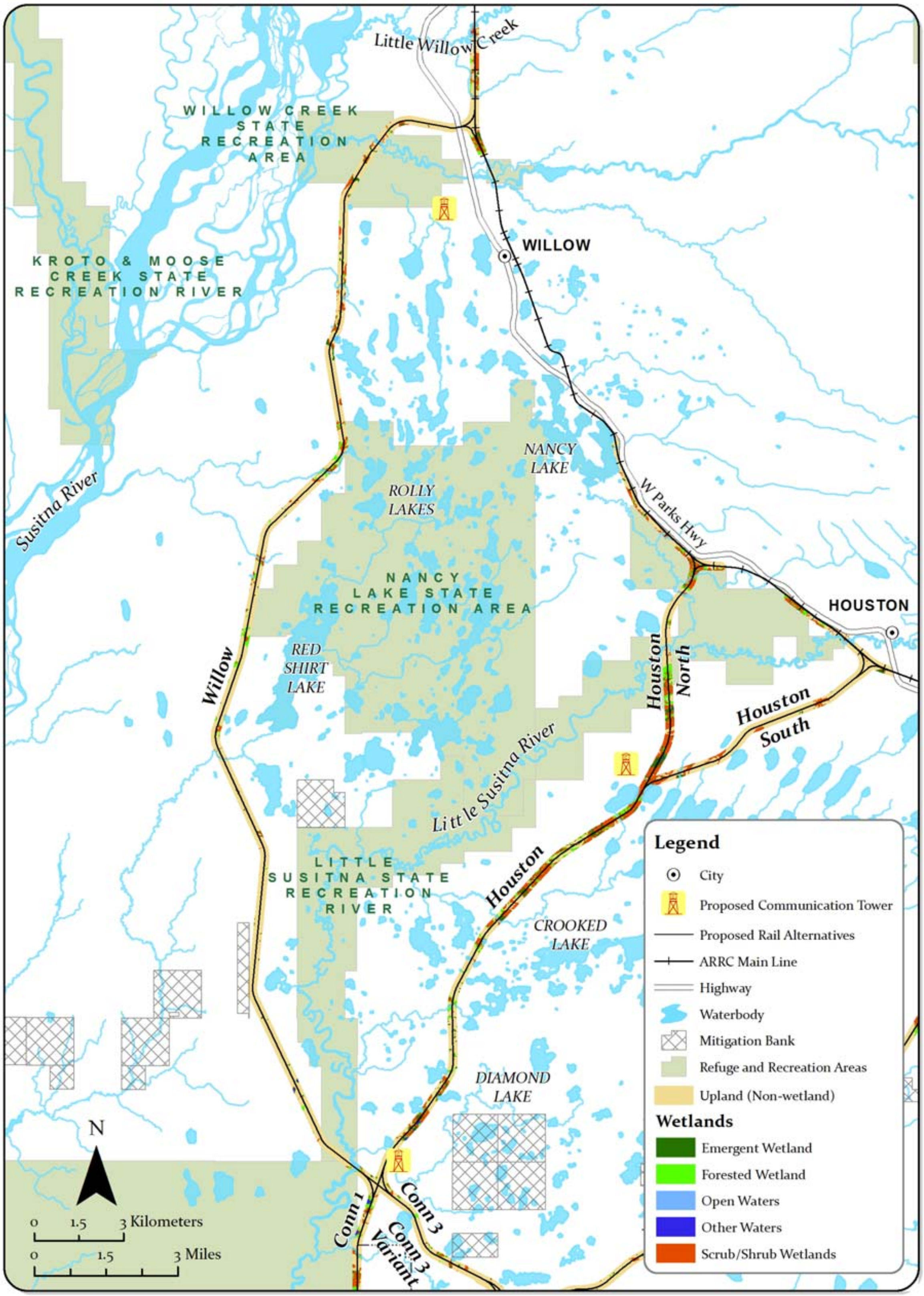

Figure 4.5-3. Willow, Houston, Houston North, and Houston South Segment Wetlands within the Study Area

