APPENDIX F
FISHERIES RESOURCES

F. FISHERIES RESOURCES

The Surface Transportation Board's (STB or the Board) Office of Environmental Analysis (OEA) analyzed of potential impacts to fisheries resources from potential rail line crossings associated with the proposed Port MacKenzie Rail Extension. The analysis considered information available on current and potential anadromous and resident fish use, existing habitats, anadromous and resident fish habitat requirements, anadromous and resident fish seasonal movement patterns, proposed crossing or conveyance types and sizes, potential stream blockages, and the stream contributions to important recreational, commercial, or personal-use fisheries. OEA identified potential instream fish habitat through review of stream-crossing characteristics, reported anadromous fish presence and habitat use data (Johnson and Daigneault, 2008), and fish habitat data collected at or near proposed stream crossings during OEA field investigations in 2008 (Noel *et al.*, 2008). In addition, in response to comments on the Draft Environmental Impact Statement (EIS), OEA performed a Geographic Information System (GIS) geomorphic analysis to characterize further the fish habitat potential upstream of the proposed rail line crossings. In response to comments, OEA used a conservative approach with this analysis by including all waterbodies currently supporting fisheries and waterbodies with the potential to support fisheries, even if they currently do not. The results of this analysis do not alter prior information included in the Draft EIS; rather, in this Final EIS, they are presented and considered in conjunction with the prior information in assessing potential impacts.

In this Final EIS, streams, rivers, lakes, and ponds were analyzed as fish-bearing if: 1) they are cataloged anadromous waters (Johnson and Daigneault, 2008), 2) they are connected to a cataloged anadromous water, 3) fish habitat was determined to be present during OEA stream-crossing investigations in 2008 (Noel *et al.*, 2008), or 4) the GIS geomorphic analysis conducted for Section 4.2 showed stream connectedness and anadromous and/or resident fish habitat potential upstream of each crossing.

The proposed project alternatives would cross drainages important for fisheries in the upper Cook Inlet – Willow Creek, Rolly Creek, and Fish Creek (tributaries of the Susitna River); the Little Susitna River Drainage; and the Big Lake Drainage, the Goose Creek Drainage, and drainages in east Susitna Flats (see Section 4.2). These drainages support between 1 and 5 species of Pacific salmon, as described in Section 5.4. This appendix provides additional information and analyses supporting the information and analysis in Section 5.4.

F.1 Recreational Fisheries

The Alaska Department of Fish and Game (ADF&G) Sport Fish Division manages recreational fisheries in the project area. The proposed rail line would lie within the northern Cook Inlet sport fish management area (Figure F-1), which includes all freshwater drainages and adjacent marine waters of Upper Cook Inlet between the southern tip of Chisak Island and the Eklutna River, excluding the upper Susitna River Drainage. The project alternatives could affect important recreational fish streams, including the Little Susitna River, Fish Creek, Willow Creek, Rogers Creek, Lake Creek, Goose Creek, Lucile Creek, Little Meadow Creek, and several unnamed tributary streams (Sweet *et al.*, 2003). Sport anglers fish in the management area for salmon – Chinook, chum, coho, pink and sockeye; rainbow trout, Dolly Varden, Arctic char,

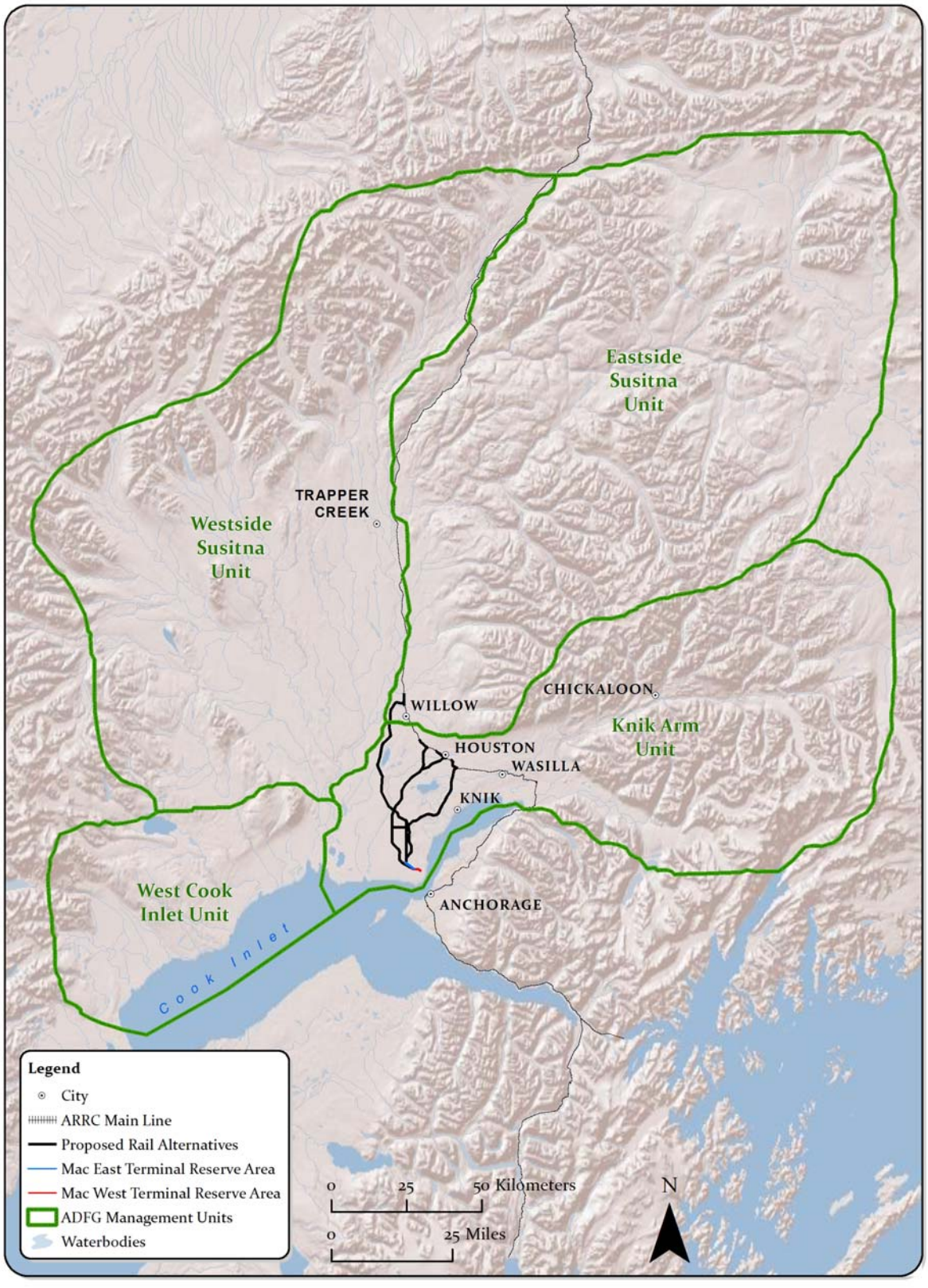

Figure F-1. Upper Cook Inlet Sport Fish Management Area (ADF&G, 2009b)

Arctic grayling, lake trout, northern pike, whitefish, and eulachon (Table F-1). Upper Cook Inlet fisheries have been the focus of allocation disputes between commercial, subsistence, and sport fishing interests for many years. Commercial fishing of these stocks takes place in Cook Inlet waters. About 60 percent of Alaska's population lives within or next to the management area and recreational fishing is an important year-round activity (Sweet *et al.*, 2003). Parks Highway, secondary roads from Port MacKenzie to the town of Willow, navigable waters, and overland trail systems provide access to fisheries resources in the project area.

Table F-1
Habitat and Ecology of Important Commercial, Recreational, Subsistence, and Personal-Use Fisheries[a] (page 1 of 2)

Common Name (Species)	Spawning Habitats/ Rearing Habitats	Overwinter Habitats	Ecology
Arctic Char (*Salvelinus alpinus*)	Spawn over steep, broken substrates or gravel shoals August to October. Rear in lakes.	Overwinter in lakes.	Little known about life history in lakes. Reach maturity at about age 6 to 9. Often exist in dwarf and normal forms in the same lake.
Arctic Grayling (*Thymallus arcticus*)	Cool, clear, small headwater streams with gravelly substrate, might travel up to 100 miles, move little during summer feeding season; feed on drifting aquatic insects, salmon eggs, outmigrating salmon smolts, and terrestrial insects; juveniles and subadults move between overwintering grounds in larger rivers to feeding grounds in clearwater tributaries.	Overwinter in lakes and in the lower reaches and deeper pools of Willow Creek and the Little Susitna River.	Highly migratory within a river system using different tributaries for spawning, juvenile rearing, summer feeding, and overwintering. Might travel up to 100 miles to spawning streams; after ice breakup, migrate to summer feeding areas and spawning grounds. Spawn at about age 4 or 5, 11 to 12 inches long, and generally return to the same spawning and feeding areas each year.
Burbot (*Lota lota*)	Spawn under the ice in late February to March. Young feed on insects and other invertebrates, larger subadults and adults feed on whitefish, sculpins, and lampreys.	Overwinter in lakes or in deeper pools along rocky outcroppings or bluffs in larger rivers.	Nocturnal, long-lived, and slow-growing; sexually mature at 8 years, 18 inches. Harvest is restricted in lakes as populations have declined.
Chinook Salmon (*Oncorhynchus tshawytscha*)	Spawn in fast, deep water over gravelly or rocky bottoms of clearwater streams where they can dig redds; fry and juveniles use sloughs, backwaters, tributaries, shallows along gravel bars, and beaver ponds.	Overwinter as eggs or juveniles. Can be found in Willow Creek and the Little Susitna River.	Juveniles smolt and outmigrate in spring following hatching, and outmigration appears to occur soon after ice breakup, peaking in mid to late May. Extensive movement within the river system in the first year of life, adults return to spawn after 4- to 5-year marine residence.
Chum Salmon (*Oncorhynchus keta*)	Spawn in small side channels and areas of larger rivers with upwelling springs; fry emerge from the gravel in spring and immediately outmigrate downriver, feeding on small insects and other detritus.	Overwinter as eggs.	Fry emerge from the gravel in early to mid April, with peak outmigration before the end of May. Adults return to spawn after 3- to 5-year marine residence (adults infrequently found in study area).

Table F-1
Habitat and Ecology of Important Commercial, Recreational, Subsistence, and Personal Use Fisheries[a] (page 2 of 2)

Common Name (Species)	Spawning Habitats/ Rearing Habitats	Overwinter Habitats	Ecology
Coho Salmon (*Oncorhynchus kisutch*)	Spawn in gravel areas of clearwater habitats, usually spring-fed; juveniles use ponds, lakes, and pools in streams and rivers or stream margins, usually among submerged woody debris and in scour pools.	Juveniles overwinter near springs and in spring-fed streams; areas with upwelling are important for both egg and fry survival.	Spend 1 to 3 years in streams, spend 1 year in marine waters before returning. Sizeable run in the Little Susitna River.
Dolly Varden (*Salvelinus malma*)	Spawn from late September to October in streams with gravel; juveniles rear in streams, remaining under rocks, logs, or undercut banks and feeding from the stream bottom.	Overwinter in lakes, migrate to different river systems to find overwintering habitat.	Anadromous and freshwater populations. Eggs hatch in March and fry emerge as late as June, mature at 5 to 9 years, with 3 to 4 summers marine residence, about 16 to 24 inches.
Eulachon – smelt (*Thaleichthys pacificus*)	Spawn in lower reaches of streams, hatch in fresh water and grow to maturity in the marine environment feeding on "krill."	Not in fresh water.	Eggs hatch in 21 to 40 days, current carries them to the marine environment. Adults return in 3 to 4 years. Adults die after spawning.
Lake Trout (*Salvelinus namaycush*)	Spawn September through November over shallow rocky shoals, clean, rocky lake bottom; eggs hatch in spring; feed on phytoplankton.	Overwinter in deep lakes.	Deep, oligotrophic mountain lakes; mature and spawn for the first time at approximately 7 or 8 years and after that, spawn every other year or even less frequently; live to about 20 but can live up to 40 years.
Northern Pike (*Esox lucius*)	Spawn in marshy, grassy banks with little or no current; young pike emerge and begin to feed on insects and small crustaceans, quickly beginning to feed on smaller fish.	Believed to overwinter in the deep, slow waters of larger rivers and in deeper lakes.	Not believed to travel long distances. Found in large and small lakes and tributaries to the Susitna River and the Little Susitna River, Big Lake, and Fish Creek.
Pink Salmon (*Oncorhynchus gorbuscha*)	Spawn in the lower reaches of freshwater streams in shallow riffles over coarse gravel; eggs hatch midwinter in the gravel and emerge in late winter to migrate to marine waters.	Eggs in the gravel until spring; do not overwinter as juveniles in Southcentral Alaska.	2-year cycle that is stronger on even years; can be found in most area streams during summer migration.
Rainbow Trout (*Oncorhynchus mykiss*)	Spawn in late winter and early spring on shallow gravel riffles in clearwater streams when fish are about 6 to 7 years. Eggs hatch in 1 to 4 months. Juveniles rear along protected lake shores and stream banks.	Overwinter in larger lakes and deeper pools.	Occur as both freshwater-resident and sea-run races known as steelhead trout. Rainbows in this area are wild stocks as well as hatchery fish.
Sockeye Salmon (*Oncorhynchus nerka*)	Usually spawn in rivers and streams and upwelling areas along lake beaches. Eggs hatch during winter and young emerge and move into rearing areas along lakes and streams.	Juveniles use deeper, large lakes for overwintering.	In stream systems with large lakes; spawning in streams and rivers will occur in backwater sloughs or oxbows. The Fish Creek-Big Lake drainage has a moderate run of sockeye salmon.

[a] Source: ADF&G, 2007a; 2007b; 2009a; Mecklenburg *et al*., 2002.

Sport angling opportunities are available year-round. Summer fishing activity coincides with the return of salmon to the area, and most sport fishing takes place along the accessible stream reaches near Parks Highway or on the larger navigable rivers and streams. During winter, anglers fish through the ice, primarily on stocked lakes with rainbow trout, Arctic grayling, Arctic char, and landlocked Chinook and coho salmon. There are also wild stocks of rainbow trout, Dolly Varden, Arctic grayling, northern pike, burbot, Arctic char, and lake trout. Figures F-2 and F-3 depict the estimated sport fishing harvest by species and fishing effort for area lakes and streams (ADF&G, 2009c). Total fishing effort on area lakes (24,000 days) was about 36 percent of the fishing effort on area streams and rivers (67,000 days) during 2007 (ADF&G, 2009c). Total harvest for rainbow trout (approximately 5,600 fish) and northern pike (approximately 3,000 fish) in area lakes was about 39 percent of the total harvest for coho salmon (approximately 15,800 fish) and Chinook salmon (approximately 6,300 fish) in area streams during 2007 (ADF&G, 2009c).

