Appendix E - Water Resources

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E. WATER RESOURCES

This appendix provides background data and analysis related to water resources, including surface water, groundwater, water quality, wetlands, and floodplains. The information in this appendix supports findings presented in Chapter 4 of this document.

E.1 Background

Numerous factors contribute to the characteristics and future of water resources. The following presents an overview of these factors as they relate to the project area.

E.1.1 Climatic Factors

Climate in the interior Tanana River Valley is characterized by long, cold winters, relatively short summers, and transitional periods during the spring and fall months (Magoun and Dean, 2000). Annual temperatures vary considerably between the summer and winter months and are generally cooler higher up in the valley towards Delta Junction. Mean January and July temperatures at Big Delta were −2.6 degrees Fahrenheit (°F) and 60.8°F between 1971 and 2000, with temperature extremes ranging from −63°F (−53 degrees Celsius [°C]) in the winter to 92°F (33°C) in the summer. Average annual rainfall at Big Delta is 11.3 inches (28.7 centimeters), with almost 70 percent of this total falling from June through September. The maximum monthly precipitation was 5.98 inches (15.2 centimeters) in July 1984. Snowfall occurs typically from mid-September to mid-April, averaging about 44.3 inches (112.5 centimeters) at Big Delta (NCDC, 2001). These climatic factors influence the physical processes of glaciation, seasonal ice breakup, seasonal flooding, and groundwater movement that affect the water resources of the region.

The Tanana River Valley is located entirely within the discontinuous permafrost zone (Yarie et al., 1998), suggesting that permafrost may not be located beneath or near large river channels. Permafrost is likely present on poorer draining soils, in flat-lying areas along river terraces that are sometimes adjacent to smaller water courses.

E.1.2 Discharge Regimes

Stream flow, including flooding and base flow, within the Tanana River Basin is influenced annually by glaciers, rainfall, spring breakup, and groundwater sources. Each of these discharge processes vary depending on the time of year and affect the magnitude of changes instream flow. Some streams are dominated primarily by one of these processes while others exhibit seasonal and annual flow characteristics of more than one discharge regime. The form of each stream's hydrograph[1] reflects the predominant nature of these various discharge regimes. The different discharge regimes are described below.

Glacially Dominated

Glaciated portions of the Alaska Range are the principal sources of water and sediment for the Tanana River, the Delta River, Delta Creek, and the Little Delta River. In early summer, glacier ice and snow at lower relative elevations begin to melt, causing river flows to increase. The peak

[1] A graph for a given point on a stream showing the discharge, stage (depth), velocity, or other property of water flow with respect to time.

melt and flow season occurs typically during July and August, and then declines through September until surface temperatures remain below freezing. Although no stream flow records exist for the Delta River, Delta Creek, and the Little Delta River, peak summer flows are typically 8 to 10 times higher than winter base flows, based on U.S. Geological Survey (USGS) flow data for the Tanana River at Tanacross, Big Delta, and Fairbanks (USGS, 2007). The Tanana River, however, is also fed by a substantial groundwater component (during the low-water period—fall through pre-breakup) that is not evident in the other three rivers, except near their junctions with the Tanana. So it is likely that peak summer flows on these three rivers are much greater (possibly two orders of magnitude) than winter base flows. Due to the high sediment loads produced during the annual meltwater periods, these rivers have formed braided channels, which are wide and shallow and covered by networks of interlacing small channels.

Breakup-Dominated

Breakup processes occur with almost all streams in the study area, but there is a large portion of streams in the region that are dominated by seasonally heightened discharge patterns due to the late spring breakup period. Thus, the hydrograph of these streams displays a large seasonal peak that is characterized by diurnal variations typically during late April to early May, and then followed by a steady decline through summer. In breakup-dominated streams, the breakup peak is substantially higher than subsequent stage increases due to summer rain storms, and in some cases these streams may become intermittent prior to freeze-up.

Over the winter months, snowfall and low stream velocity conditions coupled with cold temperatures combine to freeze the margins and surface of the streams. Once a frozen surface layer develops across the entire channel, the frozen layer thickens throughout the winter, and in many cases for small streams, freezes to the channel bottom. The thickness of the frozen layer depends on, for example, channel geometry (primarily depth of water column), flow, and winter temperatures, and can range from a few centimeters to more than 1 meter.

When warmer temperatures during springtime begin to melt the snow and ice in the channel, water begins to flow on top of or below the ice depending on the size of the river and whether the ice was frozen to the channel. Eventually flows overwhelm and lift, crack, and break up the ice, forming rafts of ice blocks moving downstream. While moving downstream, the blocks can become lodged together and trapped in narrow or shallow reaches, creating ice jams, which can redirect or block flows from continuing downstream. If this occurs, flows downstream of this point decrease and flooding occurs upstream. Once the ice jam breaks up, the dammed water behind the jam could be released rapidly downstream in a flood wave, resulting in flows occurring as irregular waves. These types of floods are usually isolated at specific locations and do not impact the entire river corridor. Ice jam-related flooding has been observed on the Tanana and Salcha rivers, while breakup-related flooding is less severe on the Delta and Little Delta rivers and Delta Creek. In general, breakup processes have not been recorded and/or observed on many of the smaller streams in the study area. Breakup is typically inconsequential in the groundwater-dominated streams due to the more or less steady discharge of springs or groundwater seepage.

Rainfall-Dominated

Rainfall-dominated flow events can occur at any time during the spring to fall months. The response of instream flows to rainfall can either be rapid (forming sharp or peaky hydrographs) or slow (forming rounded or smooth hydrographs) depending on rainfall intensity; duration; drainage basin characteristics, such as lithology; and drainage density (i.e., the length of streams

per unit area of the basin). Permafrost, impermeable bedrock, or fine sediment (silt and clay) inhibit the infiltration of rain or other precipitation, leading to direct surface runoff to the stream channel. In conjunction with this, areas that have moderate to steep gradients convey the water quickly across the ground surface. Runoff is then rapidly transported in gullies or shallow channels. In these cases, stream flows return to pre-rainfall conditions soon after the storm passes. During spring or fall, rainfall on snow can magnify the rainfall runoff effect, potentially causing extensive flooding when large quantities of snow or ice are rapidly melted. The Salcha River, the Little Salcha River, and Kiana Creek provide good examples of rainfall-dominated hydrographs.

Maximum riverbank erosion occurs during the summer months following large rainstorms (Mason and Beget, 1991). During this time, the banks are more susceptible to erosion because they are no longer frozen and the sands and gravels are more easily eroded.

Slower rises instream flows occur when the majority of rain infiltrates into shallow, permeable soils or deeper through porous media into the ground, where it recharges groundwater aquifers. Groundwater discharge to the stream slowly increases as the water table in perched zones or aquifers rises (Knighton, 1989). In comparison to direct surface runoff, this process is slower, allowing the river to rise and fall gently, and fluctuations in the overall stream flow are not as extreme, reducing the frequency and potential for flooding.

Groundwater/Spring-Dominated

Groundwater in the Tanana River Basin occurs primarily in permafrost free, unconsolidated, sandy to gravelly alluvium in the valleys at the base of moderate to high slopes and ridges. Groundwater-fed springs and seeps are common along the lower slopes and foothills where impermeable metamorphic bedrock or permafrost transitions to permeable sands and gravels (Anderson, 1970). Most commonly, flowing artesian springs emanate from hillsides where the water table is higher than the ground surface. These conditions are especially manifest along the southern side of the Tanana River, where Richardson Clearwater, Fivemile Clearwater, and other smaller streams are located (see Chapter 4 for visual representations of this area). North of the Tanana River, springs are less common due to the undifferentiated alluvial and colluvial material that have poor permeability and infiltration.

Spring-dominated streams typically flow year round, regardless of the air temperature because the groundwater remains slightly warmer than outside conditions and does not freeze at the source. In addition, spring-dominated streams typically exhibit near-steady seasonal to annual flow rates depending on the relative contributions by other sources of water.

E.2 Effects Assessment Methodology

The following describes the methods for assessing the surface water and groundwater regime that could be affected by the construction and use of the proposed rail line (including access roads, bridges and culverts) and associated facilities (e.g., camps, staging areas and borrow areas).

The analysis of impacts is understood best by evaluating the range of effects that can be expected within the six physiographic sub-regions described below and in Chapter 4 of this document. This is because the distinct set of hydrologic and hydrogeologic characteristics of each physiographic sub-region yield similar effects when stressed by similar types of activities (e.g., constructing access roads, excavating borrow areas, building bridges, etc.). The primary and

secondary attributes of each physiographic region are described herein. Then, in the effects analysis, impacts common to all alternatives and physiographic sub-regions are described in Chapter 4 of this document. This is followed by a discussion of the unique or unusual set of impacts associated with each segment or alternative rail line.