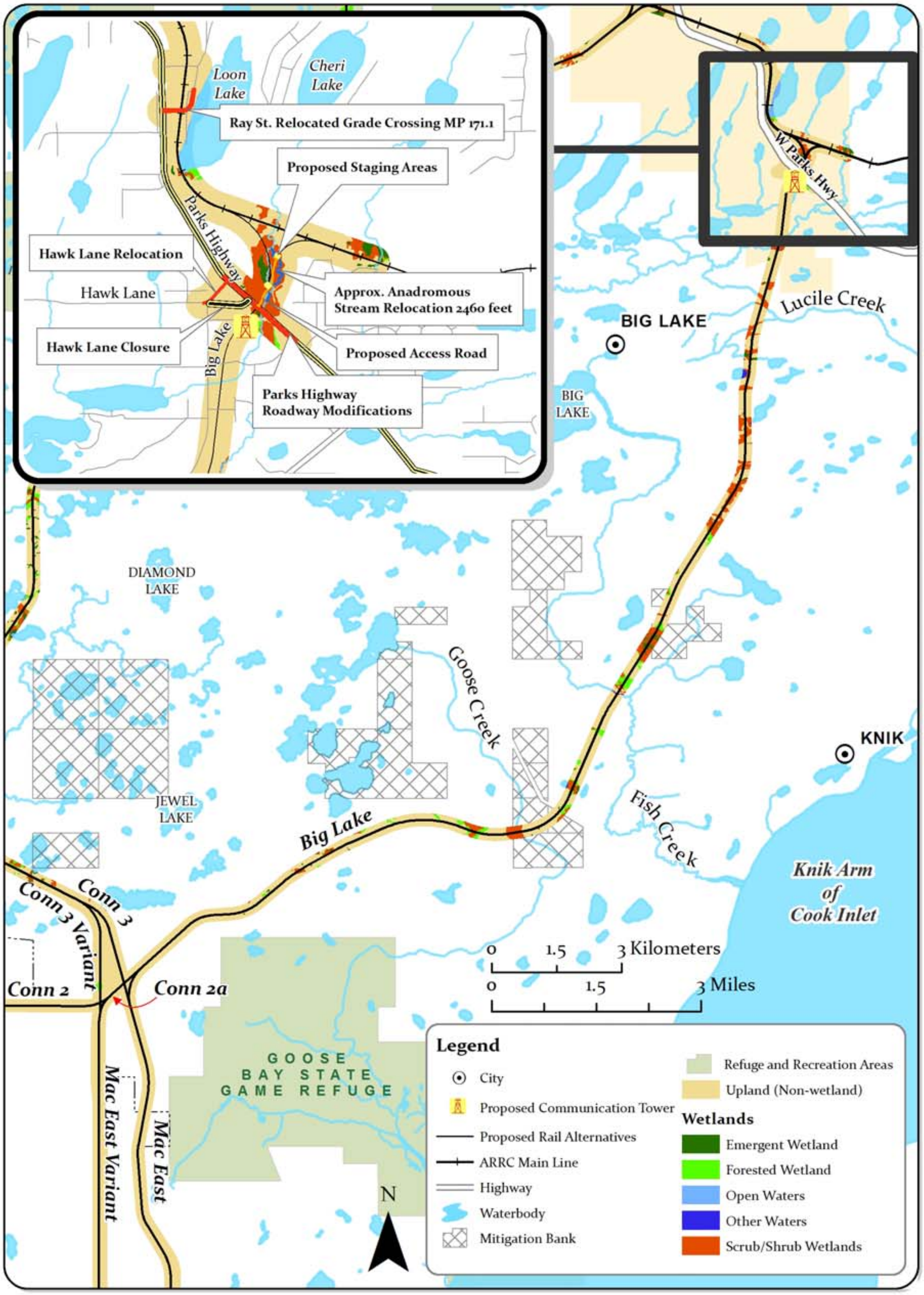

Figure 4.5-4. Big Lake Segment Wetlands within the Study Area

Table 4.5-3
Wetlands within the Rail Line Footprint for the Northern Segments and Segment Combinations