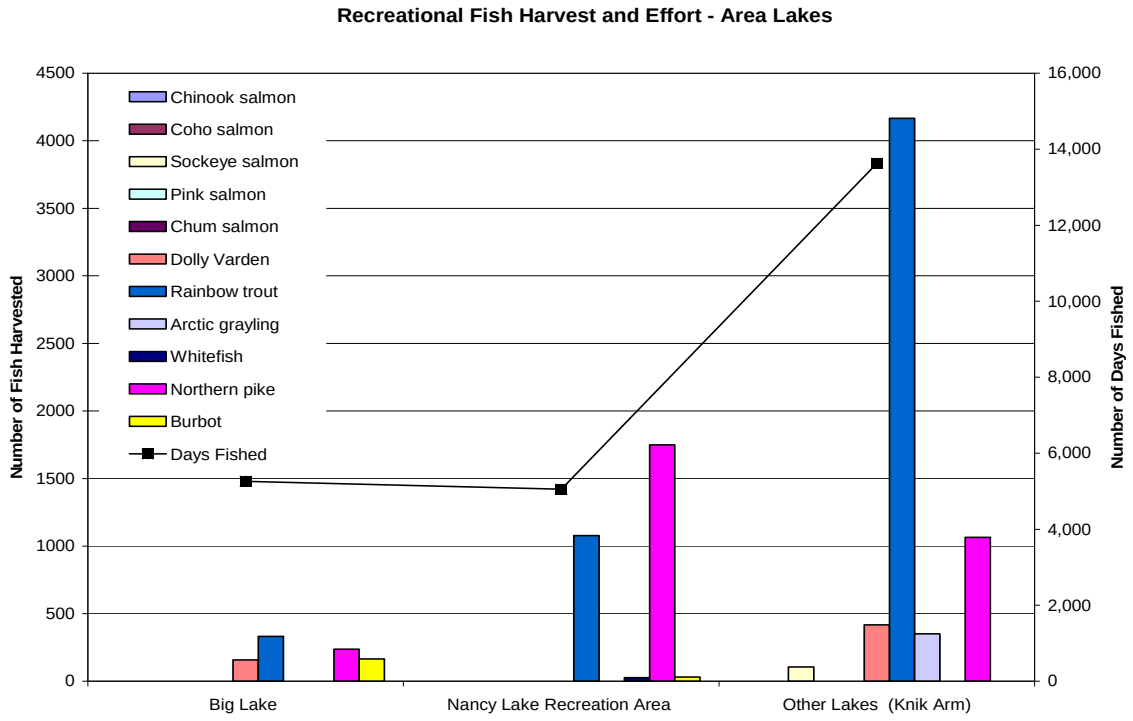

Figure F-2. Recreational Fish Harvest and Effort for Area Lakes during 2007 (ADF&G, 2009c)

F.2 Commercial Fisheries

The ADF&G Division of Commercial Fisheries manages commercial, subsistence, and personal-use fisheries. The Division of Commercial Fisheries manages the Upper Cook Inlet commercial fishing district to provide fishing opportunities to the commercial drift gill net fleet and set gill nets along the shore line. The Upper Cook Inlet management district includes the area north of Anchorage Point, and is divided into the Central and Northern districts (Figure F-4). The Northern District includes marine waters in 3 subdistricts that are within the study area –

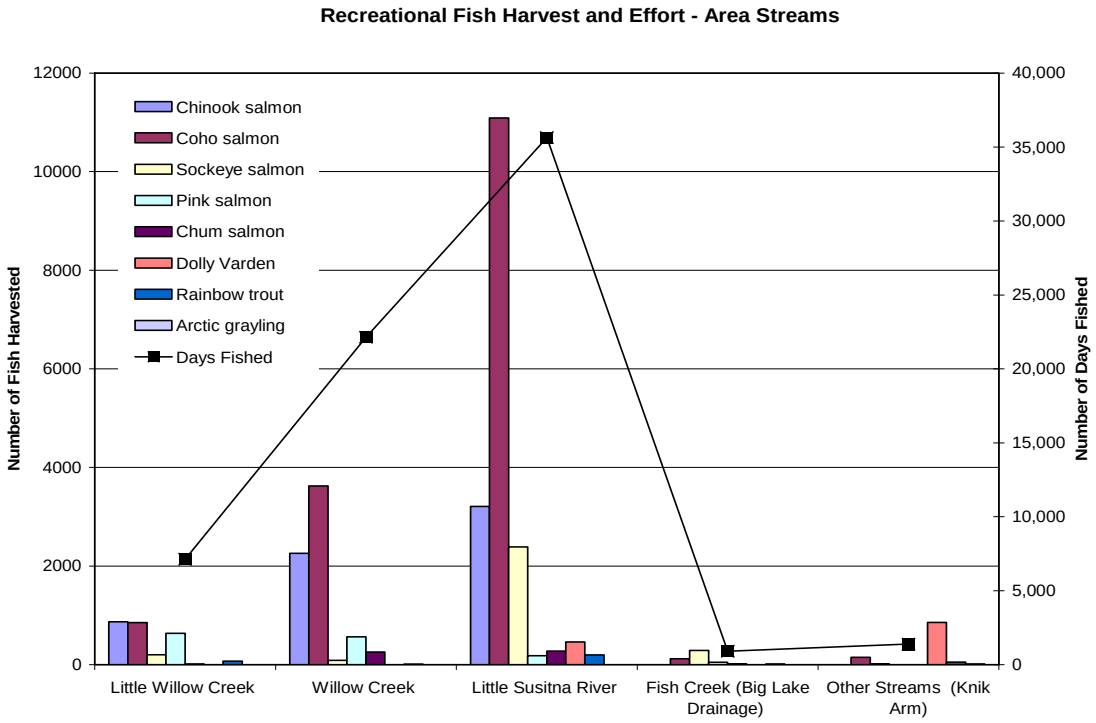

Figure F-3. Recreational Fish Harvest and Effort for Area Streams during 2007 (ADF&G, 2009c)

Subdistrict 247-41 Susitna Flats, Subdistrict 247-42 Point MacKenzie, and Subdistrict 247-50 Knik (Figure F-4). All 5 Pacific salmon, razor clams (*Siliqua patula)*, Pacific herring (*Clupea pallasi*), and eulachon or smelt are commercially harvested in the Upper Cook Inlet (ADF&G, 2007b).

Since the inception of the first commercial salmon fishery in 1882, many gear types, including fish traps, gill nets, and seines, have been used with varying degrees of success to harvest salmon in the Upper Cook Inlet. At present, (fixed) gill nets are used for harvest in the Northern District. Typically, the Upper Cook Inlet salmon harvest is about 5 percent of the statewide commercial salmon harvest, and is harvested by nearly 10 percent of all holders of statewide salmon permits (Shields, 2007). The commercial salmon harvest in Upper Cook Inlet has ranged from 1.8 to 5.7 million fish, primarily sockeye salmon, with a 10-year average of 3.5 million salmon per year (Table F-2). In the study area, the salmon harvest in 2007 in Subdistricts 247-41, 247-42, and 257-50 represented less than 1 percent of the Upper Cook Inlet harvest (Shields, 2007).

Chinook salmon stocks in late May are the earliest run of salmonids that provide Upper Cook Inlet commercial fishing opportunity. As the season progresses, sockeye, chum, and coho salmon also become available to commercial fisheries, and commercial fishing continues throughout summer. The ADF&G monitors salmon stocks returning to index streams in the study area for salmon escapement (adult salmon returning to spawning grounds – or those that have "escaped" harvest) to ensure sustainability of salmon stocks (Table F-3).

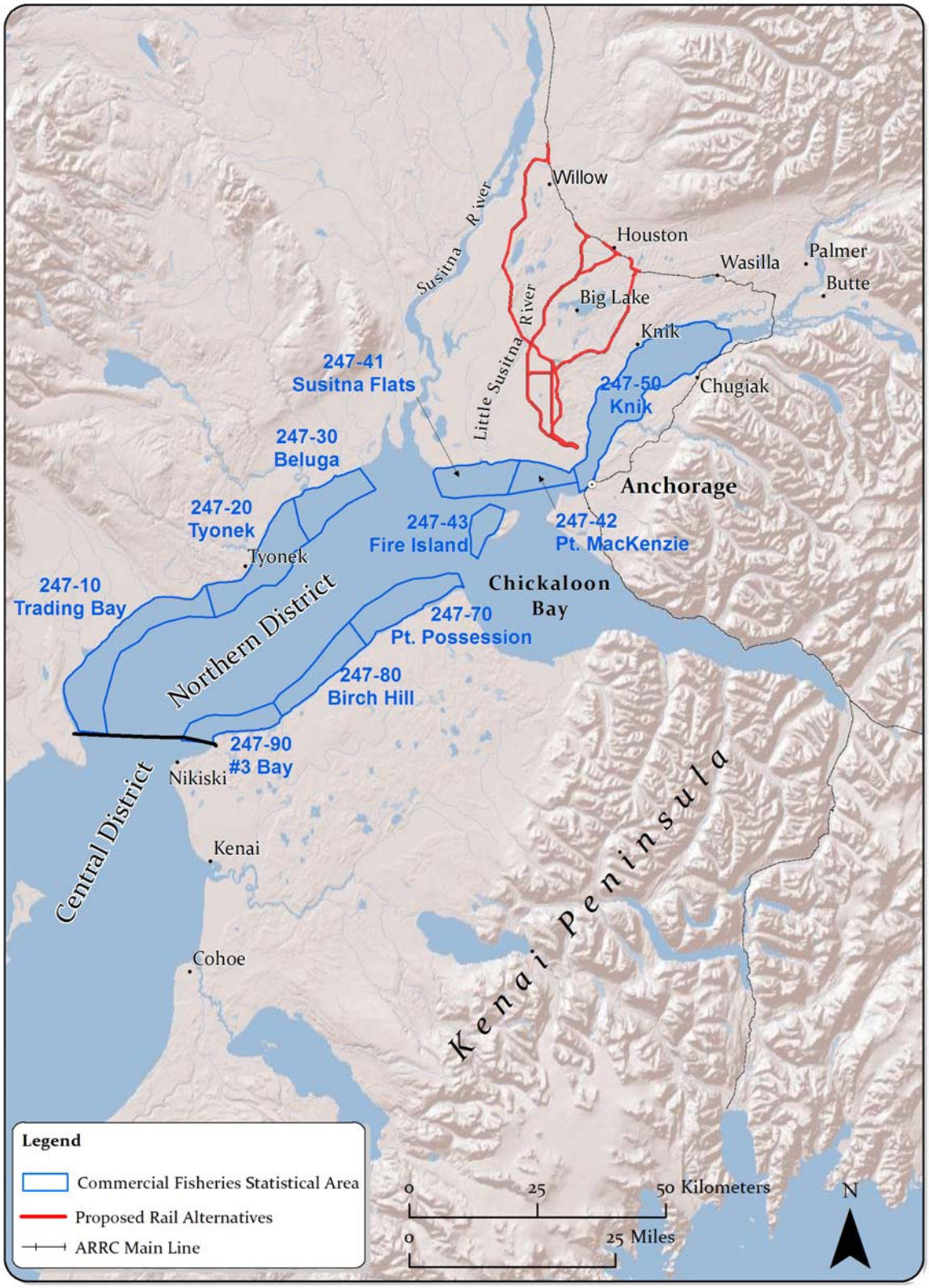

Figure F-4. Upper Cook Inlet Commercial Fisheries Districts and Subdistricts (Shields, 2007)

Table F-2

Upper Cook Inlet Commercial Salmon Harvest 1997 to 2007[a]						
Year	**Chinook**	**Sockeye**	**Coho**	**Pink**	**Chum**	**Total**
1997	13,292	4,176,738	152,404	70,933	103,036	4,516,403
1998	8,124	1,219,242	160,660	551,260	95,654	2,034,940
1999	14,383	2,680,510	125,908	16,174	174,541	3,011,516
2000	7,350	1,322,482	236,871	146,482	127,069	1,840,254
2001	9,295	1,826,833	113,311	72,559	84,494	2,106,492
2002	12,714	2,773,118	246,281	446,960	237,949	3,717,022
2003	18,490	3,476,159	101,756	48,789	120,767	3,765,961
2004	27,476	4,926,220	311,056	357,939	146,164	5,768,855
2005	28,171	5,238,168	224,657	48,419	69,740	5,609,155
2006	18,029	2,192,730	177,853	404,111	64,033	2,856,756
2007	17,625	3,316,779	177,339	147,020	77,240	3,736,003
Average, 1997 – 2006	15,732	2,983,220	185,076	216,363	122,345	3,522,736

[a] Source: Shields, 2007.

Table F-3
Salmon Escapement in Index Streams in the Port MacKenzie Rail Extension Study Area[a]

	Sustainable Escapement Goals		Escapements			
System	**Data Source**	**Range**	**2004**	**2005**	**2006**	**2007**
Chinook Salmon						
Little Susitna River	Single aerial survey index	900 to 1,800	1,694	2,095	1,855	1,731
Little Willow Creek	Single aerial survey index	450 to 1,800	2,227	1,784	816	1,103
Willow Creek[b]	Single aerial survey index	1,600 to 2,800	2,985	2,463	2,217	1,373
Coho Salmon						
Little Susitna River	Weir[c]	10,100 to 17,700	40,199	16,839	8,786	17,573
Sockeye Salmon						
Fish Creek (Big Lake)	Weir	20,000 to 70,000	22,157	14,215	32,562	27,948

[a] Sources: Shields, 2007; Tobias and Willette, 2008.
[b] Willow Creek escapement includes hatchery fish.
[c] Weir washed out of the Little Susitna River in 2005 and 2006; counts were incomplete.

The Susitna River is the largest salmon-producing stream in the Northern District. Proposed rail line alternatives would cross 4 tributaries to the main-stem Susitna River – Rogers Creek (a tributary to Little Willow Creek), Willow Creek, Rolly Creek (upstream from anadromous fish use [Johnson and Daigneault, 2008]), and Fish Creek. Salmon stocks from the Susitna River and its tributaries are an important component of the commercial fishery in Northern Cook Inlet, although the contribution of Little Willow Creek, Willow Creek, Rogers Creek, and Fish Creek stocks to the Susitna River salmon stocks is not known (Tobias and Willette, 2008).

Salmon stocks in streams the proposed rail line would cross contribute to commercial, recreational, and personal-use fisheries. In the study area, Chinook salmon stocks are found in Little Willow Creek, Willow Creek, the Little Susitna River, and the Fish Creek-Big Lake Drainage. Chum salmon are found infrequently in the study area with spawning stocks of unknown size in Little Willow Creek, Willow Creek, the Little Susitna River, Little Meadow

Creek, and the Fish Creek-Big Lake Drainage. Chum salmon are harvested incidentally to the catch of other salmon. Coho salmon stocks can be found in most streams in the study area. Pink salmon stocks are found in the study area in Little Willow Creek, Willow Creek, the Little Susitna River, an unnamed tributary of the Little Susitna River, Little Meadow Creek, and the Fish Creek-Big Lake Drainage. Pink salmon are harvested as part of the overall commercial catch, but are not targeted by Upper Cook Inlet fisheries. Sockeye salmon stocks from the Fish Creek-Big Lake Drainage, the Little Susitna River, Little Meadow Creek, Lucile Creek, and the Fish Creek-Susitna River Drainage all contribute to commercial and subsistence harvests. Stocks of sockeye salmon can be sizeable when reproduction is successful. In recent decades, stocks of native sockeye salmon have been of concern due to overstocking of hatchery fish, degradation of habitat, and predation by non-native northern pike.