E.2.2 Physiographic Regions

Yukon-Tanana Uplands

The Yukon-Tanana Uplands encompass the lower foothill area of the much larger Yukon-Tanana Uplands major physiographic region as defined by Wahrhaftig (1965). The Uplands are comprised of round-topped ridges that trend in a northwestern to eastern direction that form the major drainage divide separating the Tanana River Basin from the Yukon River basin. Within the Tanana River drainage basin, streams flow toward the south and the valleys are generally flat and wide and filled with alluvial deposits (Brabets et al., 2000). There is no documented glacial record within this region; however, discontinuous permafrost is located throughout this area (Brabets et al., 2000). Thus, stream flow within this area is dominated by groundwater and rainfall sources and other micro-climatic influences such as permafrost and aspect. The Salcha (2,170 square miles) and Little Salcha (66 square miles) watersheds have the only two streams that drain from the Yukon-Tanana region. Although the proposed Salcha Alternative Segment 2 crosses through much of the Yukon-Tanana region, the segment crosses these two rivers within less than a mile from the Tanana River within the Tanana River Valley region.

Variable topographic gradients distinctly identify this area where gradients range from less than 1 percent up to 5 percent locally, while sediments with instream channels are dominated by sand and silt sized material (Anderson, 1970).

Streams affected by rainfall events (and sometimes rain on snow events) can occur at any time during the spring to fall months. During the winter, precipitation falls as snow and remains frozen on the ground surface until spring. The response in stream flows due to rainfall events varies based on duration, size, and intensity of events, as well as the time of year (rain or snow).

In the Salcha watershed, permafrost terrain causes rapid rises in stream flow due to the relative impermeable ground surface; that is, it inhibits the infiltration of rain and snowmelt, leading to direct surface runoff to the stream channel. As soon as the rain event passes or snowmelt period has ended, stream flows return to pre-rainfall conditions. Maximum river bank erosion occurs during the summer months following large rain storm events. During this time, the banks are more susceptible to erosion because they are no longer frozen and the sands and gravels are more easily eroded (Mason and Beget, 1991). In the non-permafrost portions of the Salcha watershed, groundwater recharge is more dominant and stream flow rises and falls are slower. Therefore, the potential for flooding and subsequent erosion is reduced.

Tanana Lowlands

The Tanana Lowlands, as defined by Wahrhaftig (1965), encompasses the area between the Tanana River and the drainage divide along the southern boundary (i.e., the Alaska Range and the Wrangell Mountains). The higher elevations of these mountain areas are dominated by glaciated valleys 6,000 to 9,000 feet, and small to extensive ice fields at elevations above 9,000 feet. Large valley glaciers emanate from this region and feed large braided river systems, such as the Delta River, the Little Delta River and Delta Creek. The headwaters of the Tanana River are fed by the Nabesna and Chisana rivers which are fed by large valley glaciers that originate in the Wrangell Mountains. Below the glaciated uplands lie the Lower Foothills of the Alaska

Range and extensive lowland areas of the broad Tanana River Valley. The project area is located within these lowland areas. The lowlands are comprised of extensive glaciofluvial sedimentary deposits and large alluvial fans along the west side of the Tanana River (Anderson, 1970). The valley floor is wide (3 to 7 miles wide) with rolling hills and elevations ranging from 700 to 1,200 feet (Brabets et al., 2000). Drainage within this area flows north towards the Tanana River.

The Tanana Lowland region is sub-divided into five smaller physiographic areas which have unique sets of stream types, water types, hydrogeologic conditions and hydrologic regimes. The five physiographic areas include: Eielson Flats, Lower Foothills, Delta Moraine Wetlands, Tanana Valley Flats and the Tanana River Valley (including the valleys of the major tributaries).

Eielson Flats

Eielson Flats is located north of the Tanana River near Eielson Air Force Base (AFB), and extends northward to the Chena Floodway and southward to the Little Salcha River watershed. All of the North Common Segment and all of the Eielson alternative segments are located within this area. The substrate is comprised of sandy alluvium and floodplain deposits likely originating from the Tanana River, which results in low topographic gradients (typically less than 1 percent) and a general flat appearance throughout. Due to relatively low elevations and proximity to the Tanana River, a shallow water table occurs throughout the area and results in numerous small, groundwater-fed floodplain sloughs, streams, ponds and wetland flow-ways. Surface drainage within Eielson Flats is generally slow and to the west or north towards the Tanana River.

Most of the streams or sloughs are groundwater or spring dominated. Groundwater in the Tanana River Basin occurs primarily in unconsolidated alluvium in the valleys where the loose sediment allows infiltration of surface water and groundwater movement through aquifers. Groundwater-fed streams are comprised of clear water that does not have high concentrations of glacial flour characteristic of glacial fed streams or tea-colored water characteristic of humic streams (see Table E-2, Water Type Definitions). The larger streams in this area (i.e. Piledriver Slough, Twentythreemile Slough) likely do not freeze to the bottom during winter due to substantial and constant groundwater sources. Groundwater levels are highest following spring break and during high flows on the Tanana River (July), and tend to decline through August, September and October. Flow from the groundwater sources usually flows at a constant rate with minor annual fluctuations.

Some of the sloughs or streams also receive overbanking flows during peak flows on the Tanana River. This creates additional flows to the channel, and also changes the stream water color to a mixture of clear and glacial water.

Tanana River Valley and Major Tributaries

This region includes the active floodplains and channels of the Tanana River and its major tributaries (i.e., Delta River, Little Delta River, Delta Creek and Salcha River) with characteristic overbank channels and floodplain sloughs that are frequently inundated by flood flows. All the major river crossings (of the Tanana, Salcha, Delta and Little Delta rivers and Delta Creek) occur within this region. Numerous smaller bridge or culvert crossings over side channels, sloughs and wetlands are also proposed. Except for the major river crossings, alternative rail lines located within this region include portions of the Salcha alternative segments 1 and 2, Central Alternative Segment 1, Connector Segments B, C, D and E, and Donnelly Alternative Segment 2. This area is dominated by glacial outwash processes which include a wide, flat, braided or

ananstomosing (branched) river system which carries a high silt and sand-sized fraction, as well as large loads of gravels, cobbles and boulders during higher flows. Small streams, overflow channels, floodplain sloughs, and wetland flow-ways are common throughout this area due to the shallow groundwater table, frequent overbanking events and seasonal fluctuations in the Tanana River water levels. The high sediment loads and steep headwater gradients create a wide and shallow channel with numerous smaller channels separated by small mid-channel bars. The result is a braided or anastomosed channel.

Glacially dominated stream flow is a result of the seasonal melting of mountain glaciers located in the Alaska Range and Wrangell Mountains. The snow and ice trapped in the glaciers is released downstream annually when warmer surface temperatures melt the toe of the glaciers. Warmer surface temperatures in spring begin to melt the ice, releasing water downstream that continues through the fall months until surface temperatures drop below freezing. Typically, flows are at their highest during July and August due to sustained warmer temperatures (that reach further up the glacier). At this time, flows in the Tanana River are 8 to 10 times higher than baseline flows during winter months, which are sustained primarily by groundwater.

Glacially dominated stream flows are visually discernable by their milky white to grey colored water. The coarser material trapped beneath the glacier and along the margins is ground down through friction over time, resulting in glacial flour. The color is a result of the high amount of fine material being transported as suspended sediment. Glacial till or moraines, which consist of coarser sands, gravels and cobbles, are also abundant along the margins and bottom of the channel and materials from these sources are transported downstream during peak meltwater season when stream flows are high.

A second seasonally dominated discharge pattern of this subregion occurs in the early spring (late April to early May) during ice-breakup. Over the winter months, cold temperatures, snow fall and low velocity conditions freeze the surface layers of the Tanana River and its many sloughs and overbank channels. This ice can range from a few inches to a few feet in depth depending upon the depth of the water column. When warmer temperatures begin to melt the snow and ice in the channel, flow initiates below the ice cover and then when hydrostatic pressures get high enough, the ice breaks into small and large size blocks which then move downstream. While the blocks of ice are moving downstream, they can become lodged together creating an ice jam, and can redirect or block flows from continuing downstream. If this occurs, flows downstream of this point decrease and flooding occurs upstream. Once the ice jam breaks up, the high flows behind the jam would proceed downstream like a flood wave, resulting in flows occurring as irregular waves. These type of floods are usually isolated at specific locations and do not impact the entire river corridor. At this time, many of the side channels may transport water when the main channel is blocked by debris or during ice jams.

Also during spring break-up, some of the smaller local streams that are fed by substantial groundwater sources (e.g., Richardson Clearwater) flow over the top of the ice of the Tanana River until the main river breaks up.

Tanana Valley Flats

The Tanana Valley Flats is a broad area of low relief adjacent to and slightly above the Tanana River Valley sub-physiographic region. Alternative rail lines though this sub-physiographic region include all of Central Alternative Segment 1 and Delta Alternative Segment 2, and portions of Salcha Alternative Segment 1, Connector Segments A, C and E, Donnelly alternative segments 1 and 2, and Delta Alternative Segment 1. Much of the Tanana Valley Flats'

geomorphic (or landscape) character of long, sinuous to meandering sloughs, paleochannels and wetland flow-ways interspersed with islands of permafrost-free white spruce or black spruce-dominated forests is due to ancient positions of the Tanana River.