National Wetlands Inventory Code	Description	Willow		Big Lake		Houston-Houston North		Houston-Houston South	
		Area (acres)	Wetland Ratio (percent)	Area (acres)	Wetland Ratio (percent)	Area (acres)	Wetland Ratio (percent)	Area (acres)	Wetland Ratio (percent)
PFO1	Broadleaf Forested Wetlands	0	0	0	0	0	0	0	0
PFO4	Needleleaf Forested Wetlands	10	100.0	11	100.0	24	100.0	13	100.0
PFO#/#	Mixed Forested Wetlands	0	0	0	0	0	0	0	0
PFO	**Subtotal Forested Wetlands**	**10**	**27.2**	**11**	**15.1**	**24**	**24.2**	**13**	**21.4**
PSS1	Broadleaf Scrub/Shrub Wetlands	15	71.0	32	55.4	28	46.6	12	31.8
PSS4	Needleleaf Scrub/Shrub Wetlands	1	4.8	9	15.2	3	5.8	3	6.8
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	5	24.2	17	29.4	29	47.6	23	61.4
PSS	**Subtotal Scrub/Shrub Wetlands**	**21**	**54.6**	**58**	**77.5**	**61**	**60.8**	**38**	**63.3**
PEM	**Emergent Wetlands**	**5**	**12.7**	**5.2**	**7.0**	**13**	**13.5**	**8**	**13.6**
P	Palustrine Waters	<1	9.5	0	0	2	40.0	1	70.0
R	Riverine Waters	2	90.5	<1	100.0	1	60.0	<1	30.0
L	Lacustrine Waters	0	0	0	0	0	0	0	0
	Subtotal Other Wetlands and Waters	**2**	**5.5**	**<1**	**0.4**	**1**	**1.5**	**1**	**1.7**
	All Wetlands and Waters	***38***	***100***	***75***	***100***	***101***	***100***	***61***	***100***

[a] Source: HDR, 2008; HDR, 2010.
[b] Totals might not equal sums of values due to rounding.

combinations – approximately 2 acres. OEA cannot quantitatively assess downstream impacts to riverine wetlands outside the rail line footprint because detailed hydrology modeling has not been conducted. However, a decrease in riverine wetlands along a stream corridor would put more pressure on downstream habitats to make up for the lost functions and could, as a result, lower the ability of the downstream wetland to perform such functions as buffering storm water flows or providing habitat for fish.

There are approximately 6 acres of the Su-Knik Mitigation Bank outside the rail line footprint but within 500 feet of the Willow Segment. Mitigation bank lands within 500 feet of the segment are designated as upland in this area and impacts to wetlands within the bank lands from construction of the rail bed would not be likely.

Big Lake Segment

Construction of this segment would impact about 75 acres of wetlands and waters (Figure 4.5-4 and Table 4.5-3). The Big Lake Segment would cross predominantly scrub/shrub wetlands, which comprise 78 percent of the total wetlands along the route. Most of the scrub/shrub wetlands along the Big Lake Segment are post-fire transitional scrub/shrub wetlands (Herrera, 2008). These wetlands have evolved in places where the previous forested wetland was burned away by the Miller's Reach 2 fire of 1996. As the canopy cover of these scrub/shrub wetlands increases over time, the dominant forested wetland community will begin to take over these areas. The Big Lake Segment would also impact approximately 25 acres of the Su-Knik Mitigation Bank, primarily composed of riverine and riparian wetlands, but also including scrub/shrub wetlands and uplands. These areas are locally important to the MSB and are highly valued (Herrera Environmental Consultants, 2008). Impacts to mitigation bank wetlands could be evaluated as reaching beyond the 200-foot ROW, because the value of these bank wetlands for the purposes of the mitigation bank is based on their contiguous, unfragmented state.

Construction of the Big Lake Segment would involve the relocation of 2,440 feet (0.45 mile) of an anadromous stream. The relocated stream channel (2,460 feet) would be located within emergent and scrub/shrub wetlands. The area where the stream is flowing is a large, contiguous emergent and scrub/shrub wetland mosaic providing high-value functions to the watershed. Wetland impacts associated with the stream relocation could be minimized through careful construction methods to minimize impacts to adjacent wetlands and restoration of wetlands within the impact area after the stream relocation was completed.

There is a large floating mat fen along the Big Lake Segment, located on either side of Goose Creek. This wetland is unique to the study area and provides high-value functions to the watershed. The fen buffers floodwaters, moderates stream flow, contributes to the food chain through nutrient export, and provides safe and warm rearing habitat for overwintering juvenile fish and habitat for waterfowl. Approximately 4 acres of the fen would be within the 200-foot ROW. Impacts outside the rail line footprint would be likely for construction of the rail line over Goose Creek Fen, unless the Applicant proposed a bridge or other drainage structure that would minimize the impact footprint. Fragmentation of this fen by the rail line could significantly impact the entire fen system downstream of the rail line, depending on what type of drainage structure the Applicant proposed for the area.