In the marine waters of the study area, there is a commercial dip-net fishery that harvests spawning stocks of eulachon (smelt) as they return to the Susitna River in spring. In 2007, 11 permit holders harvested 62.5 tons of smelt in Upper Cook Inlet, less than the 100-ton harvest quota (Shields, 2007).

F.3 Subsistence/Personal-Use Fisheries

Alaskans harvest fish for personal consumptive needs under sport, subsistence, and commercial fishing regulations. Beginning in 1981, the Board of Fisheries established personal-use fisheries. Personal-use fishing provides for consumptive needs of Alaska residents unable to meet their consumptive needs under other fisheries (Shields, 2007). Other fisheries can include subsistence fisheries, commercial fisheries, recreational fisheries, marine fisheries, and salmon fisheries, among many others. There are 2 subsistence fisheries south of the study area (Tyonek and Yentna River fisheries) and 2 personal-use fisheries in the study area on the Fish Creek-Big Lake Drainage (Shields, 2007). The Fish Creek personal-use dip-net fishery sustained an annual mean harvest of 9,700 sockeye salmon from 1987 to 2001 (Shields, 2007). The ADF&G closed the Fish Creek dip-net fishery by Emergency Order in 2001 due to declining escapements and reduction in stocking levels, but could reopen the fishery when escapements are projected to be above 70,000 sockeye salmon (ADF&G, 2009d). However, sockeye salmon escapements have been below 50,000 since 2004 (Table F-4). There also is a personal-use smelt fishery on the Susitna River. The average Susitna River smelt harvest from 1996 to 2005 was 4,800 fish and generally ranged from 10 to 16,900 fish (Ivy *et al.*, 2007). The in-river return of smelt to the Susitna River Drainage ranges in the millions, with personal-use harvest accounting for less than 1 percent of this return (Shields, 2007). The ADF&G reports that this fishery will remain stable unless increased access to the Susitna River is provided (Shields, 2007).

Table F-4
Production of Sockeye Salmon in Big Lake[a]

				Hatchery Releases			Smolt Emigration	
Year	Total Run	Weir	Escapement	Fry	Pre-Smolt	Smolt	Age - 1	Age - 2
1997	131,814	54,656	48,513	0	0	0	0	0
1998	45,622	22,859	18,789	5,000,000	0	0	0	0
1999	45,714	26,749	25,199	197,000	0	0	0	0
2000	37,635	19,533	16,704	846,000	0	0	0	0
2001	70,013	43,486	39,093	0	0	0	0	0

2002	133,640	90,483	86,181	4,316,000	0	0	0	0
2003	149,586	91,743	86,858	3,589,000	0	0	114,654	2,340
2004	42,160	22,157	20,065	5,000,000	0	0	251195	25,632
2005	21,967	14,215	12,140	1,742,300	0	0	135739	22,623
2006	36,567	32,562	26,712	444,200	426,000	0	205,135	19,307
2007	49,548	27,948	24,034	3,812,400	702,500	315,700	278,351	30,928

[a] Source: Shields, 2007.

F.4 Aquatic Animals of Conservation Concern

Six aquatic animals (5 fish and 1 amphibian) of conservation concern, as identified in the Alaska Comprehensive Wildlife Conservation Strategy, potentially occur within the study area (Table F-5) (ADF&G, 2006). Two of these, the threespine and ninespine stickleback, were collected at stream crossings during OEA field studies (Noel *et al.*, 2008).

Table F-5
Aquatic Animals of Conservation Concern Potentially Present in the Port MacKenzie Rail Extension Study Area[a]

Common Name	Species	Conservation Rank	
		Global[b]	State[c]
Fish			
Bering Cisco	*Coregonus laurettae*	G4	S4
Threespine Stickleback Cook Inlet	*Gasterosteus aculeatus*	G5T1Q	S1
Ninespine Stickleback	*Pungitius pungitius*	G5	S4S5
Pacific Lamprey	*Lampetra tridentata*	G5	S4S5
Rainbow Smelt	*Osmerus mordax*	G5	S5
Amphibians			
Wood Frog	*Rana sylvatica*	G5	S3S4

[a] Source: ADF&G, 2006.
[b] Global Rankings: G5 = Secure Globally, G4 = Apparently Secure Globally, G5T1Q = Secure Globally, Infraspecific Critically Imperiled.
[c] State Rankings: S5 = Secure in State, S4 = Apparently Secure in State, S4S5 = Rank Uncertain - Long-Term Concern Due To Declines To Secure, S3 = Vulnerable to Extirpation, S3S4 = Rank Uncertain - Vulnerable To Extirpation To Long-Term Concern Due To Declines, S1 = Critically Impaired in State.

The threespine and ninespine stickleback exist as species complexes of many unique and reproductively isolated populations or potential subspecies (called radiations). They have been the focus of many evolutionary biology, developmental genetics, animal behavior, ecology, and environmental toxicology studies and though neither species is in danger of decline, many unique populations are in serious decline (ADF&G, 2006). Both males and females are territorial, with the male constructing a nest of algae and bits of debris within their territory. The female then enters the nest, deposits her eggs, and departs. The male fertilizes the eggs and remains nearby, with eggs hatching in about a week. Unique stickleback populations in Cook Inlet watersheds are declining due to invasive northern pike, human impacts on water quality, and stocking of salmonids in isolated lakes with no inlet or outlet stream (ADF&G, 2006). Sticklebacks are an important part of the food web and provide a significant portion of the diet of larger fish such as Dolly Varden, Arctic char, grayling, and lake trout.

A third species of conservation concern, the Bering cisco, is an anadromous whitefish that winters in salt or brackish water near river mouths. They return to freshwater in the spring, but

likely do not spawn until the fall (Morrow, 1980). Bering ciscos occur in the Susitna River and likely migrate into the project area (ADF&G, 2006). The Susitna River stock spends 15 to 20 days in the spawning grounds, with peak spawning over gravel and cobble substrate during the second week of October (ADF&G, 1986). Bering ciscos are believed to have highly confined, localized spawning areas, which would be susceptible to localized habitat disturbance (ADF&G, 2006). Anadromous stocks tend to be slow-growing, late maturing, and long-lived, which leaves them particularly vulnerable to changes in the environment.

Pacific lamprey exhibit two life history strategies. One type, anadromous lamprey, spends most of its adult life in salt water, moving to fresh water to spawn. The second type, fresh water lamprey, completes its life cycle entirely in fresh water. Both types are found in coastal areas and return to fresh water in fall before they spawn in spring. Lamprey dig nests or redds in cool, clear headwater streams. Adults die after the eggs are fertilized. The eggs hatch into a larval form called ammocoetes. The larvae burrow into the silt or sand and remain in this life-stage for 3 to 7 years; they then metamorphose into adults and either become parasitic or non-parasitic. Lampreys are an important part of the food web.

Rainbow smelt can be either anadromous or reside in freshwater lakes. They typically migrate a short distance upstream to spawn in freshwater streams or along lake shores. Their eggs attach to the gravels on the stream or lake bottom. After hatching, larvae drift downstream and concentrate on the bottom, except when they rise to the surface to feed at night. They are an abundant forage fish and are preyed upon by salmon and trout. Rainbow smelt are generally scarce in Alaska, although they can be locally and seasonally abundant (Morrow, 1980). Habitat alterations from water diversions, dams, and sedimentation can impact smelt survival by reducing instream flow, restricting fish passage, and degrading water quality (ADF&G, 2006).

The wood frog's preferred habitat is various kinds of forest/woodland habitats or at the edges of ponds and streams, willow thickets, and grassy/willow areas. The wood frog lays its eggs in small, fishless ponds in wooded or open areas. Wood frogs hibernate as early as August beneath snow in shallow depressions of compacted forest litter. Their range extends farther north than any other North American amphibian. Population trends are unknown, but reports indicate that wood frogs are no longer present at historical breeding sites (ADF&G, 2006). Wood frogs are vulnerable to loss of endemic taxa, climate change, habitat loss and degradation, pollution, eutrophication, predation, and disease.

F.5 Existing Fish Use and Habitat Conditions by Segment and Segment Combination

OEA based the site-specific descriptions of the proposed rail line in Sections F.5.1 through F.5.3 on anadromous fish habitat use data (Johnson and Daigneault, 2008), freshwater fish distribution data (ADF&G, 2009a), and OEA's field surveys of stream crossings (Noel *et al.*, 2008). All segments and segment combinations would cross streams or waterbodies that provide habitat for fish, which could be affected by rail line construction and operation. A discussion of potential fish habitat upstream of each crossing is located in Section F.6.

F.5.1 Southern Segments and Segment Combinations

F.5.1.1 Mac West-Connector 1 Segment Combination

The Mac West Segment would cross 3 fish-bearing streams (Tables F-6 and F-7, Figure F-5). The Mac West-Connector 1 Segment Combination would cross a small boggy stream used by resident fish at crossing MW-11.0 (Record 84, Noel *et al.*, 2008) and a drainage from a spring that flows approximately 70 feet into nearby Horseshoe Lake at crossing MW-10.1 (Record 85, Noel *et al.*, 2008). The crossing at MW-11.0 provides connectivity between lakes and ponds and contains habitat suitable for resident fish such as sticklebacks and sculpins. The spring at crossing MW-10.1 likely provides rearing habitat for juvenile salmonids via the springs' connection to Horseshoe Lake, a cataloged coho salmon habitat (Johnson and Daigneault, 2008). Drainage and filling of agricultural lands east of the Mac West Segment has likely altered runoff and groundwater input to these streams. The culverts proposed for these 2 crossings would result in loss of primarily rearing habitats (Tables F-6 and F-7). The boggy stream at crossing MW-4.6 is about 1.3 miles upstream from a stream that coho salmon use (Table F-6; 247-41-10080-2036; Johnson and Daigneault, 2008).

The Connector 1 Segment would cross a cataloged anadromous tributary of the Little Susitna River at C1-2.6 (Table F-6). This tributary provides rearing habitat for coho salmon and resident fish, and likely provides migratory access to upstream spawning and rearing habitat (Table F-7). At present, the channel is stable, with an average width of about 27 feet (Table F-6; Record 26, Noel *et al.*, 2008). The bridge proposed at this crossing for the access road and rail bed would eliminate the existing emergent vegetation along the stream margin and submergent vegetation in the stream channel, fragmenting coho salmon and resident fish rearing habitat (Photo 1, Record 26, Noel *et al.*, 2008). Substrates at the crossing site are organic debris and fines, which would not provide spawning habitat for salmonids or resident game fish, such as rainbow trout, Dolly Varden, or Arctic grayling (Record 26, Noel *et al.*, 2008).

F.5.1.2 Mac West-Connector 2 Segment Combination

The Mac West-Connector 2 Segment Combination would cross the 3 resident fish streams at crossings MW-11.0, MW-10.1, and MW-4.6, as described above. The Connector 2 Segment would not cross any fish-bearing streams (Tables F-6 and F-7, Figure F-5).

F.5.1.3 Mac East-Connector 3 Segment Combination

The Mac East-Connector 3 Segment Combination would cross the same boggy stream at ME-4.5 that the Mac West Segment would cross at MW-4.6 (Tables F-6 and F-7, Figure F-5). This crossing is about 2.3 miles upstream from a stream that coho salmon use (Table F-6; 247-41-10080-2036; Johnson and Daigneault, 2008). Although no fish were documented at this location during OEA field studies in 2008 (Noel *et al.*, 2008), habitats suitable for resident fish were present and this stream and connected wetlands might provide access between lakes and ponds that are likely used during periods of high water. The Connector 3 Segment would not cross any streams with fish habitat.

Table F-6
Fish-Bearing Streams Proposed Port MacKenzie Rail Segments would Cross[a] (page 1 of 3)

Segment/ Crossing Location	Crossing Identification	Stream Name	ADF&G Anadromous Catalog Number[b]	Waterbody	Fish	Wetted Width[f] (feet)	Diameter (inches) or Bridge Length (feet)[c]	Conveyance Size[c]	Habitat[a]				Potential Blockage[g]
									SP	R	M	OW	
Mac West													
MW-11.0	MW-084R	Inlet to Horseshoe Lake	0.8 mile upstream from COr	Stream	Resident	11	Culvert	36 inches	--	Y	Y	--	No
MW-10.1	MW-085	Inlet to Horseshoe Lake	Edge of COr in Horseshoe Lake	Spring	Resident	9	Culvert	48 inches	--	Y	--	--	No
MW-4.6	MW-095	Unnamed	1.3 miles upstream from COp	Stream	Resident	35	Culvert	48 inches	--	Y	Y	--	No
Mac East													
ME-4.5	ME-078	Unnamed	2.3 mile upstream from COp	Stream	Resident	6	Bridge	28 feet	--	Y	P	--	Yes - DS
Mac East Variant													
MEV-4.5	ME-078	Unnamed	2.3 mile upstream from COp	Stream	Resident	6	Bridge	28 feet	--	Y	P	--	Yes - DS
Connector 1													
C1-2.6	C1-026	Little Susitna Tributary	247-41-10100-2080: COpr	Stream	Anadromous	27	Bridge	56 feet	--	Y	Y	--	No
Willow													
MP-190.3	W-098	Little Willow Creek Tributary[d]	0.2 mile upstream from COr	Stream	Anadromous	12	Bridge	NA	Y	Y	Y	--	No
MP-189.6	W-099	Unnamed	NC	Stream	Resident	1 to 4	Culvert Extension	36 inches	--	Y	Y	Y	Yes – US
MP-189.3	W-100	Unnamed	NC	Stream	Resident	1 to 2	Culvert Extension	36 inches	--	Y	Y	--	Yes – US
MP-189.0	W-101R	Rogers Creek	247-41-10200-2130-3020: Cor	Stream	Anadromous	47	Bridge	NA	Y	Y	Y	Y	No
W-24.0	W-106	Willow Creek	247-41-10200-2120: CHs, Cosr, Ksr, Ps	Stream	Anadromous	98	Bridge	NA	Y	Y	Y	Y	No
W-23.1	W-107	Willow Creek Tributary	0.3 mile upstream Cor	Stream	Resident	2	Drainage Structure	NA	--	Y	Y	Y	Yes – DS
W-20.9	W-110	Susitna River Tributary[e]	Nominated	Stream	Anadromous	7	Natural Bottom Plate Pipe/Arch	8 to10 feet	Y	Y	Y	Y	Yes – US
W-19.6	W-112	Unnamed	NC	Stream	Resident	1 to 2	Drainage Structure	NA	--	Y	Y	--	No
W-16.7	W-113	Rolly Creek Tributary	1.6 miles upstream Cop	Stream	Resident	32	Culvert	72 inches	--	Y	Y	Y	No – BD
W-14.4	W-116	Rolly Creek Tributary	3.2 miles upstream Cop	Stream	Resident	2	Culvert	36 inches	--	Y	Y	Y	No – BD
W-10.0	W-118R	Fish Creek	247-41-10200-2020: Cor, Sp	Stream	Anadromous	15	Drainage Structure	NA	Y	Y	Y	Y	No – BD
W-0.6	W-121R	Little Susitna River	247-41-10100: CHs, Cos, Ks, Ps, Sp	Stream	Anadromous	105	Bridge	NA	Y	Y	Y	Y	No