The substrate consists of silty to sandy alluvial and floodplain deposits that originated from the Tanana River. The combination of fine and coarse sediment allows for some movement of groundwater through this area, but ponding or seeps are also likely. As a result, this area contains streams, wetland flow-ways, seeps and natural lakes. The spring-fed Richardson Clearwater and Fivemile Clearwater rivers occupy former Tanana River Sloughs within this area.

Stream flows within this area are dominated by groundwater spring flow, or breakup processes where groundwater sources are not substantial.

Lower Foothills

This region is located south of the Tanana Valley Flats and southward up to the base of the Alaska Range. It is crossed by the three large braided rivers (e.g., Delta River, Little Delta River and Delta Creek) that drain the glaciated Alaska Range, as well as several smaller streams (e.g. Kiana Creek) that have headwaters within the foothills. These smaller streams have very different characteristics than the large braided rivers. Sections of Donnelly Alternative Segments 1 and 2 are located within the Lower Foothills.

Gradients throughout this area are variable and range from 3 to 5 percent further upslope trending down to 1 percent near the Tanana River. The substrate is comprised primarily of river alluvium and glacial outwash with windows (isolated hillsides) of metamorphic basement rock (especially along the northern boundary between the Little Delta River and Delta Creek). Due to varying geologic source, the grain sizes of banks and channels are variable and range from silt to gravels.

A high groundwater table or springs are common along the lower slopes and foothills where impermeable metamorphic bedrock or permafrost transitions to permeable sands and gravels (Anderson, 1970). Most commonly, flowing artesian springs emanate from hillsides. These springs primarily occur along the border of the Tanana Valley Flats and the Lower Foothills. As a result of the varying hydrologic processes, stream flows within the Lower Foothills can be influenced by groundwater springs, rainfall, and glacier meltwater.

Delta Moraine Wetlands

The Delta Moraine Wetlands Region occurs south of the Tanana River between the Delta River and Delta Creek and is an extensive hummocky flat-lying terrain interspersed with many small lakes and ponds, and exhibits a high groundwater table and poor surface drainage. Alternative rail lines within this area include short sections of Donnelly Alternative Segments 1 and 2, South Common Segment, and Delta Alternative Segment 1. The poor surface drainage is a result of the substrate, which is comprised of glacial and riverine deposits consisting of fine silts and clays.

The substrate and geomorphic character is largely due to rapid downwasting of the mid Pleistocene glacier that once occupied the Delta River Valley. Surface water in this area is dominated by the lack of stream flows, numerous small springs and a high groundwater table. As a result, the primary surface water features include clear water wetland flow-ways and small streams.

E.3 Data Collection Strategy and Summary

E.3.1 Surface Water

In early 2005, a preliminary list of alternative rail lines was developed by the Alaska Railroad Corporation (ARRC). During the 2005 summer field season, a plan for investigating potential stream crossings by alternative segments was developed so that representative sites for each alignment could be evaluated with respect to hydrologic, geomorphic and biologic (primarily fish habitat) characteristics and then assessed for potential impacts. The plan entailed categorizing all potential crossings with regard to accessibility, land ownership, stream size, apparent water quality type based on color (e.g., milky gray of glacial origin, humic or tea-colored from lowland or upland bedrock sources, clear from groundwater fed sources, etc.), geomorphic conditions (e.g., planform type - river, stream, slough, pond, etc.) and seasonal flow patterns (i.e., perennial, intermittent, ephemeral). A total 116 field sites were visited by SEA during the 2005 field season.

In 2006 and 2007, ARRC continued to refine the locations of the potential rail lines based on maximizing economic and engineering feasibility as well as minimizing environmental liability. These adjustments meant that additional crossing locations would need to be evaluated, while some rail lines and, therefore, crossing locations that had previously been investigated would not be part of an alternative (in the Environmental Impact Statement [EIS]). In 2006, an additional 22 hydrologic field stations were visited by SEA, and then in 2007 another 27 stations were assessed. As a result, over the three-year period, a total of 165 potential crossings were visited within the project area, of which, approximately 45 percent are located along proposed alternative segments being discussed in this document.

Because potential crossing sites were not equally accessible, accessibility was first evaluated based on public or private ownership and whether it was accessible by car/truck or helicopter. Almost all the crossings on public lands and accessible by car/truck were evaluated in the field. The remaining helicopter-accessible crossings on public lands were characterized using the general crossing classifications described above.

Once all of the potential crossings were initially characterized, the crossings were grouped into similar groups for field site analysis. An approximately similar number of streams within each grouping were to be sampled throughout the study area. In addition, when time allotted, sites along larger rivers, near springs, and at known or possible anadromous fish locations were preferred.

Potential staging areas and borrow areas were also visually inspected either on the ground if accessible by car/truck, or visually observed by the air. Locations were assessed for proximity to water bodies, presence or likelihood of permafrost, the presence and proximity to groundwater springs, and any other features that could be affected by or would affect construction within the area.

The definitions of stream types developed and used by SEA's 2005-2007 field crews differed somewhat from the definitions used by ARRC (Table E-1). Thus, an assessment of the coverage (or representation) of crossing sites varies when comparing ARRC's field site numbers to SEA's 2005-2007 field crew classifications. Water type definitions are presented in Table E-2.

Data collection at surface water crossing sites was conducted either on the ground when possible, or by visual observation from the air (helicopter). In some cases, sites were not accessible

because there were no helicopter landing zones located nearby. In other cases, the site did not warrant a ground visit because upon aerial reconnaissance a stream crossing was not found (e.g., usually just a wetland flow-way area in a relict or paleochannel). Field data sheets were developed for the ground and aerial surveys to maintain consistency with the information collected.

Table E-1
Stream Type Definitions

Stream Types	2007 Alaska Railroad Corporations (ARRC) Working Definitions	SEA's 2005 to 2007 Field Definitions
Stream	Flowing water feature with a definable drainage basin that receives the dominate portion of its flow from an upland drainage basin, or groundwater sources. These water bodies may or may not receive flood flows from an adjacent major river (Tanana, Delta Creek, Little Delta, Salcha).	Flowing watercourse that has discernable channel banks and is supported with a constant source of water (i.e., from upstream headwater tributaries, glacier, or groundwater spring) but is not an overflow channel from a larger watercourse.
Slough or Floodplain Slough	Normally persistently wet side channel of a major river that can reasonably be expected to receive large flows from the main channel during flood flow events. There is a continuum between directly connected sloughs off the Tanana normally filled with glacial water and indirectly connected sloughs that are primarily filled with groundwater but may carry backed up or over bank floodwaters. Some of the latter are classified as streams.	Side channel of a major river that regularly receives flow from the main channel. The side channel may also have an additional groundwater source to maintain flows when not supplied from the main channel.
Overflow Channel	Normally dry side channels of major rivers that can reasonably be expected to fill with large flows from the main channel during flood flow events. These channels also represent a continuum between recently active flood channels, identified by active sediment transport, and inactive, nearly cutoff and refilled channels with thick vegetation re-growth.	Side channel of major rivers that periodically fills with flood flows from the main river. Not supported by a constant groundwater source.
Wetland Flow-way	Not all wetland crossings are included; only those that appear from aerial photo analysis to have a linear transport function. Most of these are abandoned and refilled overflow channels in the Tanana floodplain, but also includes some upland sites on the south side of the Tanana where there is considerable groundwater migration from upland basins.	Area appears to be saturated with an apparent flow direction, but no defined channel or drainage way was observed. Recognized by presence of grassy and/or boggy areas and lack of trees. These wetland flow-ways may or may not coincide with the areas of wetlands as described by the National Wetland Inventory (NWI) Codes, as defined by Classification of Wetlands and Deepwater Habitats in Cowardin et al. (1979), and used in Section 4.5.
Stream-Wetland Flow-way	No classification by ARRC.	Wetland type channel that has a combination of boggy land and open water. Stream flow appears to be minimal, if any.
Paleo Channel or Paleo Wetland Flow-way	No classification by ARRC.	Was once a channel or branch of a large river (i.e., normally the Tanana River), but is no longer active and does not receive flows from the main channel. A dry channel that appears more as a scar on the landscape. May convey spring runoff flows or become saturated during a high groundwater conditions.
Relic-Wetland or Relic-Overflow	No classification by ARRC.	This channel still has water in the channel (at least part of the year), but is no longer connected upstream to the main river, except for extreme flow events.

Table E-1
Stream Type Definitions (continued)

Stream Types	2007 Alaska Railroad Corporations (ARRC) Working Definitions	SEA's 2005 to 2007 Field Definitions
Overflow-Wetland/ Overflow-Stream	No classification by ARRC.	A combination of the two stream types. The location may receive high flows from a surrounding larger river, but appears to be supported by a minimal groundwater source, at least part of the year.
Seep	Small steeply sloping persistent drainage features with or without definable drainage basins that receive most of their base flow from groundwater springs. Conveyances for these crossings are sized primarily for dealing with winter icing conditions.	No classification– considered by character of crossing and not necessarily water source.
Drainage Way	A few select crossing sites with or without a definable drainage basin and drainage pathway identified by topography or vegetation features but lacking a definable water course or linear wetland feature.	No classification
Pond	No classification by ARRC.	Open body of water that is not in an existing or former channel.
Other	No classification by ARRC.	A potential crossing site initially identified by ARRC but upon subsequent field inspection turned out to have no water crossing characteristics.