Houston-Houston North Segment Combination

Construction of this segment combination would impact about 101 acres of wetlands and waters, the highest proportion of wetlands and waters across all the northern segments and segment combinations (37 percent) (Figure 4.5-3 and Table 4.5-3). The Houston-Houston North Segment Combination would cross predominantly mixed and broadleaf scrub/shrub wetlands. It also would impact the largest area of emergent wetlands and palustrine waters than all the other northern segments and segment combinations (14 acres). This is due to the presence of 2 patterned emergent/ scrub/shrub bogs along the Houston North Segment (Figure 4.5-3). Patterned bogs like these contain undulating ridges of peat, providing a mosaic of habitats and providing high functional capacity for improvement of water quality and, due to their large size, storm and flood water storage (HDR, 2008). Fragmentation of these habitats could result in impacts that reach beyond the rail line footprint. The extent and intensity of the impacts (if any) outside the rail line footprint would depend on the type of drainage structures proposed at any given location, and the avoidance, minimization, and mitigation measures proposed for impacts at the site. The Houston North Segment would also fragment habitat adjacent to Houston Lake and could impact the adjacent wetlands north of the segment. These wetlands would no longer be contiguous with the Houston Lake wetlands and would not function as highly for some of the wetland functions (for example, improving water quality and providing habitat for wildlife) as a forested wetland adjacent to a lake.

Houston-Houston South Segment Combination

This segment combination would impact 61 acres of wetlands and waters. The Houston-Houston South Segment Combination would predominantly cross scrub/shrub wetlands, with 63 percent of the rail line footprint along this segment combination consisting of this wetland type. Scrub/shrub wetlands are known to provide wildlife habitat for a variety of species. Fragmentation of these habitats could decrease the ability of adjacent wetlands to provide wildlife habitat due to the smaller overall area of the wetland.

Summary of Potential Impacts by Rail Line Alternative

The largest sources of disturbance and impacts to wetlands from the proposed rail line would be filling, excavating, or clearing for the rail bed and associated facilities. Impacts to wetlands from rail line construction and operation would vary by project alternative. Although some alternatives would require a relatively higher portion of wetlands fill, alternatives with fewer acres of fill could have a more intense impact to wetlands within the study area, depending on the sensitivity and/or importance of the affected wetland and the value of the adjacent habitat that would be fragmented as a result of the proposed project. In addition, the potential for impacts to wetlands could, in some cases, be significantly decreased depending on the avoidance, minimization, and mitigation measures proposed for the area. Overall, wetlands within all proposed rail line alternatives are high functioning for 5 of the 8 wetland functions analyzed for the proposed rail line. The wetlands within all rail line alternatives are moderate to low functioning for groundwater recharge. The wetlands along the proposed rail line alternatives are highest functioning for wildlife habitat, modification of water quality, and vegetation diversity. Ninety-nine to 100 percent of the wetlands scored as high functioning along any given alternative for these functions. OEA compared high-functioning wetlands between alternatives where there would be notable differences, such as for export of detritus, groundwater discharge, stream flow moderation, and storm water and flood water storage. Table 4.5-4 summarizes acreages of impacts to wetland types for each alternative. Table 4.5-5 summarizes impacts to high-functioning wetlands for each rail line alternative. Appendix C provides more detail on specific wetland functions and area of impacts to those functions from each alternative. The following summarizes impacts to wetlands by alternative.

Mac West-Connector 1-Willow Alternative

Construction of this alternative would impact 255 acres of wetlands and waters within the rail line footprint. Wetlands within the rail line footprint would be permanently affected by the construction of the proposed project and would experience loss of function. Although only 32 percent of this alternative is comprised of wetlands and waters, the Mac West-Connector 1-Willow Alternative would affect the fourth largest acreage of wetlands among the alternatives. The Mac West-Connector 1-Willow Alternative would affect the second largest proportion of wetlands that are high functioning for storm water and flood water storage (20 percent) across all wetland types. This alternative would also affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, stream flow moderation, and vegetation diversity. Adjacent wetlands outside the rail line footprint might also be affected by fragmentation or hydrological modification, especially along the Mac West-Connector 1 Segment Combination portion of the alternative.

Mac West-Connector 1-Houston-Houston North Alternative

Construction of this alternative would impact 318 acres of wetlands and waters within the rail line footprint. Compared to the other alternatives, this alternative would impact the greatest overall acreage of wetlands and waters and would have the largest proportion of uplands along its length (47 percent). It also would impact the greatest number of acres of forested, scrub/shrub, and emergent wetlands across all the alternatives. The Mac West-Connector 1-Houston-Houston North Alternative, along with the Mac West-Connector 1-Willow, Mac East Connector 3-Houston-Houston North, and Mac East Variant-Connector 3 Variant-Houston-Houston North alternatives, would impact the highest acreage of waters (3 acres). Many of the wetlands along this alternative comprise areas of patterned bog that have a high functional value for contribution to abundance and diversity of wetland fauna. The Mac West-Connector 1-Houston-Houston North Alternative would affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, stream flow moderation, storm water and flood water storage, and vegetation diversity.