Table F-6
Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a] (page 2 of 3)

Segment/ Crossing Location	Crossing Identification	Stream Name	ADF&G Anadromous Catalog Number[b]	Waterbody	Fish	Wetted Width (feet)	Conveyance Type[c]	Diameter (inches) or Bridge Length (feet)[c]	Habitat[b]				Potential Blockage[g]
									SP	R	M	OW	
Houston North													
MP-179.9	HN-056	Unnamed	NC	Stream	Resident	3	Culvert Extension	48 inches	--	Y	Y	--	Yes – US
MP-179.4	HN-061R	Unnamed	NC	Stream	Resident	3	Culvert Extension	60 inches	Y	Y	Y	--	Yes – US
MP-179.0	HN-063R	Unnamed	NC	Stream	Resident	1.7	Culvert Extension	36 inches	Y	Y	Y		Yes – US
MP-178.5	HN-065R	Lake Creek Tributary	247-41-10100-2231-3026: Cor	Stream	Anadromous	6.3	Culvert Extension	48 inches	Y	Y	Y	--	Yes – US
MP-177.5	None	Lake Creek Tributary	247-41-10100-2231-3018-4011: Cor	Stream	Anadromous	< 2	Culvert Extension	48 inches	--	Y	--	--	Yes – US & DS
HN-4.8	HNM-122R	Lake Creek Tributary	247-41-10100-2231-3018: Cor	Stream	Anadromous	9	Bridge	28 feet	--	Y	--	--	Yes – US
HN-4.4	HNM-123	Lake Creek	247-41-10100-2231: Cor, Sp	Stream	Anadromous	20	Drainage Structure	NA	--	Y	Y	Y	Yes – US & DS
HN-3.2	HN-067R	Little Susitna River	247-41-10100: CHs, Cos, Kp, Ps, Sp	Stream	Anadromous	98	Bridge	NA	Y	Y	Y	Y	No
Houston South													
MP-175.0	HS-070R	Little Susitna Tributary	247-41-10100-2255: Cor	Stream	Anadromous	14	Culvert Extension	48 inches	--	Y	Y	Y	Yes – US
MP-174.3	HS-071R	Little Susitna River	247-41-10100: CHp, Cos, Ks, Ps	Stream	Anadromous	47	Bridge	~80 feet	Y	Y	Y	Y	No
HS-1.0	HS-075R	Little Susitna Tributary	0.4 mile upstream from lake with Cor	Stream	Resident	18	Culvert	36 inches	--	Y	Y	--	Yes – US
Houston													
H-9.6	H-040R	Inlet to Colt Lake	NC	Stream	Resident	4	Culvert	48 inches	--	Y	Y	Y	No
H-6.3	H-044	Little Susitna Tributary	247-41-10100-2150: Cor	Stream	Anadromous	16	Drainage Structure	NA	--	Y	Y	Y	Yes – US
H-4.3	H-046	Little Susitna Tributary	247-41-10100-2100: Cor, Kr	Stream	Anadromous	5	Culvert	72 inches	--	Y	Y	Y	Yes – US & DS
H-2.8	H-047	Unnamed	NC	Wetland	Resident	1 to 2	Culvert	48 inches	--	--	Y	--	No
H-1.2	H-049	Unnamed	NC	Wetland	Resident	1 to 3	Culvert	24 inches	--	Y	Y	--	No
H-0.8	H-050R	Little Susitna Tributary	247-41-10100-2090: Ps, Cosr	Stream	Anadromous	14	Drainage Structure	NA	Y	Y	Y	Y	No

Table F-6
Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a] (page 3 of 3)

Segment/ Crossing Location	Crossing ID	Stream Name	ADF&G Anadromous Catalog Number[b]	Waterbody	Fish	Wetted Width (feet)	Conveyance Type[c]	Diameter (inches) or Bridge Length (feet)[c]	Habitat[b]				Potential Blockage[g]
									SP	R	M	OW	
Big Lake													
MP-170.7	BL-001R	Outlet Loon Lake	NC	Stream	Resident	2.5	Culvert Extension	48 inches	--	Y	Y	--	Yes – US & DS
MP-170.1	BL-003	Outlet Cheri Lake	247-50-10330-2050-3025: Cor	Stream	Anadromous	1.5	Culvert Extension	60 inches	--	Y	Y	--	Yes – US & DS
B-17.5	None	Inlet to Long Lake relocated channel	247-50-10330-2050-3025: Cor	Stream	Anadromous	<1	Drainage Structure	NA	--	Y	Y	--	Yes – US & DS
B-17.1 to B-17.6	None	Inlet to Long Lake	247-50-10330-2050-3025: Cor	Stream	Anadromous	<1	Stream Relocation	2,440 feet of relocation	--	Y	Y	--	Yes – US & DS
B-16.6	BL-007R	Inlet to Long Lake	247-50-10330-2050-3025: Cor	Stream	Anadromous	7	Drainage Structure	NA	--	Y	Y	--	Yes – US & DS
B-15.9	BL-008	Little Meadow Creek	247-50-10330-2050-3050: CHp, Cors, Pp, Ss	Stream	Anadromous	28	Drainage Structure	NA	Y	Y	Y	Y	Yes – US & DS
B-15.2	BL-010R	Lucile Creek	247-50-10330-2050-3030: Sp, Cor	Stream	Anadromous	12	Drainage Structure	NA	--	Y	Y	Y	Yes – US & DS
B-9.0	BL-019R	Fish Creek	247-50-10330: CHp, Cors, Kp, Ps, Sp	Stream	Anadromous	30	Drainage Structure	NA	Y	Y	Y	Y	Yes – US & DS
B-6.4	BL-022R	Goose Creek	247-50-10360: Cosr, Kr	Stream	Anadromous	6	Drainage Structure	NA	--	Y	Y	Y	Yes – DS

[a] Source: Johnson and Daigneault, 2008; Noel *et al.*, 2008.

[b] Anadromous catalog codes: K = Chinook salmon, CH = chum salmon, CO = coho salmon, P = pink salmon, S = sockeye salmon, p = present, r = rearing, s = spawning. Kr = Chinook rearing observed but not noted in ADF&G Anadromous Catalog. Habitat abbreviations: Rearing (I), Migration (M), and Overwintering (OW) habitats for either or both anadromous and resident fish species; Spawning (SP) habitat evaluated for resident trout, Arctic grayling, and Dolly Varden, and anadromous salmon (i.e., gravels and upwelling suitable for spawning are present at crossing site). Culverts are closed cylindrical structures; size is diameter. Culvert extension is an extension of an existing culvert. Drainage structures could include open bottom box culverts, multiplate culverts, precast arches, or single or multiple short-span bridges; type and size to be determined during final design and permitting. Bridges are single or multiple 28-foot short-span bridges (HDR Alaska, Inc., and TNH-Hanson, LLC, 2008; Pochop, 2008). NA = Not Available.

[d] Spawning substrates, adult coho salmon and juvenile salmonids observed (Noel *et al.*, 2008).

[e] Nominated for the Anadromous Stream Catalog based on data from survey (Noel *et al.*, 2008).

[f] For some crossings, wetted width includes channel width and the width of any surrounding wetlands. However, the proposed conveyance structure is sized to convey actual lateral flow.

[g] Y = verified, -- = not present, P = probable. Potential Blockage abbreviations: BD = beaver dam, US = artificial – upstream, DS = artificial – downstream.

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 1 of 11)

Segment/Crossing Location	Fish Presence	Crossing Identification	Record Number	Life Stages					Habitats			
				Eggs	Fry/Larvae	Juveniles	Adults	Spawning	Rearing	Overwintering	Summer Foraging	Migratory
Mac West												
MW-11.0	Inlet to Horseshoe Lake	MW-084R	84									
	Rainbow trout					X			X		X	X
	Stickleback			X	X	X	X	X	X		X	X
	Resident game fish					X			X		X	X
MW-10.1	Inlet to Horseshoe Lake	MW-085	85									
	Coho salmon (in lake)					X			X		X	
	Rainbow trout					X			X			
	Threespine stickleback			X	X	X	X	X	X		X	
	Resident game fish					X	X		X		X	
MW-4.6	Unnamed Stream	MW-095	95									
	Stickleback			X	X	X	X	X	X		X	X
	Resident non-game fish					X			X		X	X
Mac East												
ME-4.5	Unnamed Stream	ME-078	78									
	Stickleback			X	X	X	X	X	X		X	X
	Resident non-game fish					X			X		X	X
Mac East Variant												
MEV-4.5	Unnamed Stream	ME-078	78									
	Stickleback			X	X	X	X	X	X		X	X
	Resident non-game fish					X			X		X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 2 of 11)

				Life Stages					Habitats			
Segment/Crossing Location	**Fish Presence**	**Crossing Identification**	**Record Number**	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Overwintering**	**Summer Foraging**	**Migratory**
Connector 1												
C1-2.6	Little Susitna Tributary	C1-026	26									
	Coho salmon					X	X		X		X	X
	Rainbow trout					X	X		X		X	X
	Slimy sculpin					X	X		X		X	X
	Threespine stickleback			X	X	X	X	X	X		X	X
	Pacific lamprey								X		X	X
Willow												
MP-190.3	Little Willow Creek Tributary[c]	W-098	98									
	Coho salmon			X	X	X	X	X	X		X	X
	Rainbow trout			X	X	X	X	X	X		X	X
	Resident game fish			X	X	X	X	X	X		X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
MP-189.6	Unnamed Stream	W-099	99									
	Resident non-game fish			X	X	X	X	X	X	X	X	X
MP-189.3	Unnamed Stream	W-100	100									
	Resident non-game fish					X	X		X		X	X
MP-189.0	Rogers Creek	W-101R	101									
	Coho salmon					X	X		X	X	X	X
	Resident game fish			X	X	X	X	X	X	X	X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 3 of 11)

				Life Stages					Habitats			
Segment/Crossing Location	**Fish Presence**	**Crossing Identification**	**Record Number**	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Overwintering**	**Summer Foraging**	**Migratory**
Willow (continued)												
W-24.0	Willow Creek	W-106	106									
	Chinook salmon			X	X	X	X	X	X	X	X	X
	Coho salmon			X	X	X	X	X	X	X	X	X
	Pink salmon			X	X		X	X				X
	Chum salmon			X	X		X	X				X
	Rainbow trout			X	X	X	X	X	X	X	X	X
	Dolly Varden			X	X	X	X	X	X	X	X	X
	Resident game fish			X	X	X	X	X	X	X	X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
W 23.1	Willow Creek Tributary	W-107	107									
	Coho salmon (potential)					X			X		X	X
	Stickleback			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X		X	X
W 20.9	Susitna River Tributary[d]	W-110	110									
	Coho salmon				X	X			X		X	X
	Slimy sculpin					X	X		X		X	X
	Resident game fish			X	X	X	X	X	X	X	X	X
W 19.6	Unnamed Stream	W-112	112									
	Stickleback					X	X		X		X	X
	Resident non-game fish					X	X		X		X	X
W-16.7	Rolly Creek Tributary	W-113	113									
	Ninespine stickleback			X	X	X	X	X	X	X	X	X
	Resident game fish					X			X		X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 4 of 11)

Segment/Crossing Location	Fish Presence	Crossing Identification	Record Number	Life Stages				Habitats				
				Eggs	Fry/Larvae	Juveniles	Adults	Spawning	Rearing	Overwintering	Summer Foraging	Migratory
Willow (continued)												
W-14.4	Rolly Creek Tributary	W-116	116									
	Stickleback			X	X	X	X	X	X	X	X	X
	Resident game fish					X			X		X	X
W-10.0	Fish Creek	W-118R	118									
	Coho salmon			X	X	X	X	X	X	X	X	X
	Sockeye salmon				X		X					X
	Rainbow trout			X	X	X	X	X	X	X	X	X
	Arctic grayling			X	X	X	X	X	X	X	X	X
	Northern pike					X	X		X		X	X
	Resident game fish			X	X	X	X	X	X	X	X	X
W-0.6	Little Susitna River	W-121R	121									
	Chinook salmon			X	X	X	X	X	X	X	X	X
	Sockeye salmon				X		X					X
	Coho salmon			X	X	X	X	X	X	X	X	X
	Pink salmon			X	X		X	X		X		X
	Chum salmon			X	X		X	X		X		X
	Whitefish					X	X		X	X	X	X
	Rainbow trout			X	X	X	X	X	X	X	X	X
	Arctic grayling			X	X	X	X	X	X	X	X	X
	Burbot					X	X		X	X	X	X
	Dolly Varden			X	X	X	X	X	X	X	X	X
	Slimy sculpin			X	X	X	X	X	X	X	X	X
	Stickleback			X	X	X	X	X	X	X	X	X
	Lampreys								X		X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 5 of 11)

				Life Stages					Habitats			
Segment/Crossing Location	Fish Presence	Crossing Identification	Record Number	Eggs	Fry/Larvae	Juveniles	Adults	Spawning	Rearing	Overwintering	Summer Foraging	Migratory
Houston North												
MP 179.9	Unnamed Stream	HN-056	56									
	Resident non-game fish			X	X	X	X	X	X		X	X
MP 179.4	Unnamed Stream	HN-061R	61									
	Resident non-game fish			X	X	X	X	X	X		X	X
	Resident game fish			X	X	X	X		X		X	X
MP 179.0	Unnamed Stream	HN-063R	63									
	Resident non-game fish			X	X	X	X	X	X		X	X
	Resident game fish			X	X	X	X		X		X	X
MP 178.5	Lake Creek Tributary	HN-065R	65									
	Coho salmon					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish			X	X	X	X	X	X		X	X
MP 177.5	Lake Creek Tributary	None										
	Coho salmon					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X		X	X
HNM-4.8	Lake Creek Tributary	HNM-122R	122									
	Coho salmon					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X	X	X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 6 of 11)

				Life Stages					Habitats			
Segment/Crossing Location	**Fish Presence**	**Crossing Identification**	**Record Number**	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Overwintering**	**Summer Foraging**	**Migratory**
Houston North (continued)												
HNM-4.4	Lake Creek	HNM-123	123									
	Coho salmon					X	X		X		X	X
	Sockeye salmon				X		X					X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X	X	X	X
HN-3.2	Little Susitna River	HN-067R	67									
	Chinook salmon					X	X		X	X	X	X
	Sockeye salmon						X					X
	Coho salmon			X	X	X	X	X	X	X	X	X
	Pink salmon			X	X		X	X		X		X
	Chum salmon			X	X		X	X		X		X
	Round whitefish			X	X	X	X	X	X	X	X	X
	Rainbow trout			X	X	X	X	X	X	X	X	X
	Arctic grayling			X	X	X	X	X	X	X	X	X
	Burbot					X	X		X	X	X	X
	Northern pike					X	X		X	X	X	X
	Dolly Varden			X	X	X	X	X	X	X	X	X
	Slimy sculpin			X	X	X	X	X	X	X	X	X
	Stickleback			X	X	X	X	X	X	X	X	X
	Lampreys								X		X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 7 of 11)