Table E-2
Water Type Definitions

Stream Color	
Clear	Clear water stream. Source of water from seeps or groundwater.
Mixed	Multiple sources of water and can change seasonally depending upon the location. Mixed flows can be any combination or clear, glacial, or humic.
Glacial	Glacial draining streams, usually consists of a milky gray color from the glacial flour.
Humic	Dark brown or tea-colored water as a result of acids (tannic and humic) leaching from plants and other organic matter from the surrounding area.
Dry or Unknown	Water was not present or was not determined at the sampling time.

The information collected during the ground assessments included a description of the general stream environment and parameters, channel and floodplain dimensions, channel and bank substrate, surrounding vegetation types, bank stability, and stream channel classifications (e.g. modified Rosgen and U.S. Forest Service (USFS) classifications – see Table E-3 for definitions). Photographs of the crossing were taken from the air and the ground, and cataloged for future reference. When feasible, channel and floodplain measurements were taken with a tape measure. When the channel could not be waded, a laser range finder was used to estimate channel and floodplain dimensions. Bank angles were visually estimated using a hand-held clinometer. Channel and bank material were also estimated and noted on the field sheets. Discharge and field water quality measurements were also conducted where feasible.

The aerial assessment consisted of broader information due to limited site access. The information included a description of the general stream and floodplain environment, estimates on channel and floodplain dimensions, vegetation present and channel stability. Aerial photos of the crossings were also taken.

Tables E-4 to E-9 summarize the final distribution and coverage of crossing sites based on stream type (Tables E-4 and E-5), water type (Table E-6), crossing type (Table E-7), permafrost terrain (Table E-8) and stream classifications (Table E-9). In general, the final distribution of field stations within each sub-physiographic regions as described above is generally representative of the number of actual crossings being considered in that region.

Table E-3
Stream Classification Definitions

Modified Rosgen Stream Classification (not all Rosgen types are shown)

Rosgen Type	***Modified Sub-Types Used During Field Assessment***	***General Description***
C	No sub-types were used.	Meandering stream with pools and riffles and a defined floodplain. Can occur in glacial outwash locations where materials are abundant. Typically have high width/depth ratios.
D	No sub-types were used.	Wide braided river channel with numerous longitudinal and traverse bars. Eroding banks are also common.
DA	DA-S - single backwater or floodplain slough developed in former anastamosed branch; narrow entrenched channels on broad low-gradient wetland floodplains DA-B - single side branch of larger anastamosed system; banks are not necessarily stable; planform is entrenched and moderately stable DA-O - single overflow side branch of larger anastamosed or braided system; planform is aggrading and relatively stable DA-R - relic channel of overflow side branch of former anastamosed system; aggraded and planform poorly defined.	Anastomosing channel, similar to a D channel, but has stable mid-channel bars with vegetation.
E	E-W - low gradient riffle-pool-run meandering stream, high width:depth ratio; emergent vegetation, not confined E-M - low gradient shallowly incised riffle-pool-run meandering stream; moderate to high width:depth ratios; stable and unstable banks. E - stream is similar to E-W or E-M, but classification is not a good overall match	Meandering stream with some riffles and pools and have high width/depth ratios. Channel banks can be stabilized by dense bank vegetation.
F	F-P - small entrenched very low-gradient sinuous stream (pond-pool like without riffles) with low width:depth ratios and unstable banks F-N - small to moderate sized entrenched low-gradient meandering stream with pools and riffles, low width:depth ratios and unstable banks F- M - small to moderate sized open marshy very low-gradient meandering stream with pools, high width:depth ratios and poorly defined banks.	Confined or entrenched channel, with variable sinuosities. Eroding banks are common.
NA	A reasonable Rosgen stream classification was not found for the observed stream channel.	Not applicable.

Table E-3
Stream Classification Definitions (continued)

Modified U.S. Forest Service (USFS) Alaska Stream Classifications (not all USFS Alaska classes shown)		
USFS Groups	***Modified Sub-Groups Used During Field Assessment***	***General Description***
PA: Palustrine Process Group	PA1 = Narrow Placid Flow Channel PA2 = Moderate Width Placid Flow Channel PA3 = Shallow Groundwater Fed Slough PA4 = Floodplain Backwater Slough PA5 = Beaver Dam/Pond Channel PA6 = Wide Placid Boggy Stream PA7 = Narrow Placid Boggy Stream	Very low gradient (<1%) streams associated with low relief landforms and wetland drainage networks; water movement is slow and sediment transport low; channels act as traps and storage areas for fine organic and inorganic sediments.
LM: Low Gradient Contained Process Group	LM1 = shallowly incised low gradient meandering stream LM2 = moderately incised low gradient meandering stream LM3 = deeply incised low gradient meandering stream	Low to moderate gradient (1-3%) channels are moderately incised with good low containment; stream flow is well contained by adjacent landforms; larger valley or the long-term potential of an area to be able to support animals.
GO: Glacial Outwash Group	GO1 = Glacial Outwash Floodplain Side Channel GO2 = Large Meandering Glacial Outwash Channel GO3 = Large Braided Glacial Outwash Channel GO4 = Moderate Width Glacial Channel	Mountain glacier meltwater is a source of runoff to these streams; streams carry extremely high sediment loads and turbid water; gradients usually <3%.
FP: Floodplain Process Group	FP1 = Uplifted Beach Channel FP2 = Foreland Uplifted Estuarine Channel FP3 = Narrow Low Gradient Floodplain Channel FP4 = Low Gradient Floodplain Channel FP5 = Wide Low Gradient Floodplain Channel	Generally lowland and valley bottom streams and rivers; high stream flows not commonly contained within the active channel banks and some degree of floodplain development evident; usually low gradient (<2%) channels where alluvial deposition is prevalent.

Table E-4a
Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type

				Wetlands				
	Stream	**Floodplain Slough**	**Overflow Channel**	**Wetland Flow-way**	**Stream-Wetland**	**Paleo-Channel/ Paleo-Wetland**	**Relic-Wetland/ Overflow**	**Overflow-Wetland/ Stream**
ARRC Site Crossings	43	21	28	64	-	-	-	-
All 2005-2007 SEA Field Crews Sites Sampled	63	3	13	14	17	13	10	15
2005-2007 SEA Field Crews EIS Alts Sites[1]	21	1	4	4	8	6	3	9
Physiographic Regions								
Eielson Flats								
ARRC	2	10	12	14	-	-	-	-
2005-2007 Field Crews -EIS Alts[1]	5	1	-	-	-	1	-	-
2005-2007 Field Crews -Off EIS Alts[2]	7	2	2	-	-	1	4	1

Table E-4a
Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type (continued)

	Stream	Floodplain Slough	Overflow Channel	Wetlands				
				Wetland Flow-way	Stream-Wetland	Paleo-Channel/ Paleo-Wetland	Relic-Wetland/ Overflow	Overflow-Wetland/ Stream
Tanana River Valley and Major Tributaries								
ARRC	20	11	14	13	-	-	-	-
2005-2007 Field Crews -EIS Alts[1]	5	-	2	2	5	1	1	6
2005-2007 Field Crews -Off EIS Alts[2]	12	-	4	2	7	6	1	3
Yukon-Tanana Uplands								
ARRC	-	-	-	-	-	-	-	-
2005-2007 Field Crews -EIS Alts[1]	-	-	-	-	-	-	-	-
2005-2007 Field Crews -Off EIS Alts[2]	-	-	-	-	-	-	-	-
Tanana Valley Flats								
ARRC	6	-	-	10	-	-	-	-
2005-2007 Field Crews -EIS Alts[1]	5	-	-	-	3	2	-	-
2005-2007 Field Crews -Off EIS Alts[2]	16	-	1	2	1	-	2	2
Delta Moraine Wetlands								
ARRC	5	-	-	12	-	-	-	-
2005-2007 Field Crews -EIS Alts[1]	2	-	-	1	-	-	-	-
2005-2007 Field Crews -Off EIS Alts[2]	-	-	-	5	-	-	-	-
Lower Foothills								
ARRC	10	-	2	15	-	-	-	-
2005-2007 Field Crews -EIS Alts[1]	4	-	2	1	1	2	2	-
2005-2007 Field Crews -Off EIS Alts[2]	5	-	2	1	1	-	-	-

1 Field sites in proximity to an EIS alternative: field sites located along watercourse within 500 to 1000 feet of proposed crossing location that are considered representative of crossing location; in some cases two or more sites may have been characterized for one crossing, so that the total number of sites would not necessarily be the same as the total number of crossings

2 Field sites located along watercourse more than 1000 feet of a potential crossing location. While not located at a crossing location, field sites were used as representative sites for the area in which they were sampled.