Mac West-Connector 1-Houston-Houston South Alternative

Construction of this alternative would impact 278 acres of wetlands and waters within the rail line footprint. Wetlands within the rail line footprint would be permanently affected by construction of the proposed project and would experience loss of function. Like the Mac West-Connector 1-Houston-Houston North Alternative, Mac West-Connector 1-Houston-Houston South also would affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, stream flow moderation, storm water and flood water storage, and vegetation diversity.

Table 4.5-4
Summary of Impacts to Wetlands (acres) within the Rail Line Footprint by Alternative[a,b,c]

Alternative	Forested Wetlands	Scrub/ Shrub Wetlands	Emergent Wetlands	Total Wetlands	Other Wetlands and Waters[d]	Total Wetlands and Waters	Total Uplands
Mac West-Connector 1-Willow	120	113	19	253	3	255	541
Mac West-Connector 1-Houston-Houston North	134	153	29	315	3	318	347
Mac West-Connector 1-Houston-Houston South	123	130	23	276	2	278	343
Mac West-Connector 2-Big Lake	118	138	18	274	<1	275	473
Mac East-Connector 3-Willow	82	51	6	138	2	140	699
Mac East-Connector 3-Houston-Houston North	96	91	14	201	3	204	507
Mac East-Connector 3-Houston-Houston South	85	68	9	162	2	164	502
Mac East-Big Lake	82	86	6	174	<1	175	587
Mac East Variant-Connector 2a-Big Lake	82	82	5	169	<1	169	576
Mac East Variant-Connector 3 Variant-Willow	83	46	5	135	2	137	701
Mac East Variant-Connector 3 Variant-Houston-Houston North	98	86	14	198	3	200	508
Mac East Variant-Connector 3 Variant-Houston-Houston South	86	64	9	159	2	160	503

[a] Source: HDR, 2008; HDR, 2010.
[b] Acres for alternatives will not match the sum of the acres for individual segments. Segment curves and overlaps were eliminated to represent each alternative as a contiguous area.
[c] Wetland impacts within the Mac East, Mac East Variant, and Mac West segments include impacts from the terminal reserve areas.
[d] Includes palustrine, riverine, and lacustrine waters.

Table 4.5-5
Summary of High-Functioning Wetlands within the Rail Line Footprint by Alternative[a,b,c,d]

		Wetland Function													
	Total	Export of Detritus		Groundwater Discharge		Stream Flow Moderation		Wildlife Habitat		Storm Water and Flood Water Storage		Modification of Water Quality		Vegetation Diversity	
Alternative	Acres	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Mac West-Conn 1-Willow	253	207	82	182	72	8	3	251	99	51	20	253	10	251	99
Mac West-Conn 1-Houston-Houston North	315	272	86	245	78	8	3	314	100	49	15	315	100	314	100
Mac West-Conn 1-Houston-Houston South	276	233	84	211	76	5	2	275	100	46	17	276	100	275	100
Mac West-Conn 2-Big Lake	274	226	82	200	73	8	3	273	100	56	21	274	100	273	100
Mac East-Conn 3-Willow	138	130	95	114	83	18	13	137	99	13	9	138	100	137	99
Mac East-Conn 3-Houston-Houston North	201	196	98	178	89	17	9	200	99	11	5	201	100	200	100
Mac East-Conn 3-Houston-Houston South	162	157	97	144	89	14	9	161	99	8	5	162	100	161	99
Mac East-Big Lake	174	165	95	148	85	19	11	174	100	18	10	174	100	174	100
Mac East Var-Conn 2a-Big Lake	169	160	95	142	84	19	11	168	99	17	10	169	100	168	99
Mac East Var-Conn 3 Var-Willow	135	125	93	109	81	18	13	134	99	15	11	135	100	134	99
Mac East Var-Conn 3 Var-Houston-Houston North	198	191	96	173	88	17	9	197	99	12	6	198	100	197	99
Mac East Var-Conn 3 Var-Houston-Houston South	159	152	96	139	87	14	9	158	99	9	6	159	100	158	99

[a] Source: HDR, 2008; HDR, 2010.
[b] Acres for alternatives will not match the sum of the acres for individual segments. Segment curves and overlaps were eliminated to represent each alternative as a contiguous area.
[c] Wetland impacts within the Mac East, Mac East Variant, and Mac West segments include impacts from the terminal reserve areas.
[d] There were no impacts to high functioning wetlands for groundwater recharge; as such, was not included in the table.