				Life Stages					Habitats			
Segment/Crossing Location	**Fish Presence**	**Crossing Identification**	**Record Number**	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Overwintering**	**Summer Foraging**	**Migratory**
Houston South												
MP- 175.0	Little Susitna Tributary	HS-070R	70									
	Coho salmon					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X		X	X
MP-174.3	Little Susitna River	HS-071R	71									
	Chinook salmon			X		X	X		X	X	X	X
	Sockeye salmon						X					X
	Coho salmon			X	X	X	X	X	X	X	X	X
	Pink salmon			X	X		X	X		X		X
	Chum salmon				X		X	X		X		X
	Round whitefish			X	X	X	X	X	X	X	X	X
	Rainbow trout			X	X	X	X	X	X	X	X	X
	Arctic grayling			X	X	X	X	X	X	X	X	X
	Burbot					X	X		X	X	X	X
	Northern pike					X	X		X	X	X	X
	Dolly Varden			X	X	X	X	X	X	X	X	X
	Slimy sculpin			X	X	X	X	X	X	X	X	X
	Stickleback			X	X	X	X	X	X	X	X	X
	Lampreys								X		X	X
HS-1.0	Little Susitna Tributary	HS-075R	75									
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X		X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 8 of 11)

				Life Stages					Habitats			
Segment/Crossing Location	**Fish Presence**	**Crossing Identification**	**Record Number**	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Overwintering**	**Summer Foraging**	**Migratory**
Houston												
H-9.6	Inlet to Colt Lake	H-040R	40									
	Stickleback			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X		X	X
H-6.3	Little Susitna Tributary	H-044	44									
	Coho salmon					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X	X	X	X
H-4.3	Little Susitna Tributary	H-046	46									
	Chinook salmon					X			X		X	X
	Coho salmon					X			X		X	X
	Ninespine stickleback			X	X	X	X	X	X	X	X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X	X	X	X
H-2.8	Unnamed Stream	H-047	47									
	Resident non-game fish					X	X					X
H-1.2	Unnamed Stream	H-049	49									
	Resident non-game fish					X	X		X		X	X
H-0.8	Little Susitna Tributary	H-050R	50									
	Coho salmon			X	X	X	X	X	X	X	X	X
	Pink salmon			X	X		X	X		X		X
	Rainbow trout			X	X	X	X	X	X	X	X	X
	Slimy sculpin			X	X	X	X	X	X	X	X	X
	Resident game fish			X	X	X	X	X	X	X	X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 9 of 11)

				Life Stages					Habitats			
Segment/Crossing Location	**Fish Presence**	**Crossing Identification**	**Record Number**	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Overwintering**	**Summer Foraging**	**Migratory**
Big Lake												
MP-170.7	Outlet Loon Lake	BL-001R	1									
	Rainbow trout					X			X		X	X
	Resident non-game fish			X	X	X	X	X	X		X	X
	Resident game fish					X			X		X	X
MP-170.1	Outlet Cheri Lake	BL-003	3									
	Coho salmon					X	X		X		X	X
	Rainbow trout					X	X		X		X	X
	Slimy sculpin					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X		X	X
	Resident game fish					X	X		X		X	X
B-17.5	Inlet to Long Lake	None										
	Coho salmon					X	X		X		X	X
	Rainbow trout					X	X		X		X	X
	Slimy sculpin					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X		X	X
	Resident game fish					X	X		X		X	X
B-17.1 to B-17.6	Inlet to Long Lake	None										
	Coho salmon					X	X		X		X	X
	Rainbow trout					X	X		X		X	X
	Slimy sculpin					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X		X	X
	Resident game fish					X	X		X		X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 10 of 11)

				Life Stages					Habitats			
Segment/Crossing Location	**Fish Presence**	**Crossing Identification**	**Record Number**	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Overwintering**	**Summer Foraging**	**Migratory**
Big Lake (continued)												
B- 16.6	Inlet to Long Lake	BL-007R	7									
	Coho salmon					X	X		X		X	X
	Rainbow trout					X	X		X		X	X
	Slimy sculpin					X	X		X		X	X
	Resident non-game fish			X	X	X	X	X	X		X	X
	Resident game fish					X	X		X		X	X
B-15.9	Little Meadow Creek	BL-008	8									
	Coho salmon			X	X	X	X	X	X	X	X	X
	Pink salmon						X					X
	Chum salmon						X					X
	Sockeye salmon			X	X		X	X		X		x
	Rainbow trout			X	X	X	X	X	X	X	X	X
	Slimy sculpin			X	X	X	X	X	X	X	X	X
	Threespine stickleback			X	X	X	X	X	X	X	X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish			X	X	X	X	X	X	X	X	X
B-15.2	Lucille Creek	BL-010R	10									
	Coho salmon					X	X		X	X	X	X
	Sockeye salmon						X					X
	Slimy sculpin					X	X		X	X	X	X
	Threespine stickleback			X	X	X	X	X	X	X	X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X	X	X	X

Table F-7
Fish, Life Stages, and Habitats at Fish-Bearing Streams the Proposed Port MacKenzie Rail Segments would Cross[a,b]
(page 11 of 11)

Segment/Crossing Location	Fish Presence	Crossing Identification	Record Number	Life Stages					Habitats			
				Eggs	Fry/Larvae	Juveniles	Adults	Spawning	Rearing	Overwintering	Summer Foraging	Migratory
Big Lake (continued)												
B- 9.0	Fish Creek	BL-019R	19									
	Chinook salmon			X	X	X	X	X	X	X	X	X
	Sockeye salmon			X	X		X	X		X		X
	Coho salmon			X	X	X	X	X	X	X	X	X
	Pink salmon			X	X		X	X		X		X
	Chum salmon			X	X		X	X		X		X
	Rainbow trout			X	X	X	X	X	X	X	X	X
	Dolly Varden			X	X	X	X	X	X	X	X	X
	Northern pike					X	X		X		X	X
	Longnose sucker			X	X	X	X	X	X	X	X	X
	Round whitefish			X	X	X	X	X	X	X	X	X
	Slimy sculpin			X	X	X	X	X	X	X	X	X
	Threespine stickleback			X	X	X	X	X	X	X	X	X
	Ninespine stickleback			X	X	X	X	X	X	X	X	X
	Lampreys					X	X		X	X	X	X
B-6.4	Goose Creek	BL-022R	22									
	Chinook salmon					X			X	X	X	X
	Coho salmon			X	X	X	X		X	X	X	X
	Rainbow trout					X	X		X	X	X	X
	Threespine stickleback			X	X	X	X	X	X	X	X	X
	Resident non-game fish			X	X	X	X	X	X	X	X	X
	Resident game fish					X	X		X	X	X	X

[a] Sources: ADF&G, 2007a; ADF&G, 2009a; Johnson and Daigneault, 2008; Noel *et al.*, 2008.
[b] Evaluation based on habitat at crossing location, waterbody connectivity, reported fish occurrence, and surveyed fish occurrence.
[c] Nominated for the Anadromous Stream Catalog based on data from survey (Noel *et al.,* 2008).
[d] Suitable spawning habitat for anadromous and resident game fish present (Noel *et al.*, 2008).

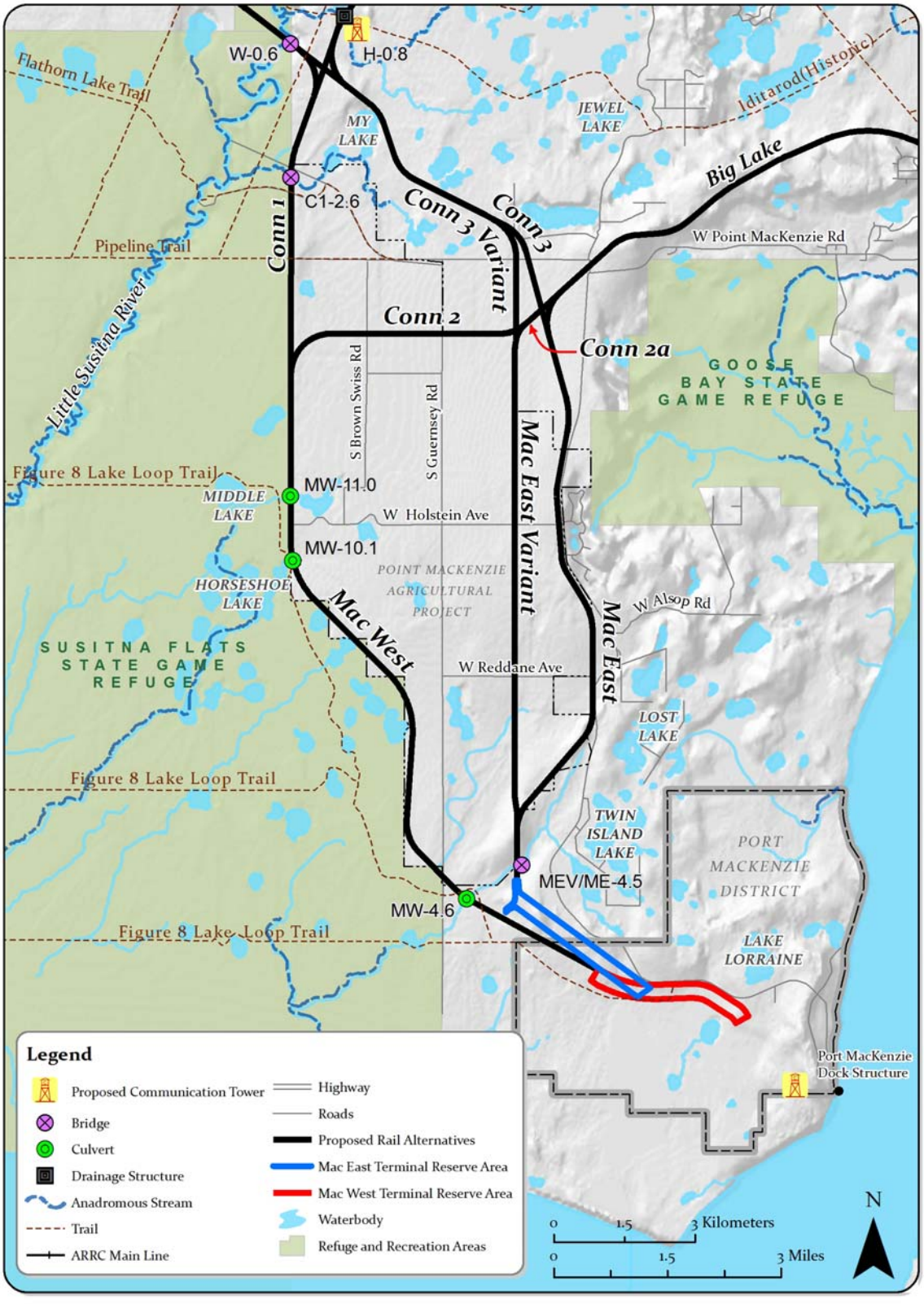

Figure F-5. Fish-Bearing Stream Crossings along the Mac East, Mac West, and Connector Segments (Johnson and Daigneault, 2008; ADF&G, 2009a; Noel *et al.*, 2008)

F.5.1.4 Mac East Segment

The Mac East Segment would cross the boggy stream at ME-4.5, as described above (Tables F-6 and F-7, Figure F-5).

F.5.1.5 Mac East Variant-Connector 2a Segment Combination

The Mac East Variant-Connector 2a Segment Combination would cross the same boggy stream at MEV-4.5 that the Mac East Segment would cross at ME-4.5 (Tables F-6 and F-7, Figure F-5). This crossing is about 2.3 miles upstream from a stream that coho salmon use (Table F-6; 247-41-10080-2036; Johnson and Daigneault, 2008). Although no fish were documented at this location during OEA field studies in 2008 (Noel *et al.*, 2008), habitats suitable for resident fish were present and this stream and connected wetlands might provide access between lakes and ponds that are likely used during periods of high water. The Connector 2a Segment would not cross any streams with fish habitat.

F.5.1.6 Mac East Variant-Connector 3 Variant Segment Combination

The Mac East Variant-Connector 3 Variant Segment Combination would cross the boggy stream at MEV-4.5, as described above. The Connector 3 Variant Segment would not cross any streams with fish habitat.

F.5.2 Northern Segments and Segment Combinations

F.5.2.1 Willow Segment

The Willow Segment would cross waters important for sustaining recreational and commercial salmon fisheries in Southcentral Alaska, including Rogers Creek, Willow Creek, the Fish Creek-Susitna River tributary, and the Little Susitna River. The Willow Segment would cross 12 streams with fish or fish habitat (Tables F-6 and F-7, Figure F-6), including 4 crossings documented as used by anadromous fish, 1 crossing that has been nominated as used (W-20.9), and 1 crossing (MP-190.3) where spawning habitat and salmon were observed within the floodplain of Little Willow Creek (Johnson and Daigneault, 2008; Noel *et al.*, 2008).

The Willow Segment would cross tributaries of the Susitna River including Rogers Creek, Willow Creek, Rolly Creek, Fish Creek, and several unnamed streams (Table F-6, Figure F-6). Four of these crossings (MP-190.3, MP-189.6, MP-189.3, and MP-189.0), an unnamed tributary of Little Willow Creek, 2 boggy streams, and Rogers Creek, parallel existing crossings of the Alaska Railroad Corporation (ARRC) main line. The existing structures at these crossings include a bridge at crossing MP-190.3 (Photo 2, Record 98, Noel *et al.*, 2008), culverts at crossings MP-189.6 (Photo 3, Record 99, Noel *et al.*, 2008) and MP-189.3 (Photo 4, Record 100, Noel *et al.*, 2008), and another bridge at crossing MP-189.0 (Photo 5, Record 101, Noel *et al.*, 2008). Construction of similar bridges and extensions of existing culverts as proposed by ARRC would result in additional habitat loss and degradation at these locations. Some of the existing culverts have resulted in ponding and potential blockage of fish movements (Photos 3 and 4). In addition, the end of the siding would encroach on the Little Willow Creek crossing of the main line and would result in placement of some fill into an oxbow of this creek.