Table E-4b
Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type

	Seeps	Drainageway	Pond	Other	Total Number	Total Field Stations
ARRC Site Crossings	29	43	-	-	228	
All 2005-2007 SEA Field Crews Sites Sampled	-	-	2	15	169	**169**
2005-2007 SEA Field Crews EIS Alts Sites[1]	-	-	1	5	62	
Physiographic Regions						
Eielson Flats						
ARRC	-	1	-	-	39	
2005-2007 Field Crews -EIS Alts[1]	-	-	-	2	9	**45**
2005-2007 Field Crews -Off EISAlts[2]	-	-	1	-	18	
Tanana River Valley and Major Tributaries						
ARRC	3	6	-	-	58	
2005-2007 Field Crews -EIS Alts[1]	-	-	1	-	22	**59**
2005-2007 Field Crews -Off EISAlts[2]	-	-	-	2	37	
Yukon-Tanana Uplands						
ARRC	-	-	-	-	0	
2005-2007 Field Crews -EIS Alts[1]	-	-	-	-	0	**2**
2005-2007 Field Crews -Off EIS Alts[2]	-	-	-	-	2	
Tanana Valley Flats						
ARRC	13	5	-	-	28	
2005-2007 Field Crews -EIS Alts[1]	-	-	-	1	8	**38**
2005-2007 Field Crews -Off EIS Alts[2]	-	-	-	6	30	
Delta Moraine Wetlands						
ARRC	-	11	-	-	29	
2005-2007 Field Crews -EIS Alts[1]	-	-	-	-	4	**9**
2005-2007 Field Crews -Off EIS Alts[2]	-	-	-	-	5	
Lower Foothills						
ARRC	13	20	-	-	60	
2005-2007 Field Crews -EIS Alts[1]	-	-	-	2	15	**16**
2005-2007 Field Crews -Off EIS Alts[2]	-	-	-	2	11	

1 Field sites in proximity to an EIS alternative: field sites located along watercourse within 500 to 1000 feet of proposed crossing location that are considered representative of crossing location; in some cases two or more sites may have been characterized for one crossing, so that the total number of sites would not necessarily be the same as the total number of crossings

2 Field sites located along watercourses more than 1000 feet of a potential crossing location. While not located at a crossing location, field sites were used as representative sites for the area in which they were sampled.

Table E-5a
Detailed Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type

	Stream	Floodplain Slough	Overflow Channel	Wetlands				
				Wetland Flow-way	Stream-Wetland	Paleo-Channel/ Paleo-Wetland	Relic-Wetland/ Overflow	Overflow-Wetland/ Stream
Physiographic Regions								
Eielson Flats								
ARRC	**2**	**10**	**12**	**14**	**-**	**-**	**-**	**-**
North Common	1	1	-	-	-	-	-	-
Eielson 1	-	-	4	4	-	-	-	-
Eielson 1, Eielson 2	-	1	2	3	-	-	-	-
Eielson 2	1	1	2	-	-	-	-	-
Eielson 2, Eielson 3	-	1	--	2	-	-	-	-
Eielson 3	-	6	2	5	-	-	-	-
Salcha 2	-	-	2	-	-	-	-	-
SEA's 2005-2007 Field Crews	**5**	**1**	**-**	**-**	**-**	**1**	**-**	**-**
North Common	1	1	-	-	-	-	-	-
Eielson 1	-	-	-	-	-	-	-	-
Eielson 1, Eielson 2	1	-	-	-	-	1	-	-
Eielson 2	1	-	-	-	-	-	-	-
Eielson 2, Eielson 3	-	-	-	-	-	-	-	-
Eielson 3	2	-	-	-	-	-	-	-
Salcha 2	-	-	-	-	-	-	-	-
Tanana River Valley and Major Tributaries								
ARRC	**22**	**11**	**14**	**12**	**-**	**-**	**-**	**-**
Salcha 1	2	1	-	1	-	-	-	-
Salcha 2	5	8	1	2	-	-	-	-
Connector A	-	-	-	-	-	-	-	-
Connector B	1	1	-	-	-	-	-	-
Connector C	3	1	1	-	-	-	-	-
Connector D	4	-	-	-	-	-	-	-
Connector E	1	-	-	4	-	-	-	-
Central Alternative 2	-	-	9	2	-	-	-	-
Donnelly 1	2	-	1	-	-	-	-	-
Donnelly 2	2	-	2	3	-	-	-	-
Delta 1	1	-	-	-	-			
Delta 2	1	-	-	-	-	-	-	-

Table E-5a
Detailed Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type (continued)

	Stream	Floodplain Slough	Overflow Channel	Wetlands				
SEA's 2005-2007 Field Crews	**5**	**-**	**2**	**2**	**5**	**1**	**1**	**6**
Salcha 1	1	-	-	-	-	-	-	2
Salcha 2	2	-	1	-	-	1	1	-
Connector A	-	-	-	-	1	-	-	-
Connector B	1	-	1	-	-	-	-	1
Connector C	-	-	-	-	-	-	-	1
Connector D	-	-	-	-	-	-	-	-
Central Alternative 2	1	-	-	1	1	-	-	2
Donnelly 1	-	-	-	-	-	-	-	-
Donnelly 2	-	-	-	1	3	-	-	-
Delta 1	-	-	-	-	-	-	-	-
Delta 2	-	-	-	-	-	-	-	-
Yukon-Tanana Uplands								
ARRC	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Salcha 2	-	-	-	-	-	-	-	-
SEA's 2005-2007 Field Crews	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Salcha 2	-	-	-	-	-	-	-	-
Tanana Valley Flats								
ARRC	**6**	**-**	**-**	**12**	**-**	**-**	**-**	**-**
Salcha 1	-	-	-	5	-	-	-	-
Central Alternative 1	2	-	-	4	-	-	-	-
Connector A	1	-	-	2	-	-	-	-
Connector C	1	-	-	1	-	-	-	-
Connector E	-	-	-	-	-	-	-	-
Donnelly 1	-	-	-	-	-	-	-	-
Donnelly 2	2	-	-	-	-	-	-	-
SEA's 2005-2007 Field Crews	**5**	**-**	**-**	**-**	**3**	**2**	**-**	**-**
Salcha 1	-	-	-	-	-	-	-	-
Central Alternative 1	1	-	-	-	-	-	-	-
Connector A	1	-	-	-	-	-	-	-
Connector C	2	-	-	-	1	-	-	-
Connector E	-	-	-	-	-	1	-	-
Donnelly 1	-	-	-	-	-	-	-	-
Donnelly 2	1	-	-	-	-	1	-	-

Table E-5a
Detailed Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type (continued)

	Stream	Floodplain Slough	Overflow Channel	Wetlands				
Delta Moraine Wetlands								
ARRC	**5**	**-**	**-**	**12**	**-**	**-**	**-**	**-**
Donnelly 1	-	-	-	3	-	-	-	-
Donnelly 2	2	-	-	-	-	-	-	-
Delta 1	-	-	-	-	-	-	-	-
South Common	3	-	-	9	-	-	-	-
SEA's 2005-2007 Field Crews	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**
Donnelly 1	-	-	-	-	-	-	-	-
Donnelly 2	-	-	-	-	-	-	-	-
South Common	2	-	-	1	-	-	-	-
Delta 1	-	-	-	-	-	-	-	-
Lower Foothills								
ARRC	**10**	**-**	**2**	**15**	**-**	**-**	**-**	**-**
Donnelly 1	6	-	-	11	-	-	-	-
Donnelly 2	4	-	2	4	-	-	-	-
Delta 1	-	-	-	-	-	-	-	-
Delta 2	-	-	-	-	-	-	-	-
SEA's 2005-2007 Field Crews	**4**	**-**	**2**	**1**	**1**	**2**	**2**	**-**
Donnelly 1	3	-	2	1	2	1	2	-
Donnelly 2	1	-	-	-	-	1	-	-
Delta 1	-	-	-	-	-	-	-	-
Delta 2	-	-	-	-	-	-	-	-

Table E-5b
Detailed Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type

	Seeps	Drainageway	Pond	Other	Total Number	Total Field Stations
Physiographic Regions						
Eielson Flats						
ARRC	**-**	**1**	**-**	**-**		
North Common	-	-	-	-	2	
Eielson 1	-	-	-	-	8	
Eielson 1, Eielson 2	-	-	-	-	6	
Eielson 2	-	-	-	-	4	
Eielson 2, Eielson 3	-	-	-	-	3	
Eielson 3	-	1	-	-	14	
Salcha 2	-	-	-	-	2	**38**
SEA's 2005-2007 Field Crews	**-**	**-**	**-**	**2**		
North Common	-	-	-	-	2	
Eielson 1	-	-	-	-	0	
Eielson 1, Eielson 2	-	-	-	-	2	
Eielson 2	-	-	-	-	1	
Eielson 2, Eielson 3	-	-	-	-	0	
Eielson 3	-	-	-	2	4	
Salcha 2	-	-	-	-	0	**9**
Tanana River Valley and Major Tributaries						
ARRC	**-**	**4**	**-**	**-**		
Salcha 1	-	2	-	-	6	
Salcha 2	-	-	-	-	16	
Connector A	-	1	-	-	1	
Connector B	-	1	-	-	3	
Connector C	-	-	-	-	5	
Connector D	-	-	-	-	4	
Connector E	-	-	-	-	5	
Central Alternative 2	-	-	-	-	11	
Donnelly 1	-	-	-	-	3	
Donnelly 2	-	-	-	-	7	
Delta 1	-	-	-	-	1	
Delta 2	-	-	-	-	1	**63**
SEA's 2005-2007 Field Crews	**-**	**-**	**1**	**-**		
Salcha 1	-	-	-	-	3	
Salcha 2	-	-	-	-	5	