Adjacent wetlands outside the rail line footprint could also be affected by fragmentation or hydrological modification, especially within the Mac West-Connector 1 Segment Combination. Compared to other alternatives, impacts to forested and emergent wetlands along this alternative would be the second highest (123 and 23 acres, respectively), and impacts to scrub/shrub wetlands along this alternative would be third highest (130 acres). This alternative also has the second highest proportion of wetlands along the overall rail line footprint (45 percent).

Mac West-Connector 2-Big Lake Alternative

Construction of this alternative would impact 275 acres of wetlands and waters. The Big Lake Segment of this alternative would impact locally important Su-Knik Mitigation Bank areas that contain high-value wetlands. This alternative would also impact the unique floating fen located on either side of Goose Creek along the Big Lake Segment. Impacts to this high value wetland would depend on the size of the drainage structure or crossing designed for the waterbody. The Mac West-Connector 2-Big Lake Alternative would affect the highest proportion of wetlands with high functionality for storm water and flood water storage (21 percent) across all alternatives. This alternative also would affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, stream flow moderation, and vegetation diversity across all wetland types. This is likely due to the Big Lake Segment, because this segment also contains the largest proportion of high-functioning wetlands across all the segments. While the acres affected would not be as great as some of the other alternatives (second highest acreage of scrub/shrub impacts at 138 acres), there would be impacts to functions and values of locally important wetlands, such as the floating fen, and the intensity of the impacts would depend on the avoidance, minimization, and mitigation measures proposed for the area.

Mac East-Connector 3-Willow Alternative

Construction of this alternative would impact 140 acres of wetlands and waters, the second lowest impact to wetlands and waters across all the alternatives. Compared to other alternatives, this alternative would have the second lowest proportion of wetlands, with approximately 17 percent of the rail line footprint being comprised of wetlands. Although the overall acreage of impacts to wetlands in the rail line footprint would be relatively low for this alternative, impacts to other wetlands and waters could be locally significant, depending on the avoidance, minimization, and mitigation measures incorporated into the project. The Mac East-Connector 3-Willow Alternative, along with the Mac East Variant-Connector 3 Variant-Willow Alternative, would affect the highest proportion of wetlands with high functionality for stream flow moderation (13 percent). This alternative also would affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, storm water and flood water storage, and vegetation diversity. The alternative would cross a moderate number of riverine habitats and would pass between lakes and other open water habitat. Impacts to these wetland types could extend beyond the rail line footprint, depending on best management practices incorporated into the project.

Mac East-Connector 3-Houston-Houston North Alternative

Construction of this alternative would impact 204 acres of wetlands and waters (approximately 29 percent of the area within the rail line footprint). Impacts to other wetlands and waters along this alternative would be the highest across all the alternatives, along with the Mac West-Connector 1-Willow, Mac West-Connector 1-Houston-Houston North, and Mac East Variant-Connector 3 Variant-Houston-Houston North alternatives. The Mac East-Connector 3-Houston-Houston North Alternative would affect the largest proportion of wetlands with high functionality for export of detritus (98 percent). Along with the Mac East-Connector 3-Houston-Houston North Alternative, it would affect the largest proportion of wetlands with high functionality for groundwater discharge (89 percent) across all alternatives. This alternative also would affect wetlands that are high functioning for wildlife habitat, modification of water quality, stream flow moderation, storm water and flood water storage, and vegetation diversity. Because of the sensitivity of these habitats to fragmentation, the presence of open and flowing water adjacent to and within the rail line footprint potentially increases the chances that impacts to wetlands could extend beyond the rail line footprint into adjacent habitats.

Mac East-Connector 3-Houston-Houston South Alternative

Construction of this alternative would impact 164 acres of wetlands and waters. Compared to other alternatives, this alternative would impact the fourth lowest overall acres of wetlands and waters, with more than half of that impact being the loss of forested wetlands. There could be impacts to wetlands outside the rail line foot print from fragmentation of wetland communities that provide wildlife habitat. The Mac East-Connector 3-Houston-Houston South Alternative, along with Mac East-Connector 3-Houston-Houston North Alternative would affect the largest proportion of wetlands with high functionality for groundwater discharge (89 percent) across all alternatives. This alternative also would affect wetlands that are high functioning for export of detritus, wildlife habitat, modification of water quality, stream flow moderation, storm water and flood water storage, and vegetation diversity. Although the overall acres of impacts to wetlands for this alternative would be relatively low, the intensity of the impacts could be greater than others, depending on the avoidance, minimization, and mitigation measures incorporated into the project.