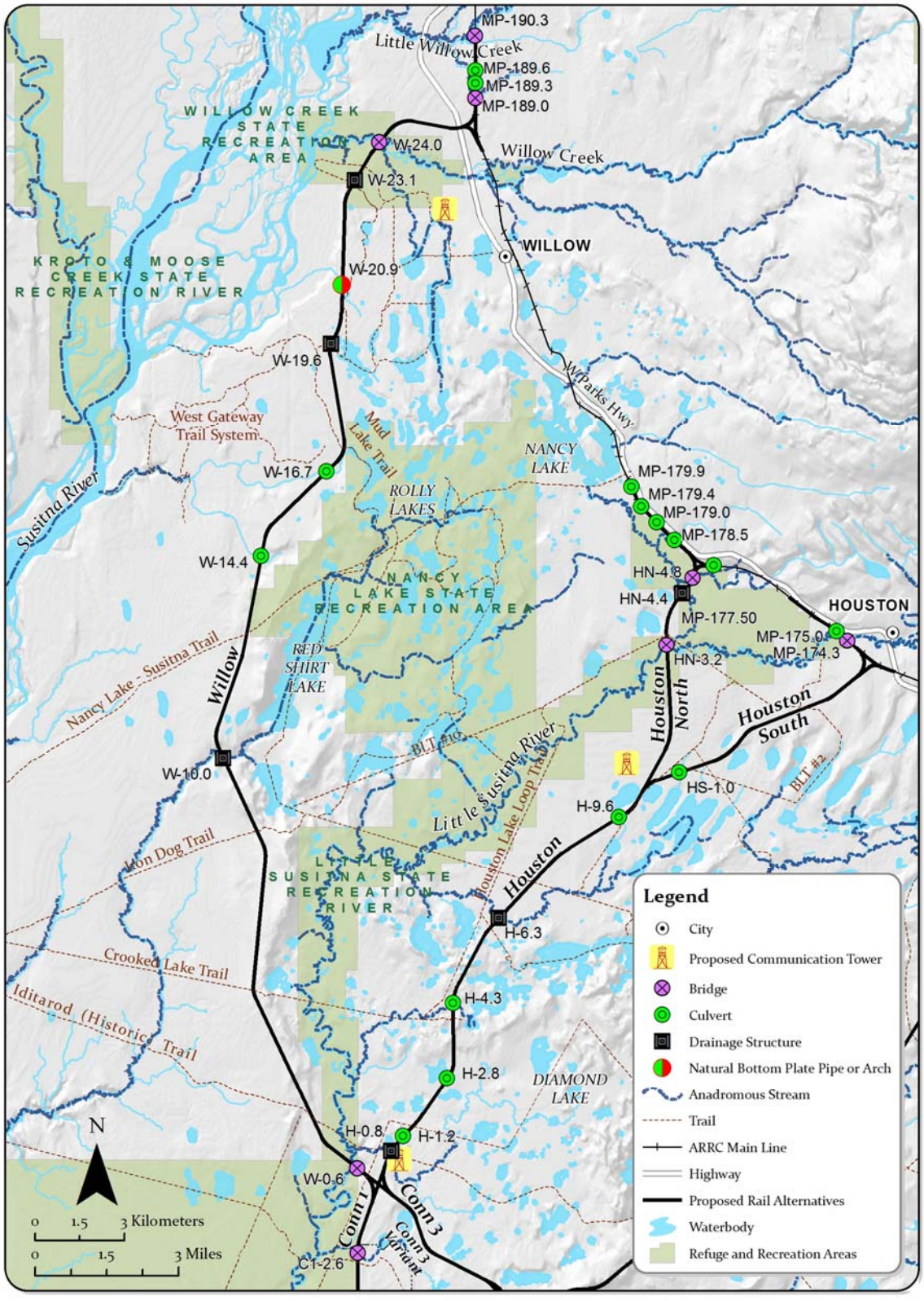

Figure F-6. Fish-Bearing Stream Crossings along the Willow, Houston, Houston North, and Houston South Segments (Johnson and Daigneault, 2008; ADF&G, 2009a; Noel *et al.*, 2008)

The crossing of Willow Creek (W-24.0; Photo 6, Record 106, Noel *et al.*, 2008) would be within the Willow Creek State Recreation Area (Figure F-6). Willow Creek is the second most popular sport fishery in the study area, with an estimated 22,000 angler days and almost 7,000 fish harvested in 2007 (ADF&G, 2009c). Construction of a crossing at this location would result in loss of spawning and rearing habitat and the bridge would potentially intercept large woody debris input from the surrounding spruce forest. OEA observed pink salmon spread out along the left bank on a spawning bed at the crossing location during field investigations (Record 106, Noel *et al.*, 2008). The proposed bridge would be the first structure on Willow Creek above its confluence with the Susitna River. The section of Willow Creek at the proposed crossing supports coho salmon rearing and migration and Willow Creek supports Chinook, chum, coho, and pink salmon (Table F-6; Johnson and Daigneault, 2008).

Upstream about 0.4 mile from the Fish Creek crossing (W-10.0; Photo 7, Record 118, Noel *et al.*, 2008) habitats were observed to be suitable for anadromous and resident fish spawning, rearing, and overwintering; however, no fish were observed or collected (Table F-6). There were several active beaver dams downstream from the site, including a new dam that had caused recent overbank flooding. This section of Fish Creek supports sockeye salmon (Johnson and Daigneault, 2008).

The Willow Segment would cross the Little Susitna River, which is a stable productive system that supports all 5 Pacific salmon, and contributed to an estimated harvest of more than 17,000 fish, primarily salmon (96 percent), over an estimated 35,000 fisherman days during 2007 (ADF&G, 2009c). Approximately 0.5 mile upstream of the proposed crossing site (W-0.6), there are habitats suitable for salmon and resident game fish spawning, rearing, migration, and overwintering (Table F-6; Photo 8, Record 121, Noel *et al.*, 2008). This section of the Little Susitna River supports spawning habitat for coho and pink salmon and rearing habitat for coho salmon and migration habitat for Chinook, chum, and sockeye salmon (Johnson and Daigneault, 2008).

F.5.2.2 Houston-Houston North Segment Combination

The Houston-Houston North Segment Combination would cross waters important for sustaining recreational and commercial salmon fisheries in Southcentral Alaska, including Lake Creek and the Little Susitna River, and many unnamed tributaries to these waters (Figure F-6). The Houston-Houston North Segment Combination would cross 14 fish-bearing streams (Tables F-6 and F-7, Figure F-6). Eight crossings are streams documented to provide anadromous fish habitat (Johnson and Daigneault, 2008). Four crossings provide resident fish habitat, and an additional 2 wetland crossings likely provide seasonal connections between lakes (Tables F-6 and F-7).

The placement of the rail siding along the main line at the segment combination tie-in area would cross the same fish-bearing streams as the main line, requiring culvert extensions for the siding. All of the crossings of streams along the existing main line (MP-179.9 to MP-177.5) might have upstream blockages as a result of the main line, Parks Highway, or secondary road crossings (Table F-6, Figure F-6). The main line crossing upstream of MP-178.5 would be an extension of the existing culvert, which is slightly perched above the stream bottom (Photo 9, Record 65, Noel *et al.*, 2008). Upstream from the crossing at MP-177.5, a secondary road might be blocking

this stream. Both streams (at MP-178.5 and MP-177.5) are tributaries of Lake Creek and have been documented as providing rearing habitat for coho salmon (Table F-6, Figure F-6). The wetted width of Lake Creek is about 20 feet at the proposed crossing (HN-4.4) and provides rearing habitat for coho salmon and resident fish, and sockeye salmon use the channel to access Nancy Lake (Table F-6, Figure F-6). This reach of Lake Creek is within the Little Susitna State Recreation River and is considered high value for fish habitat and recreational use (Photo 10, Record 123, Noel *et al.*, 2008).

The Little Susitna River is a highly productive system that supports all 5 species of Pacific salmon, Dolly Varden, burbot, and Arctic grayling (ADF&G, 1988). The bridge proposed for the Little Susitna River crossing would likely require instream supports to span the channel, which has a wetted width of about 98 feet at this location (HN-3.2; Photo 11, Record 67, Noel *et al.*, 2008).

The Houston Segment of the Houston-Houston North Segment Combination would cross 3 tributaries of the Little Susitna River that support anadromous fish (H-6.3, H-4.3, and H-0.8; Tables F-6 and F-7, Figure F-6). Two of these tributaries, at crossings H-6.3 and H-4.3, provide access for coho salmon to Horseshoe Lake and Finger Lake, respectively (Figure F-6); and the other tributary, at crossing H-0.8, provides spawning habitat for pink and coho salmon (Photo 12, Record 50, Noel *et al.*, 2008). One stream crossing (H-9.6) provides resident fish habitat and connectivity between Muleshoe Lake and Colt Lake, which supports coho salmon (Record 40, Noel *et al.*, 2008). Two wetland crossings (H-2.8 and H-1.2), while not identified as important for providing fish habitat during OEA field evaluations, likely provide seasonal interlake connectivity for resident fish and provide nutrient input for the production of invertebrate prey for downstream resident and anadromous fish (Table F-6; Records 47 and 49, Noel et al., 2008).

F.5.2.3 Houston-Houston South Segment Combination

The Houston-Houston South Segment Combination would cross 9 fish-bearing streams, including 5 anadromous fish streams (Johnson and Daigneault, 2008) and 2 streams that provide seasonal interlake connectivity for resident fish (Table F-6, Figure F-6).

The existing main line crosses and the proposed rail line would cross a small tributary of the Little Susitna River (MP-175.0; Record 70, Noel *et al.*, 2008) that connects to an abandoned meander. This stream, which is cataloged as coho rearing habitat (Table F-6), appears to have been blocked upstream by construction of Parks Highway and a submerged culvert in the existing rail bed (Photo 13, Record 70, Noel *et al.*, 2008).

The placement of the rail siding where the main line connects with the proposed segment combination would cross the same fish-bearing streams as the main line, requiring a culvert extension and a new bridge for the siding. The Little Susitna River crossing (MP-174.3) would be above the river's confluence with Lake Creek and would be above the occurrence of sockeye salmon, although pink salmon spawning has been documented above this reach (Table F-6, Figure F-6; Johnson Daigneault, 2008). The crossing area provides some spawning habitat, but most of the Chinook salmon in the Little Susitna River system spawn in habitats upstream of Parks Highway (Ivey, 2009). The proposed bridge would be just downstream of the existing rail bridge (Photo 14, Record 71, Noel *et al.*, 2008), and some of these backwaters would be filled.

The increased loss of riparian vegetation due to bridge construction, the filling of backwater habitats, and the increased need for bank hardening with riprap as the meandering channel continues to erode the existing bridge and edges toward the existing rail bed would decrease habitat suitability for spawning and rearing salmon.

The remaining Houston-Houston South Segment Combination crossings (H-9.6 to H-0.8) are as described for Houston-Houston North Segment Combination in Section F.5.2.2.

F.5.2.4 Big Lake Segment

The Big Lake Segment would cross waters important for sustaining recreational and commercial salmon fisheries in the Big Lake and Goose Creek drainages in Southcentral Alaska, including Little Meadow Creek, Lucile Creek, Fish Creek, and Goose Creek. The Big Lake Segment would cross fish-bearing streams in 9 locations, including 1 stream the segment would cross or alter in 4 different locations (Tables F-6). Five streams the Big Lake Segment would cross provide anadromous fish habitat for coho salmon; sockeye salmon also use 3 of these streams (Tables F-6 and F-7, Johnson and Daigneault, 2008). Late-run sockeye salmon are an important stock that has experienced wide fluctuations in abundance, but in most years provides a surplus for users, indicating the population is healthy (Shields, 2007; Tobias and Willett, 2008). One crossing provides resident fish habitat (Table F-6).

The placement of the rail siding along the main line at the segment tie-in area would cross the same fish-bearing streams as the main line, requiring culvert extensions for the siding. Two culverted stream crossings under the main line provide conveyance for Loon Lake (MP-170.7) and Cheri Lake (MP-170.1) outflows. ARRC would extend these existing culverts for the construction of the rail siding to ensure continued conveyance of these streams. The existing culvert crossing for the Loon Lake outflow (MP-170.7) appears to allow passage of water; however, repairs to this structure indicate that the culvert is in danger of collapse (Photo 15, Record 1, Noel *et al.*, 2008). The existing culvert crossing for the Cheri Lake outflow is perched above the stream bed (MP-170.1; Photo 16, Record 3, Noel *et al.*, 2008).

The Cheri Lake outflow stream connects Cheri Lake and Long Lake, and is documented as coho salmon rearing habitat; the Big Lake Segment would cross the Cheri Lake outflow 4 times (MP-170.1, B-17.5, B-17.1 to 17.6, and B-16.6; Table F-6), with one of the crossings (B-B-17.1 to 17.6) a result of relocating the stream. ARRC would relocate a total of 2,440 feet of this stream channel into a new 2,460-foot channel between Mile Post B-17.1 and Mile Post B-17.6. The stream channel is not well defined in this area and the construction of the Big Lake Segment would require filling and relocating this stream. Parks Highway and 2 secondary roads upstream from the proposed rail crossing at B-16.6 also cross this stream. The existing culvert at the road crossing downstream from B-16.6 had been replaced at least once because there is a perched dry culvert and 2 culverts receiving flow from this stream (Photo 17, Record 7, Noel *et al.*, 2008). Water velocity is very slow at this location due to the improperly bedded road culverts, and it does not appear to gain sufficient velocity to provide for passage of adult salmon. With construction of the 2 new crossings and 1 culvert extension for this stream from the Big Lake Segment and 5 existing culverts under roads, there would be a total of 8 crossings on the stream connecting Cheri and Long lakes, in addition to a relocation of the channel. The multiple culvert crossings appear to have reduced the capacity of this stream to provide habitat for anadromous

and resident fish, although coho salmon were captured just above the road culvert, 400 feet downstream from the proposed rail crossing at B-16.6 (Record 7, Noel *et al.*, 2008).

Little Meadow Creek at the proposed crossing (B-15.9; Photo 18, Record 8 Noel *et al.*, 2008) has a wetted width of 28 feet and provides spawning, rearing, migratory, and overwinter habitats for chum, coho, pink, and sockeye salmon, and habitats for resident fish (Tables F-6 and F-7). Spawning sockeye salmon were observed during an OEA field visit, along with redds created by earlier spawning salmon (Record 8, Noel *et al.*, 2008). The proposed drainage structure could adversely impact fish if it is not designed to allow passage for juvenile and adult fish to and from upstream and downstream lakes and tributaries and for movement of stream bed gravels. The Lucile Creek crossing (B-15.2) contains juvenile rearing and likely overwintering habitat and a migration passage for both coho and sockeye salmon (Photo 19, Record 10, Noel *et al.*, 2008).

The Fish Creek Drainage supports Chinook, coho, chum, pink, and sockeye salmon and contributes to sockeye salmon production in the Upper Cook Inlet (Tables F-6 and F-7, Figure F-7). The crossing location (B-9.0) supports coho rearing and sockeye migration and resident fish spawning, rearing, migration, and overwintering (Tables F-6 and F-7; Photo 20, Record 19, Noel *et al.*, 2008). Fish Creek supports a large and complex population of resident and anadromous fish. It is a migratory corridor to Big Lake that supports one of the most important sockeye salmon runs in the study area. The habitat at the crossing location is complex and undisturbed, with spawning gravels and deep pools for overwintering (Record 19, Noel *et al.*, 2008).