Table E-5b
Detailed Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type (continued)

	Seeps	Drainageway	Pond	Other	Total Number	Total Field Stations
Connector A	-	-	-	-	1	
Connector B	-	-	-	-	3	
Connector C	-	-	-	-	1	
Connector D	-	-	-	-	5	
Central Alternative 2	-	-	-	-	-	
Donnelly 1	-	-	-	-	-	
Donnelly 2	-	-	-	-	4	
Delta 1	-	-	-	-	-	
Delta 2	-	-	-	-	-	**22**
Yukon-Tanana Uplands						
ARRC	**-**	**-**	**-**	**-**		
Salcha 2	-	-	-	-	-	**0**
SEA's 2005-2007 Field Crews	**-**	**-**	**-**	**-**		
Salcha 2	-	-	-	-	-	**0**
Tanana Valley Flats						
ARRC	**13**	**4**	**-**	**-**		
Salcha 1	-	2	-	-	7	
Central Alternative 1	3	1	-	-	10	
Connector A	-	-	-	-	3	
Connector C	-	-	-	-	2	
Connector E	-	1	-	-	1	
Donnelly 1	-	-	-	-	-	
Donnelly 2	-	-	-	-	2	**25**
SEA's 2005-2007 Field Crews	**-**	**-**	**-**	**1**		
Salcha 1	-	-	-	-	-	
Central Alternative 1	-	-	-	-	1	
Connector A	-	-	-	-	1	
Connector C	-	-	-	-	3	
Connector E	-	-	-	-	1	
Donnelly 1	-	-	-	-	-	
Donnelly 2	-	-	-	-	2	**8**
Delta Moraine Wetlands						
ARRC	**-**	**11**	**-**	**-**		
Donnelly 1	-	5	-	-	8	
Donnelly 2	-	3	-	-	5	
Delta 1	-	1	-	-	1	
South Common	-	2	-	-	14	**28**

Table E-5b
Detailed Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Stream Type (continued)

	Seeps	Drainageway	Pond	Other	Total Number	Total Field Stations
SEA's 2005-2007 Field Crews	**-**	**-**	**-**	**-**		
Donnelly 1	-	-	-	-	-	
Donnelly 2	-	-	-	-	-	
South Common	-	-	-	1	4	
Delta 1	-	-	-	-	-	**4**
Lower Foothills						
ARRC	**13**	**20**	**-**	**-**		
Donnelly 1	-	9	-	-	26	
Donnelly 2	13	11	-	-	34	
Delta 1	-	-	-	-	-	
Delta 2	-	-	-	-	-	**60**
SEA's 2005-2007 Field Crews	**-**	**-**	**-**	**2**		
Donnelly 1	-	-	-	-	11	
Donnelly 2	-	-	-	2	4	
Delta 1	-	-	-	-	-	
Delta 2	-	-	-	-	-	**15**

Table E-6
Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Water Type

Physiographic Regions		Clear	Mixed	Glacial	Humic	Dry or Unknown	Total Number	
Eielson Flats								
ARRC	North Common	2	-	-	-	-	2	
	Eielson 1	-	7	1	-	-	8	
	Eielson 1, Eielson 2		2	2	-	2	6	
	Eielson 2	-	4	-	-	-	4	
	Eielson 2, Eielson 3	-	1	-	-	2	3	
	Eielson 3	1	7	-	-	6	14	
	Salcha 2	-	1	1	-	-	2	**39**
SEA's 2005-2007 Field Crews	North Common	2	-	-	-	-	2	
	Eielson 1	-	-	-	-	-	-	
	Eielson 1, Eielson 2	1	-	-	-	1	2	
	Eielson 2	-	1	-	-	-	1	
	Eielson 2, Eielson 3	-	-	-	-	-	-	
	Eielson 3	4	-	-	-	-	4	
	Salcha 2	-	-	-	-	-	-	
	Off Proposed Alts[1]	12	1	2	2	1	18	**27**
Tanana River Valley and Major Tributaries								
ARRC	Salcha 1	-	1	4	-	1	6	
	Salcha 2	2	5	6	1	2	16	
	Connector A					1	1	
	Connector B	1	1	-	-	1	3	
	Connector C	5	-	-	-	-	5	
	Connector D	4	-	-	-	-	4	
	Connector E	1	-	-	-	4	5	
	Central Alternative 2	5	1	5	-	-	11	
	Donnelly 1	1	-	2	-	-	3	
	Donnelly 2	-	-	4	-	3	7	
	Delta 1	-	-	1	-	-	1	
	Delta 2	-	-	1	-	-	1	**63**
SEA's 2005-2007 Field Crews	Salcha 1	-	-	1	1	1	3	
	Salcha 2	2	-	3	-	-	5	
	Connector A	1	-	-	-	-	1	
	Connector B	1	1	-	-	1	3	
	Connector C	1	-	-	-	-	1	
	Connector D	5	-	-	-	-	5	
	Central Alternative 2	-	-	-	-	-	-	
	Donnelly 1		-	-	-	-	-	

Table E-6
Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Water Type (continued)

Physiographic Regions		Clear	Mixed	Glacial	Humic	Dry or Unknown	Total Number	
	Donnelly 2	2	-	-	-	2	4	
	Delta 1		-	-	-	-	-	
	Delta 2		-	-	-	-	-	
	Off Proposed Alts[1]	15	-	11	4	9	39	**61**
Yukon-Tanana Uplands								
ARRC	Salcha 2	-	-	-	-	-	-	**0**
SEA's 2005-2007 Field Crews	Salcha 2	-	-	-	-	-	-	
	Off Proposed Alts[1]	-	-	-	-	-	-	**0**
Tanana Valley Flats								
ARRC	Salcha 1	-	-	-	-	7	7	
	Central Alternative 1	5	-	-	-	5	10	
	Connector A	1	-	-	-	2	3	
	Connector C	1	-	-	-	1	2	
	Connector E	-	-	-	-	1	1	
	Donnelly 1	-	-	-	-	-	-	
	Donnelly 2	2	-	-	-	-	2	**25**
SEA's 2005-2007 Field Crews	Salcha 1	-	-	-	-	-	-	
	Central Alternative 1	-	-	-	1	-	1	
	Connector A	1	-	-	-	-	1	
	Connector C	1	2	-	-	-	3	
	Connector E	-	-	-	-	1	1	
	Donnelly 1	-	-	-	-	1	-	
	Donnelly 2	-	1	-	-	1	2	
	Off Proposed Alts[1]	17	4	3	3	3	30	**38**
Delta Moraine Wetlands								
ARRC	Donnelly 1	1	-	-	-	7	8	
	Donnelly 2	2	-	-	-	3	5	
	Delta 1	-	-	-	-	1	1	
	South Common	3	-	-	-	11	14	**28**
SEA's 2005-2007 Field Crews	Donnelly 1	-	-	-	-	-	-	
	Donnelly 2	-	-	-	-	-	-	
	Delta 1	-	-	-	-	-	-	
	South Common	3	-	-	-	1	4	
	Off Proposed Alts[1]	1	-	-	-	4	5	**9**
Lower Foothills (Alaksa Range)								
ARRC	Donnelly 1	11	-	-	-	15	26	
	Donnelly 2	17	-	2	-	15	34	

Table E-6
Summary of Alaska Railroad Corporation (ARRC) Crossings and SEA's 2005-2007 Field Crews Field Stations by Water Type (continued)

	Delta 1	-	-	-	-	-	-	
Physiographic Regions		**Clear**	**Mixed**	**Glacial**	**Humic**	**Dry or Unknown**	**Total Number**	
	Delta 2	-	-	-	-	-	-	**60**
SEA's 2005-2007 Field Crews	Donnelly 1	-	-	-	3	8	11	
	Donnelly 2	2	1	-	-	1	4	
	Delta 1	-	-	-	-	-	-	
	Off Proposed Alts[1]	2	2	3	1	3	11	**26**

1 Field sites located along watercourses more than 1000 feet of a potential crossing location. While not located at a crossing location, field sites were used as representative sites for the area in which they were sampled.