Mac East-Big Lake Alternative

Construction of this alternative would impact 175 acres of wetlands and waters, with approximately half of the impact attributed to scrub/shrub wetlands and half attributed to forested wetlands. This alternative would have the second lowest impact on emergent wetlands, along with Mac East-Connector 3-Willow Alternative, the lowest impact on forested wetlands, along with the Mac East-Connector 3-Willow and Mac East Variant-Connector 2a-Big Lake alternatives, and the lowest impact on other wetlands and waters, along with the Mac West-Connector 2-Big Lake and Mac East Variant-Connector 2a-Big Lake alternatives. The Mac East-Big Lake Alternative would cover the fourth highest overall acreage across all the alternatives, the rail line footprint comprising 762 acres. This alternative would impact approximately 25 acres of Su-Knik Mitigation Bank, and likely require additional mitigation to replace these high-value wetlands. This alternative would also impact the unique floating fen located on either side of Goose Creek along the Big Lake Segment. Impacts to this high-value wetland would depend on the size of the drainage structure or crossing designed for the waterbody. The Mac East-Big Lake Alternative would affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, stream flow moderation, storm water and flood water storage, and vegetation diversity. This is mostly due to the Big Lake Segment, because this segment also contains the highest proportion of high-functioning wetlands compared to other rail line segments. Although the acreage of impacts to wetlands would be relatively low for this alternative, impacts to sensitive habitats like the Goose Creek Fen and the Su-Knik Mitigation Bank could be more intense, depending on the avoidance, minimization, and mitigation measures incorporated into the project.

Mac East Variant-Connector 2a-Big Lake Alternative

Construction of this alternative would impact 169 acres of wetlands and waters, with approximately half of the impact attributed to scrub/shrub wetlands and half attributed to forested wetlands. This alternative would have the lowest impact on emergent wetlands, along with the Mac East Variant-Connector 3 Variant-Willow Alterative, and the lowest impact to other wetlands and waters, along with the Mac West-Connector 2-Big Lake and Mac East-Big Lake alternatives. This alternative would impact 25 acres of the Su-Knik Mitigation Bank and likely require additional mitigation to replace these high-value wetlands. This alternative would also impact the unique floating fen located on either side of Goose Creek along the Big Lake Segment. Impacts to this high-value wetland would depend on the size of the drainage structure or crossing designed for the waterbody. The Mac East Variant-Connector 2a-Big Lake Alternative would affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, stream flow moderation, storm water and flood water storage, and vegetation diversity. This is mostly due to the Big Lake Segment, because this segment also contains the highest proportion of high-functioning wetlands compared to other rail line segments. Although the acreage of impacts to wetlands would be relatively low for this alternative, impacts to sensitive habitats like the Goose Creek Fen and the Su-Knik Mitigation Bank could be more intense, depending on the avoidance, minimization, and mitigation measures incorporated into the project.

Mac East Variant-Connector 3 Variant-Willow Alternative

Construction of this alternative would impact 137 acres of wetlands and waters, the lowest impact to wetlands and waters across all the alternatives. Compared to other alternatives, this alternative would also have the lowest proportion of wetlands, with just 16 percent of the rail line footprint being comprised of wetlands. Although the overall acreage of impacts to wetlands in the rail line footprint would below for this alternative, impacts to other wetlands and waters could be locally significant, depending on the avoidance, minimization, and mitigation measures incorporated into the project. The Mac East Variant-Connector 3 Variant-Willow Alternative, along with the Mac East-Connector 3-Willow Alternative, would affect the highest proportion of wetlands with high functionality for stream flow moderation (13 percent). This alternative would also affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, storm water and flood water storage, and vegetation diversity. The alternative would cross a moderate number of riverine habitats and would pass between lakes and other open water habitat. Impacts to these wetland types could extend beyond the rail line footprint, depending on best management practices incorporated into the project.