The Goose Creek Drainage supports coho salmon spawning and rearing and many resident fish. The crossing location (B-6.4) is within a large fen complex with the stream surrounded by floating wetland vegetation (Photo 21, Record 22, Noel *et al.*, 2008; see the wetlands discussion in Chapter 4). This system is likely primarily groundwater fed, with a relatively stable water level that remains unfrozen during winter and provides overwintering habitat for anadromous and resident fish. The proposed crossing would result in the potential disturbance of about 4 acres of high-value wetland habitat due to excavation, filling, and draining of the system required for construction of the rail bed approach to the drainage structure, which would likely result in reduced productivity as fish rearing habitat for this system. Providing a staging area for construction of a crossing at this location would destroy unique habitat features because the fen would either have to be drained to provide an area for construction, or the water transport under the floating mat vegetation would have to be channeled and filled, unless these features and functions could be restored following construction. This wetland is likely one of the largest juvenile rearing areas, other than lakes with large shelves, in the project area.

F.6 Fish Habitat Potential

A GIS geomorphic analysis was used to apply a fisheries model to estimate upstream habitat potential for several fish species. The model incorporated previously published species-specific models of biological performance to estimate the relative potential of habitat associated with crossings, segments, and alternatives. The biological performance models were selected from

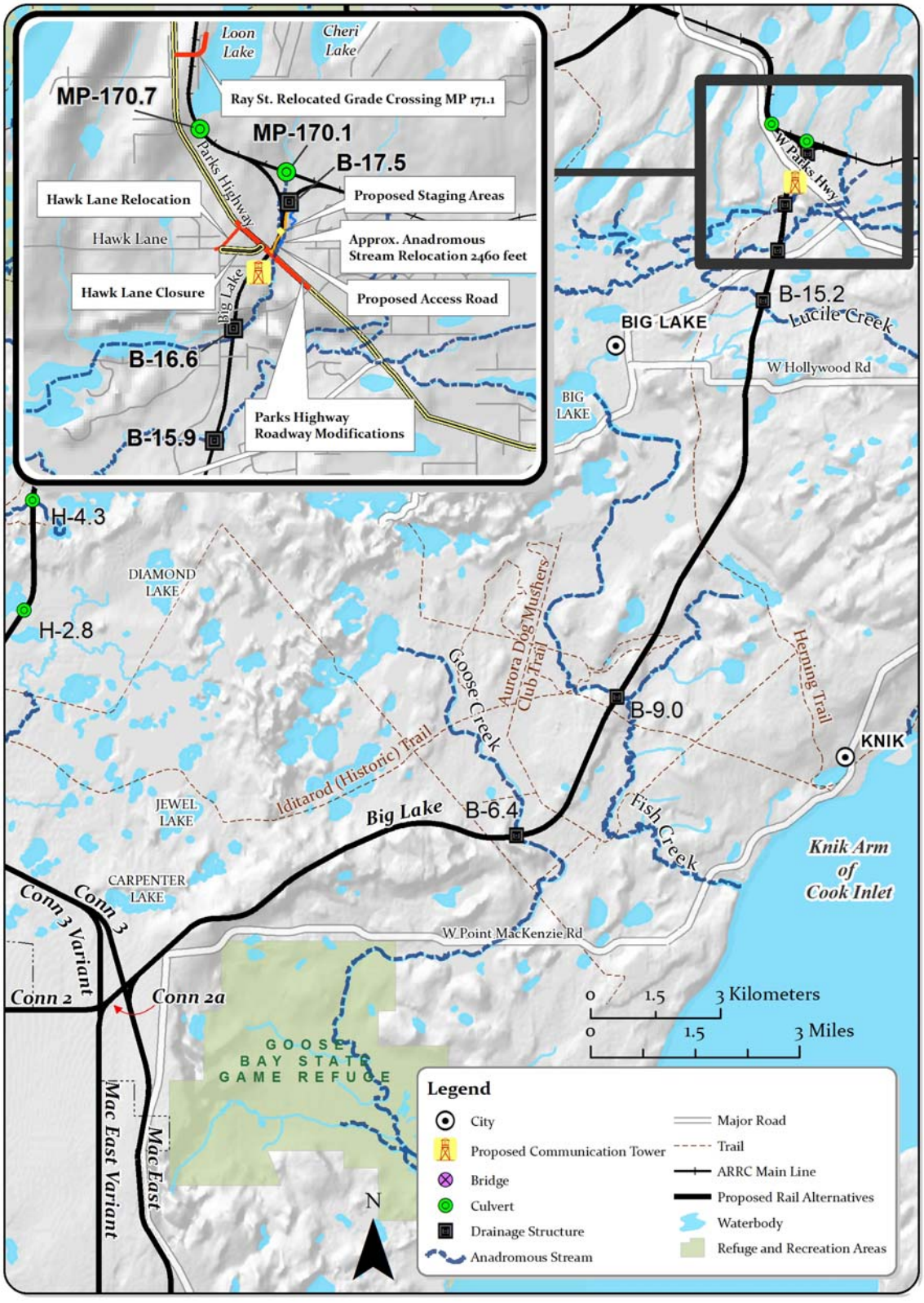

Figure F-7. Fish-Bearing Stream Crossings along the Big Lake Segment (Johnson and Daigneault, 2008; ADF&G, 2009a; Noel *et al.*, 2008)

publicly available literature based on their applicability to the affected environment, and on their data requirements. All of the models used in the analysis were populated using geomorphic information such as accessible watershed size, stream gradient, stream order, or other surface water information (see Section 4.2). This information was used to produce estimates of accessible or suitable habitat and estimates of potential adult fish abundance. The potential fish abundance estimates provide a basis for comparison between segments, segment combinations, and alternatives. The resulting index of fish habitat potential assumes relatively undisturbed conditions with unimpaired passage throughout the watersheds. It was used to compare the geographic quantity and geomorphic quality of fisheries habitat associated with the project alternatives. Figure F-8 shows the potentially affected habitats associated with all of the build alternatives and Figures F-9 through F-11 show the potentially affected habitats associated with each alternative. The fish abundance estimates do not represent forecasts or estimates of actual biological performance. As such, this information was not considered to inform designation of anadromy at stream crossings.

F.6.1 Southern Segments and Segment Combinations

Table F-8 shows the southern segment and segment combination results of the potential adult fish abundance model and selected geomorphic data inputs, such as accessible watershed size, slope, stream length, and other surface water information. Fish-bearing waters and upstream habitat along the Mac West-Connector 1 Segment Combination have the highest estimated index of fish habitat potential among all southern segments and segment combinations. Fish-bearing waters and upstream habitat along those segments and segment combinations containing the Mac East and Mac East Variant segments have the lowest estimated index of fish habitat potential among all southern segments and segment combinations. Fish-bearing waters and upstream habitat along all southern segments have the highest estimated fish abundance for sockeye salmon and the lowest fish abundance for Dolly Varden. As previously stated, the resulting index of fish habitat potential assumes relatively undisturbed conditions with unimpaired passage throughout the watersheds. The index does not represent forecasts or estimates of actual biological performance. As such, this information was not considered to inform designation of anadromy at stream crossings.

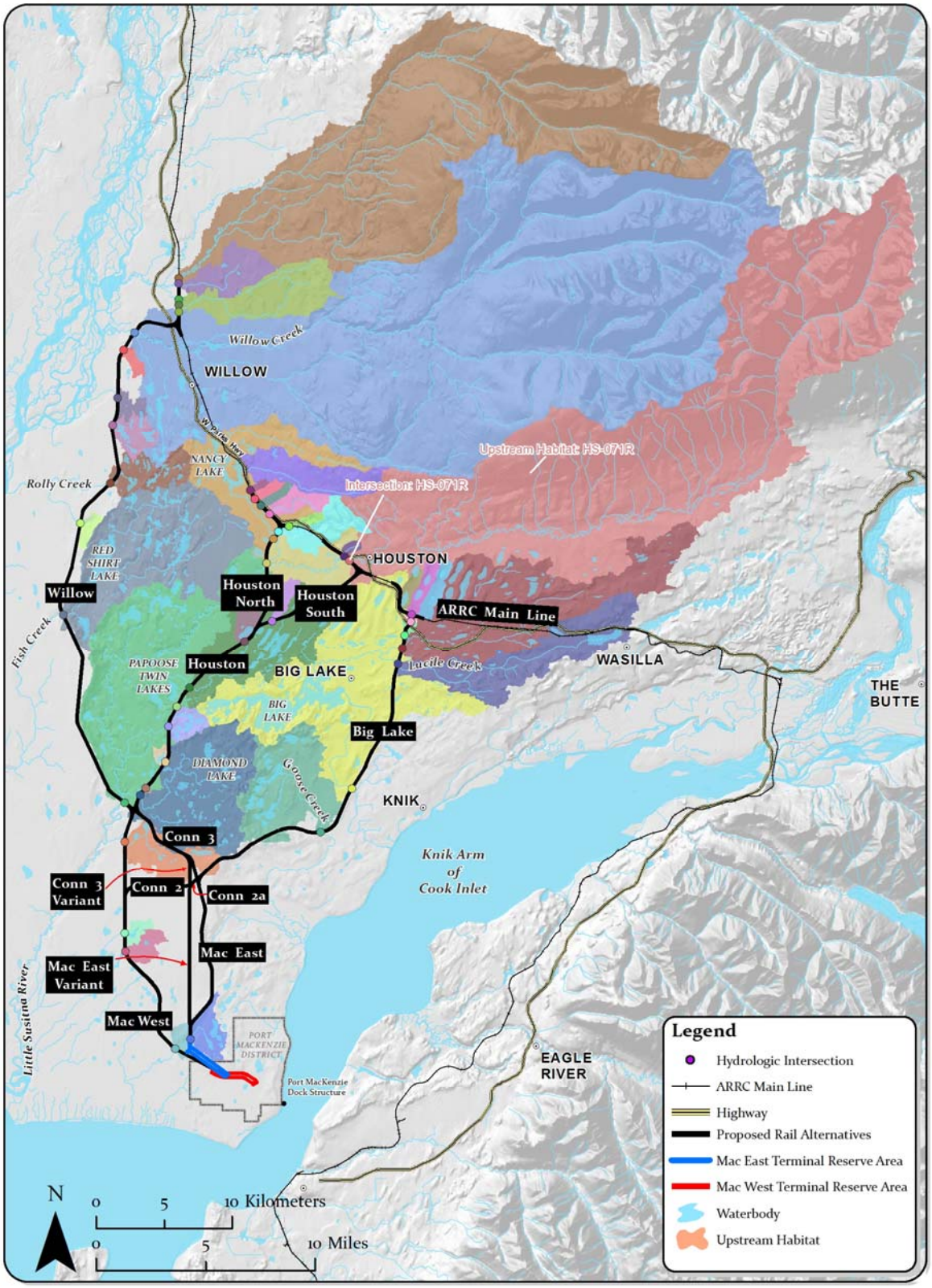

Figure F-8. Watersheds Upstream of Fish-Bearing Streams Crossed by the Port MacKenzie Rail Extension Alternatives

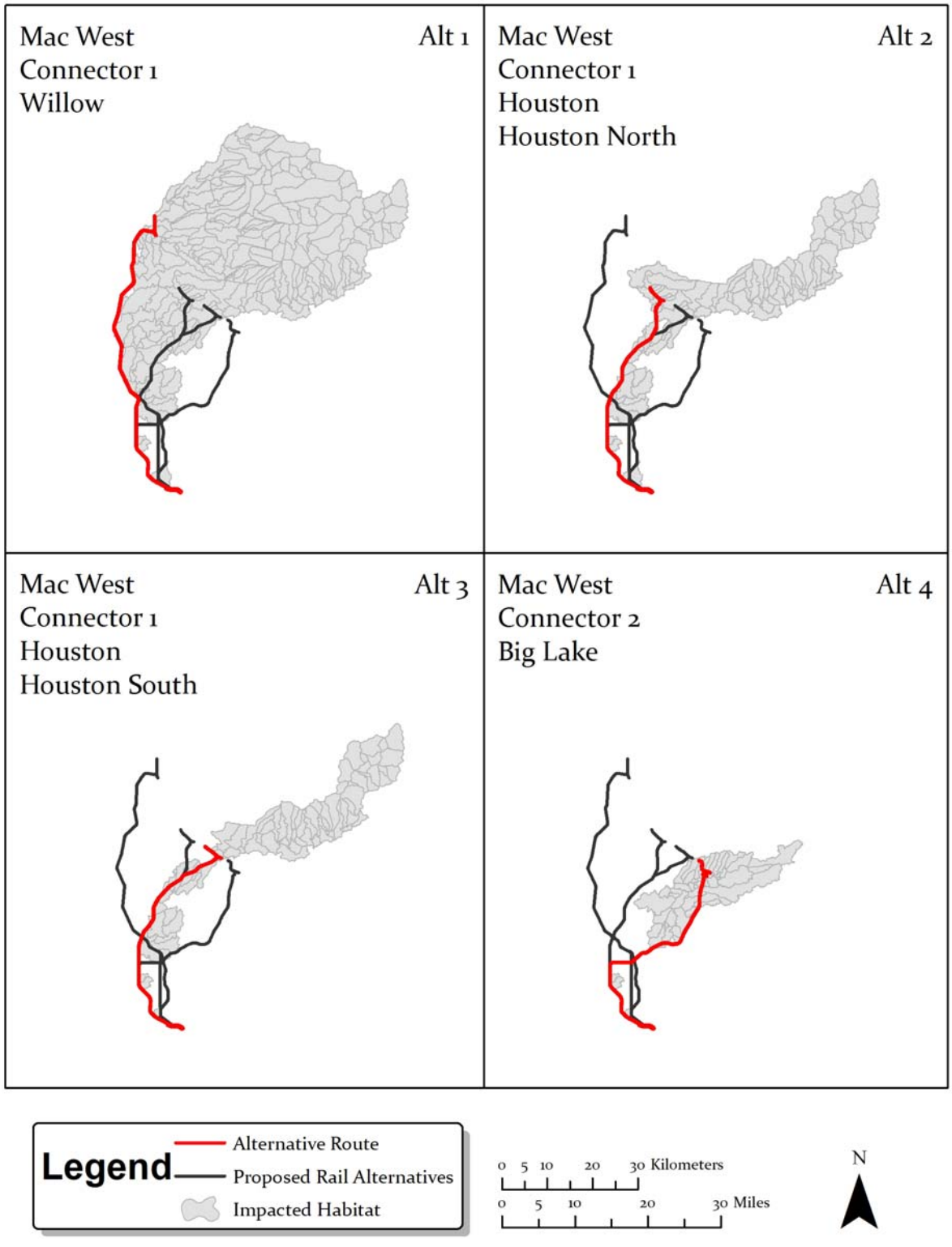

Figure F-9. Watersheds Upstream of Fish-Bearing Streams Crossed by the Port MacKenzie Rail Extension Alternatives that Include the Mac West Segment