Table E-7
Summary of ARRC Crossing Stations by Crossing Type

Physiographic Regions	Culvert	Small Bridge	Large Bridge	Total Crossings
Eielson Flats	**33**	**6**	**-**	**39**
North Common	1	1	-	2
Eielson 1	8	-	-	8
Eielson 1, Eielson 2	5	1	-	6
Eielson 2	3	1	-	4
Eielson 2, Eielson 3	2	1	-	3
Eielson 3	12	2	-	14
Salcha 2	2	-		2
Tanana River Valley	**41**	**14**	**8**	**63**
Salcha 1	5	-	1	6
Salcha 2	11	4	1	16
Connector A	1	-	-	1
Connector B	2	1	-	3
Connector C	3	2	-	5
Connector D	1	3	-	4
Connector E	4	1	-	5
Central Alternative 2	9	2	-	11
Donnelly 1	-	1	2	3
Donnelly 2	5	-	2	7
Delta 1	-	-	1	1
Delta 2	-	-	1	1
Yukon-Tanana Uplands	**-**	**-**	**-**	**0**
Salcha 2	**-**	**-**	-	-
Tanana Valley Flats	**22**	**5**	**-**	**27**
Salcha 1	7	-	-	7
Central Alternative 1	9	1	-	10
Connector A	2	1	-	3
Connector C	1	1	-	2
Connector E	1	-	-	1
Donnelly 1	-	-	-	-
Donnelly 2	1	1	-	2
Delta Moraine Wetlands	**25**	**3**	**-**	**28**
Donnelly 1	8	-	-	8
Donnelly 2	5	-	-	5
Delta 1	1	-	-	1
South Common	11	3	-	14
Lower Foothills (Alaska Range)	**36**	**3**	**6**	**60**
Donnelly 1	24	2	-	26
Donnelly 2	33	1	2	34
Delta 1	-	-	-	-
Delta 2	-	-	-	-

Table E-8
Summary of 2005-2007 Field Crews Field Stations Associated with Permafrost

Physiographic Regions	Yes	No	Disc	Unknown	Total Crossings
Eielson Flats	2	10	12	3	27
North Common	-	-	2	-	2
Eielson 1	-	-	-	-	-
Eielson 1, Eielson 2	-	1	-	1	2
Eielson 2	-	1	-	-	1
Eielson 2, Eielson 3	-	-	-	-	-
Eielson 3	-	2	-	2	4
Salcha 2	-	-	-	-	-
Off Proposed Alts[1]	2	6	10	-	18
Tanana River Valley and Major Tributaries	9	36	5	11	61
Salcha 1	-	2	-	1	3
Salcha 2	-	5	-	-	5
Connector A	-	-	-	-	1
Connector B	2	1	-	-	3
Connector C	1	-	-	-	1
Connector D	-	1	-	4	5
Central Alternative 2	-	-	-	-	-
Donnelly 1	-	-	-	-	-
Donnelly 2	-	2	1	1	4
Delta 1	-	-	-	-	-
Delta 2	-	-	-	-	-
Off Proposed Alts[1]	6	25	4	4	39
Yukon-Tanana Uplands	-	-	-	-	-
Salcha 2	-	-	-	-	-
Off Proposed Alts[1]	-	-	-	-	-
Tanana Valley Flats	6	16	9	7	38
Salcha 1	-	-	-	-	-
Central Alternative 1	-	1	-	-	1
Connector A	-	1	-	-	1
Connector C	-	1	2	-	3
Connector E	-	-	1	-	1
Donnelly 1	-	-	-	-	-
Donnelly 2	-	1	1	-	2
Off Proposed Alts[1]	6	12	5	7	30
Delta Moraine Wetlands	7	-	-	2	9
Donnelly 1	-	-	-	-	-
Donnelly 2	-	-	-	-	-
South Common	2	-	-	2	4
Off Proposed Alts[1]	5	-	-	-	5
Lower Foothills (Alaska Range)	2	13	4	7	26
Donnelly 1	1	5	2	3	11
Donnelly 2	-	2	-	2	4
Delta 1	-	-	-	-	-
Off Proposed Alts[1]	1	6	2	2	11

1 Field sites located along watercourses more than 1000 feet of a potential crossing location. While not located at a crossing location, field sites were used as representative sites for the area in which they were sampled.

Table E-9a
Summary of 2005-2007 Field Crews Field Stations by Stream Classification

Rosgen Stream Types							
Physiographic Regions	**C**	**D**	**DA**	**E**	**F**	**NA**	**Total Crossings**
Eielson Flats	**-**	**-**	**4**	**4**	**12**	**7**	**27**
North Common	-	-	-	-	2	-	2
Eielson 1	-	-	-	-	-	-	-
Eielson 1, Eielson 2	-	-	2	-	-	-	2
Eielson 2	-	-	-	-	1	-	1
Eielson 2, Eielson 3	-	-	-	-	-	-	-
Eielson 3	-	-	-	-	2	2	4
Salcha 2	-	-	-	-	-	-	-
Off Proposed Alts[1]	-	-	2	4	7	5	18
Tanana River Valley and Major Tributaries	**1**	**1**	**27**	**2**	**19**	**11**	**61**
Salcha 1	-	-	2	-	1	-	3
Salcha 2	-	-	4	-	-	1	5
Connector A	-	-	1	-	-	-	1
Connector B	-	-	2	-	1	-	3
Connector C	-	-	-	-	1	-	1
Connector D	-	-	5	-	-	-	5
Central Alternative 2	-	-	-	-	-	-	-
Donnelly 1	-	-	-	-	-	-	-
Donnelly 2	-	-	-	-	4	1	4
Delta 1	-	-	-	-	-	-	-
Detla 2	-	-	-	-	-	-	-
Off Proposed Alts[1]	1	1	13	2	12	10	39
Yukon-Tanana Uplands	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Salcha 2	-	-	-	-	-	-	-
Off Proposed Alts[1]	-	-	-	-	-	-	-
Tanana Valley Flats	**-**	**1**	**2**	**7**	**16**	**12**	**38**
Salcha 1	-	-	-	-	-	-	-
Central Alternative 1	-	-	-	-	1	-	1
Connector A	-	-	-	-	1	-	1
Connector C	-	-	1	-	2	-	3
Connector E	-	-	-	-		1	1
Donnelly 1	-	-	-	-	-	-	-
Donnelly 2	-	-	-	-	1	1	2
Off Proposed Alts[1]	-	1	1	7	11	10	30
Delta Moraine Wetlands	**-**	**-**	**-**	**-**	**1**	**8**	**9**
Donnelly 1	-	-	-	-	-	-	-
Donnelly 2	-	-	-	-	-	-	-
South Common	-	-	-	-	1	3	4
Off Proposed Alts[1]	-	-	-	-	-	5	5
Lower Foothills (Alaska Range)	**-**	**5**	**-**	**1**	**8**	**12**	**26**
Donnelly 1	-	1	-	-	5	5	11
Donnelly 2	-	-	-	-	1	3	4
Delta 1	-	-	-	-	-	-	-
Off Proposed Alts[1]	-	4	-	1	2	4	11

1 Field sites located along watercourses more than 1000 feet of a potential crossing location. While not located at a crossing location, field sites were used as representative sites for the area in which they were sampled.

Table E-9b
Summary of 2005-2007 Field Crews Field Stations by Stream Classification

USFS Stream Types						
Physiographic Regions	**PA**	**LM**	**GO**	**FP**	**NA**	**Total Crossings**
Eielson Flats	**21**	**-**	**2**	**-**	**4**	**27**
North Common	2	-	-	-	-	2
Eielson 1	-	-	-	-	-	-
Eielson 1, Eielson 2	1	-	-	-	1	2
Eielson 2	1	-	-	-	-	1
Eielson 2, Eielson 3	-	-	-	-	-	-
Eielson 3	4	-	-	-	-	4
Salcha 2	-	-	-	-	-	-
Off Proposed Alts[1]	13	-	2	-	3	18
Tanana River Valley and Major Tributaries	**25**	**2**	**23**	**-**	**11**	**61**
Salcha 1	1	-	1	-	1	3
Salcha 2	2	-	3	-	-	5
Connector A	-	-	1	-	-	1
Connector B	1	-	2	-	-	3
Connector C	1	-	-	-	-	1
Connector D	-	-	5	-	-	5
Central Alternative 2	-	-	-	-	-	-
Donnelly 1	-	-	-	-	-	-
Donnelly 2	4	-	-	-	-	4
Delta 1	-	-	-	-	-	-
Delta 2	-	-	-	-	-	-
Off Proposed Alts[1]	16	2	11	-	10	39
Yukon-Tanana Uplands	**-**	**-**	**-**	**-**	**-**	**-**
Salcha 2	-	-	-	-	-	-
Off Proposed Alts[1]	-	-	-	-	-	-
Tanana Valley Flats	**18**	**6**	**7**	**-**	**7**	**38**
Salcha 1	-	-	-	-	-	-
Central Alternative 1	1	-	-	-	-	1
Connector A	1	-	-	-	-	1
Connector C	2	1	-	-	-	3
Connector E	-	-	-	-	1	1
Donnelly 1	-	-	-	-	-	-
Donnelly 2	1	-	-	-	1	2
Off Proposed Alts[1]	13	5	7	-	5	30
Delta Moraine Wetlands	**2**	**-**	**-**	**-**	**7**	**9**
Donnelly 1	-	-	-	-	-	-
Donnelly 2	-	-	-	-	-	-
South Common	2	-	-	-	2	4
Off Proposed Alts[1]	-	-	-	-	5	5
Lower Foothills (Alaska Range)	**4**	**5**	**6**	**-**	**8**	**26**
Donnelly 1	3	2	1	1	4	11
Donnelly 2	1	2	-	-	1	4
Delta 1	-	-	-	-		-
Off Proposed Alts[1]	1	2	5	-	3	11