Mac East Variant-Connector 3 Variant-Houston-Houston North Alternative

Construction of this alternative would impact 200 acres of wetlands and waters (approximately 28 percent of the area within the rail line footprint). Impacts to other wetlands and waters along this alternative, along with the Mac West-Connector 1-Willow, Mac West-Connector 1-Houston-Houston North, and Mac East-Connector 3-Houston-Houston North alternatives, would be the highest across all the alternatives. The Mac East Variant-Connector 3 Variant-Houston-Houston North Alternative would affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, stream flow moderation, storm water and flood water storage, and vegetation diversity. Because of the sensitivity of these habitats to fragmentation, the presence of open and flowing water adjacent to and within the rail line footprint potentially increases the chances that impacts to wetlands could extend beyond the rail line footprint and into adjacent habitats.

Mac East Variant-Connector 3 Variant-Houston-Houston South Alternative

Construction of this alternative would impact 160 acres of wetlands and waters. Compared to other alternatives, this alternative would impact the third lowest overall acres of wetlands and waters, with more than half of that impact being the loss of forested wetlands. This alternative also impacts the second lowest amount of scrub/shrub wetlands and third lowest amount of other wetlands and waters. There could be impacts to wetlands outside the rail line foot print from fragmentation of wetland communities that provide wildlife habitat. The Mac East Variant-Connector 3 Variant-Houston-Houston South Alternative would affect wetlands that are high functioning for export of detritus, groundwater discharge, wildlife habitat, modification of water quality, stream flow moderation, storm water and flood water storage, and vegetation diversity. Although the overall acres of impacts to wetlands for this alternative would be relatively low, the intensity of the impacts could be greater than others, depending on the avoidance, minimization, and mitigation measures incorporated into the project.

4.5.4.2 No-Action Alternative

Under the No-Action Alternative, the proposed Port MacKenzie Rail Extension would not be constructed and operated, and there would be no wetland-fill losses or reduction of wetland function.

4.5.5 Unavoidable Environmental Consequences of the Proposed Action

To avoid or minimize the potential environmental impacts to wetlands from the proposed rail line as described above in Section 4.5.4.1, OEA is recommending that the Board impose up to 9 mitigation measures, including 3 measures volunteered by the Applicant and 1 alternative-specific mitigation measure. These measures include requiring: the acquisition of appropriate Federal and state permits; measures to mitigate unavoidable impacts to wetlands, including mitigating encroachment on the Su-Knik Mitigation Bank; avoidance and minimization of impacts to wetlands and waters of the United States; construction designed to maintain natural water flow and drainage; utilization of best management practices imposed by the USACE; and the removal of debris from wetlands and waters at rail line crossings.

Commenters suggested elevating the proposed rail line on a trestle across wetlands and floodplains to further avoid or reduce potential impacts to wetland resources; however, OEA verified that the cost of such a measure would be approximately $13,000 per foot to build an elevated trestle, as compared to $1,000 per foot to build the rail at ground level. The greater cost of an elevated trestle would make the measure impractical. For example, the elevation of only 1.5 miles of track would increase the anticipated total project cost by approximately 50 percent.

Notwithstanding the recommended mitigation measures, there still would be potential unavoidable impacts to wetlands within and adjacent to the proposed rail line ROW. Potential impacts would include: unavoidable filling of wetlands; permanent loss of wetland functions within the fill area; potential changes to natural drainage and altered flood hydraulics near crossings; increased potential for debris jams and overbank flooding upstream of water crossings; changes to recharge potential and aquifer dewatering; impacts to the Su-Knik Mitigation Bank; and impacts to Goose Creek Fen (for alternatives that include the Big Lake Segment). As discussed in the mitigation measures, the Applicant would be required to provide compensatory mitigation for unavoidable impacts to wetlands and waters of the United States. This could include utilizing wetland banks or creating new wetlands. Though wetland acreage and functionality could be compensated, functionality from an existing system would be lost. If wetland creation is required as part of the permitting process, a created wetland at a different site might not have the same ecological value as the wetlands being filled.

There is also some chance that there could be additional potential impacts due to culvert or bridge design or maintenance. Recommended mitigation would require water crossing structures to be designed to meet specific hydrologic criteria (such as the 100-year flood), but natural fluctuations in hydrology could create instances where culvert and bridge design cannot move flow effectively, potentially leading to an alteration in water flow through wetlands. For example, flooding levels exceeding the culvert design could result in impeded surface water flow, impacting wetland function. Culverts would result in greater potential impacts to flow than bridges due to the greater potential of culverts to constrict and alter flows than bridges.