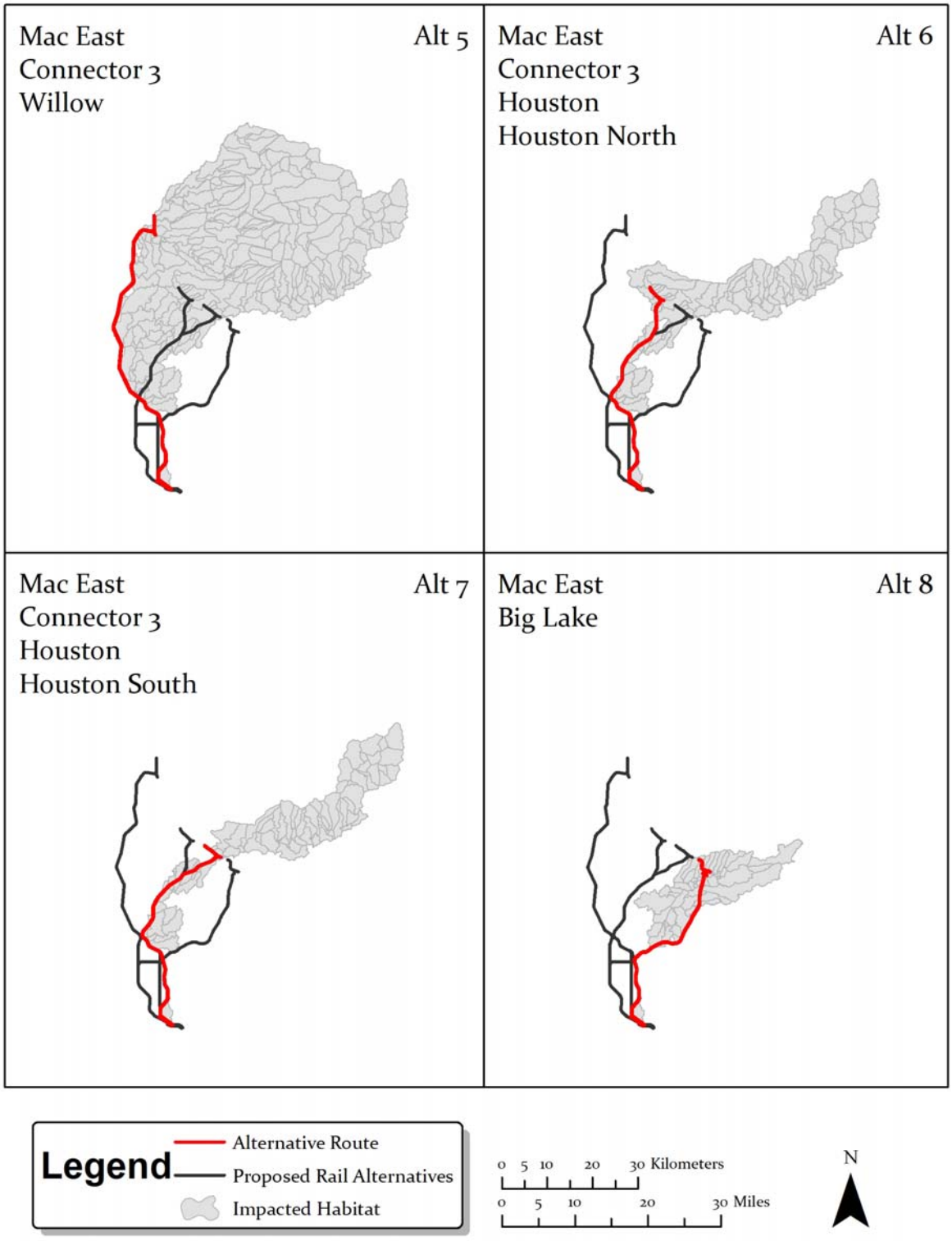

Figure F-10. Watersheds Upstream of Fish-Bearing Streams Crossed by the Port MacKenzie Rail Extension Alternatives that Include the Mac East Segment

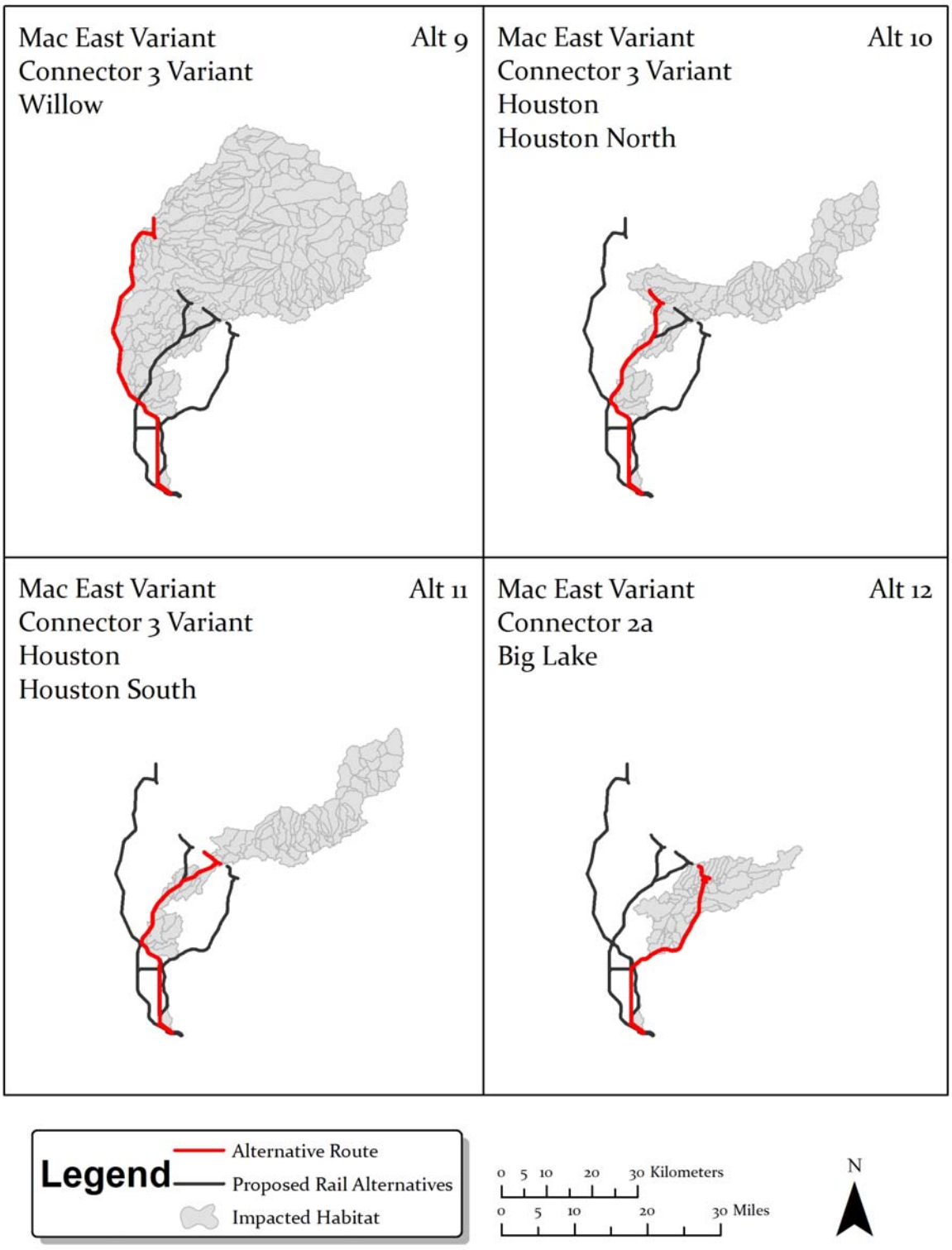

Figure F-11. Watersheds Upstream of Fish-Bearing Streams Crossed by the Port MacKenzie Rail Extension Alternatives that Include the Mac East Variant Segment

Table F-8
Summary Comparison of Fish Habitat Potential for Fish-Bearing Streams Crossed by the Southern Segments and Segment Combinations

	Mac West-Conn 1	Mac West-Conn 2	Mac East-Conn 3	Mac East	Mac East Variant-Conn 2a	Mac East Variant-Conn 3 Variant
Watershed Geomorphic Characteristics						
Upstream Watershed Area (acres)	8,800	4,595	2,048	2,048	2,048	2,048
Mean Elevation (feet)	134	132	153	153	153	153
Average Slope (percent)	1.1	1.1	2.1	2.1	2.1	2.1
Mean Rugosity[b]	1.0	1.0	1.0	1.0	1.0	1.0
Mean Annual Precipitation (inches)	20	20	20	20	20	20
Lake Area (acres)	185	116	59	59	59	59
Accessible Stream Length (miles)[c]	6.6	3.3	1.7	1.7	1.7	1.7
Index of Fish Habitat Potential[a,d]	**7,100**	**3,700**	**2,300**	**2,300**	**2,300**	**2,300**
Fish Species						
Chinook	1,351	825	317	317	317	317
Sockeye	3,718	1,991	1,488	1,488	1,488	1,488
Coho	1,274	622	291	291	291	291
Dolly Varden	165	35	4	4	4	4
Lake Trout	472	267	165	165	165	165

[a] The index of fish habitat potential is determined using previously published analyses that were based on the number of fish per unit area produced in monitored locations where both the amount of habitat and the number of fish produced by that habitat are known. As applied in this EIS the index of fish habitat potential assumes relatively undisturbed conditions with unimpaired passage throughout the watersheds. The index does not represent forecasts or estimates of actual future or past biological performance.

[b] Rugosity is an index of topographic variability of a surface, and is an indicator of the "roughness" or "bumpiness" of the landscape within a watershed.

[c] The length of a stream that is accessible by anadromous fish because (1) it has a connection to the ocean and (2) has a natural gradient that is not a barrier to fish migration.

[d] Totals may not equal sum of numbers due to rounding.

F.6.2 Northern Segments and Segment Combinations

For the northern segments, Table F-9 shows the results of the potential adult fish abundance model that were generated using geomorphic information, such as accessible watershed size, stream gradient, stream order, or other surface water information. Fish-bearing waters and upstream habitat along the Willow Segment have the highest estimated index of fish habitat potential among all northern segments and segment combinations. Fish-bearing waters and upstream habitat along the Houston-Houston South Segment combination have the lowest estimated index of fish habitat potential among all northern segments and segment combinations. Fish-bearing waters and upstream habitat along all northern segments have the highest fish abundance for coho salmon and the lowest fish abundance for lake trout. As previously stated,

Table F-9
Summary Comparison of Fish Habitat Potential for Fish-Bearing Streams Crossed by the Northern Segments and Segment Combinations

	Willow	Houston-Houston North	Houston-Houston South	Big Lake
Watershed Geomorphic Characteristics				
Upstream Watershed Area (acres)	476,142	162,711	137,220	78,347
Mean Elevation (feet)	1,300	1,212	1,418	220
Average Slope (percent)	6.5	7.7	9.1	1.9
Mean Rugosity[b]	1.0	1.0	1.0	1.0
Mean Annual Precipitation (inches)	26	26	28	20
Lake Area (acres)	7,041	2,402	1,543	4,964
Accessible Stream Length (miles)[c]	774.7	289.4	244	74.8
Index of Fish Habitat Potential[a,d]	**264,500**	**90,200**	**68,400**	**77,100**
Fish Species				
Chinook	28,842	11,363	8,332	6,576
Sockeye	79.526	28,622	20,356	51,007
Coho	105,605	34,367	27,093	13,097
Dolly Varden	38,867	11,755	9,632	1,797
Lake Trout	11,678	4,069	3,010	4,618

[a] The index of fish habitat potential is determined using previously published analyses that were based on the number of fish per unit area produced in monitored locations where both the amount of habitat and the number of fish produced by that habitat are known. As applied in this EIS the index of fish habitat potential assumes relatively undisturbed conditions with unimpaired passage throughout the watersheds. The index does not represent forecasts or estimates of actual future or past biological performance.

[b] Rugosity is an index of topographic variability of a surface, and is an indicator of the "roughness" or "bumpiness" of the landscape within a watershed.

[c] The length of a stream that is accessible by anadromous fish because (1) it has a connection to the ocean and (2) has a natural gradient that is not a barrier to fish migration.

[d] Totals may not equal sum of numbers due to rounding.

the resulting index of fish habitat potential assumes relatively undisturbed conditions with unimpaired passage throughout the watersheds. The index does not represent forecasts or estimates of actual biological performance. As such, this information was not considered to inform designation of anadromy at stream crossings.

F.7 Impacts to Aquatic Animals of Conservation Concern

Three aquatic animals of conservation concern (threespine stickleback, ninespine stickleback, and Pacific lamprey) have either been reported to occur at or near a stream crossing or have been reported to occur within the stream upstream or downstream of the crossing (ADF&G, 2009a; Noel *et al.*, 2008). Of the total of 42 proposed fish-bearing stream crossings, 18 contained sticklebacks, Pacific lamprey, or both (Table F-10). Occurrence of sticklebacks and Pacific

lamprey for fish-bearing stream crossings summarized by alternative indicates that the Mac West-Connector 1-Willow Alternative would have the most (10) occurrences and the Mac East-Connector 3-Houston-Houston North, Mac East-Connector 3-Houston-Houston South, Mac East Variant-Conn 3 Variant-Houston-Houston North, and Mac East Variant-Conn 3 Variant-Houston-Houston South alternatives would have the fewest (5) occurrences (Table F-11).

Table F-10
Summary of Crossings of Fish-Bearing Streams Containing Aquatic Animals of Conservation Concern[a]

Segment/Location	Threespine Stickleback	Ninespine Stickleback	Stickleback	Pacific Lamprey
Mac West				
MW-11.0			Y	
MW-10.1	Y			
MW-4.6			Y	
Mac East				
ME-4.5			Y	
Mac East Variant				
MEV-4.5			Y	
Connector 1				
C1-2.6	Y			Y
Willow				
W-23.1			Y	
W-19.6			Y	
W-16.7		Y		
W-14.4			Y	
W-0.6				Y
Houston North				
HN-3.2			Y	Y
Houston South				
MP-174.3			Y	Y
Houston				
H-4.3		Y		
H-9.6			Y	
Big Lake				
B-15.2	Y			
B-15.9	Y			
B-6.4	Y			
B-9.0	Y	Y		Y
Total Crossings	**6**	**3**	**9**	**5**

[a] Sources: ADF&G, 2007a; ADF&G, 2009a; Noel *et al*., 2008.
Note: No fish-bearing streams along Connector 2, Connector 2a, Connector 3, and Connector 3 Variant segments.

Table F-11
Crossings of Fish-Bearing Streams Containing Aquatic Animals of Conservation Concern by Proposed Port MacKenzie Rail Extension Alternative

	Threespine Stickleback	Ninespine Stickleback	Stickleback	Pacific Lamprey
Alternatives				
Mac West-Connector 1-Willow	2	1	5	2
Mac West-Connector 1-Houston-Houston North	2	1	4	2
Mac West-Connector 1-Houston-Houston South	2	1	4	2
Mac West-Connector 2-Big Lake	5	1	2	1
Mac East-Connector 3-Willow	0	1	4	1
Mac East-Connector 3-Houston-Houston North	0	1	3	1
Mac East-Connector 3-Houston-Houston South	0	1	3	1
Mac East-Big Lake	4	1	1	1
Mac East Variant-Connector 2a-Big Lake	4	1	1	1
Mac East Variant-Connector 3 Variant-Willow	0	1	4	1
Mac East Variant-Connector 3 Variant-Houston-Houston North	0	1	3	1
Mac East Variant-Connector 3 Variant-Houston-Houston South	0	1	3	1

[a] Sources: ADF&G, 2007a; ADF&G, 2009a; Noel *et al*., 2008.

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