Groundwater and Surface Water Quality

Historical Data

The chemical composition of the surface water within the project area, specifically the Tanana River Basin, is influenced by natural features such as geology, soils, and climate. Studies by Anderson (1970) indicate that most surface water samples in the area contain less than 200 parts per million (ppm) of dissolved solids. Within this, the primary constituents include calcium, magnesium, sodium, potassium, sulfate, and bicarbonate. Minor trace amounts of iron, silica, fluoride, and nitrate are present in the watershed, with some reports of elevated iron. Chloride and fluoride concentrations are low in all reported samples. The chemical composition of the surface water is influenced by surface runoff, where dissolved solids decrease following periods of high surface runoff and dissolved solids increase during low-flow periods when groundwater flow dominates (Anderson, 1970).

Anderson (1970) summarized information regarding groundwater and known aquifer locations within the project area. The USGS also has published information regarding aquifers and known locations of groundwater in the Ground Water Atlas of the United Stated (Miller and Whitehead, 1999). Williams (1970) describes general characteristics of groundwater in permafrost regions of the Tanana Valley area.

Anderson (1970) also compiled water quality data for some of the major rivers and streams and also groundwater wells in the Tanana Valley area. A summary of relevant sites from Anderson (1970) is provided in Tables E-10 and Table E-11. The USGS collected surface water quality samples of several rivers and creeks within and around the project area. Table E-12 below lists the sampling locations and the years of sample collection. Some of these sites coincide with the ones reported by Anderson. Samples were not collected at regular intervals and varied from one sample per year to one sample per month. The parameters collected also varied during the sampling periods, but at most locations potential of hydrogen (pH), turbidity, temperature, suspended sediment concentrations and discharge were collected.

In 1983, a water quality study was conducted by the State of Alaska along Richardson Clearwater Creek and surrounding areas (Mauer, 1999). Water quality was measured at ten locations throughout this area and included stream flow, temperature, pH, specific conductance, dissolved oxygen, and alkalinity. Grab samples were also collected for additional laboratory analysis of various inorganic and organic constituents. In summary, Mauer (1999) concluded that stream flow fluctuated within a very narrow range at each site, and that the flow water quality data reflected the spring-dominated character of the streams. Water temperatures ranged from 0.1°C in October to 12.4°C in July, while mainstem water temperatures were generally similar among sites. The pH ranged from near neutral to basic (6.9 to 8.2 s.u.), while specific conductance ranged from 193 to 285 micro-siemens per centimeters (µS/cm). Dissolved oxygen concentrations were moderate to high (66 percent of samples greater than 10.0 milligrams per liter [mg/L], and 89 percent of samples greater than 8.0 mg/L), while alkalinity ranged from 97 to 152 mg/L displaying good acid-neutralizing capacity (Table E-13).

Table E-10
Summary of Historical Surface Water Quality Data in Study Area Compiled by Anderson (1970)

Station	Date of Collection	Location	Mean Discharge (cfs)	SiO_2	Fe	Ca	Mg	Na	K	HCO_3	SO_4	Cl	F	NO_3	TDS	$CaCO_3$ - C	$CaCO_3$ - NC	SC	pH	Color
S-6	2/17/1953	Tanana River near Tok Junction	1,600	17	0.03	49	10	6.8	2.2	182	24	2	0	1.5	202	164	15	316	7.2	5
S-9	6/21-30/57	Tanana River near Tanacross	23,700	12	0	29	4.1	5.6	1.3	102	17	2.5	0.2	0.9	123	89	6	202	7.8	10
S-10	5/25-31/64	Tanana River near Tanacross	7,710	12	0	36	7.8	5.5	1.2	127	22	2.5	0.1	0.6	151	122	18	266	6.9	10
S-11	4/9/1959	Tanana River near Tanacross	1,960	17	0.02	46	10	5.5	2	168	26	3	0.1	0.6	193	156	18	322	6.6	0
S-18	1/5/1958	Delta River near rapids	~	5.7	0.02	39	12	5.3	2.5	121	55	3	0	0.6	183	147	48	308	7.5	0
S-19	12/11-20/50	Tanana River near Big Delta	6,160	9.2	0.03	44	9.3	4.9	0.8	154	30	1.5	~	0.6	187	148	22	305	7.4	5
S-21	12/9/1952	Salcha River near Salchaket	360	10	~	20	5.6	2.2	1.2	67	25	0.2	0.1	1.5	98	74	18	156	6.5	5
S-22	10/3/1948	Salcha River near Salchaket	1,880	4.9	0.12	19	5.7	1.8	1.8	66	18	1	0	1.5	90	71	17	141	~	~
S-23	5/10/1950	Salcha River near Salchaket	8,800			7.6	2.7	0.8	0.8	28	7	0.2	~	1.4	60	30	7	66	~	~

Legend: Silica=SiO_2, Iron=Fe, Calcium=Ca, Magnesium= Mg, Sodium=Na, Potassium=K, Bicarbonate=HCO_3, Sulfate=SO_4, Chloride=Cl, Fluoride=F, Nitrate=NO_3, Dissolves Solids (residue on evaporation)= TDS, Hardness as $CaCO_3$ Carbonated=$CaCO_3$-C, Hardness as Ca CO_3- Non Carbonate=$CaCO_3$-NC, Specific Conductance (micromhos at 25°C)=SC, Cubic Feet Per Second= CFS
Note: All values are ppm or mg/l unless otherwise noted; Color is measured in mg Pt/L (milligrams Platinum/Liter).

Table E-11
Summary of Historical Groundwater Quality Data in Study Area Compiled by Anderson (1970)

Station	Date of Collection	Owner or User	Major Aquifer	Depth of Well (feet)	SiO_2	Fe	Ca	Mg	Na	K	HCO_3	SO_4	Cl	F	NO_3	TDS	$CaCO_3$ - C	$CaCO_3$ - NC	SC	pH	Color
G-12	9/29/1948	Fort Greely	sandy-gravel	198	10	0.04	46	10	4.4	4.4	146	36	2.8	0.1	4.8	186	156	36	313	~	~
G-13	7/26/1951	Bert-Mary's Road House	bedrock	230	13	~	31	9.4	7.4	7.4	112	33	3.5	~	0.9	153	116	~	248	7.1	5
G-14	9/7/1965	Eielson AFB	gravel	115	28	7.11	38	9.7	7.5	0.8	166	15	4.6	0.1	0	135	135	0	290	7.5	15

Legend: Silica=SiO_2, Iron=Fe, Calcium=Ca, Magnesium= Mg, Sodium=Na, Potassium=K, Bicarbonate=HCO_3, Sulfate=SO_4, Chloride=Cl, Fluoride=F, Nitrate=NO_3, Dissolves Solids ((residue on evaporation at 180°C))= TDS, Hardness as $CaCO_3$ Carbonated=$CaCO_3$-C, Hardness as Ca CO_3- Non Carbonate=$CaCO_3$-NC, Specific Conductance (micromhos at 25°C)=SC
Note: All values are ppm or mg/l unless otherwise noted; Color is measured in mg Pt/L (milligrams Platinum/Liter).

Table E-12
Summary of Water Quality Data Collection Conducted by the U. S. Geological Survey (USGS) for Study Area

USGS ID	Station Name	Collection Dates
15478000	Tanana River at Big Delta	1949-1952, 1955-1958, 1971, 1975, 1978, 1979
642905146402400	Salcha River 6.5 miles above gauge near Salchaket	1976
642857146412500	Salcha River 5 miles above gauge near Salchaket	1976
640125145432500	Jarvis Creek near Delta Junction	1949, 1953-1956, 1974, 1975, 1978, 1979
15481000	Tanana River near Harding Lake	1971
15484000	Salcha River near Salchaket	1948-1958, 1967, 1968, 1970-1972, 1974-1976
640735145500000	Delta River near Big Delta	1955-1958, 1966, 1975, 1978, 1979

Table E-13
Stream flow and Water Quality Data for Richardson Clearwater Creek (RCC) Compiled by Mauer (1999)

Site Number	Site	Date	Flow	Water Temperature	pH	Specific Conductance	Dissolved Oxygen	Alkalinity
			(cfs)	*°C*	*standard units*	*µS/cm at 25 °C*	*mg/L*	*mg/L as $CaCO_3$*
1	**RCC near Vanderbilt's Cabin**	5/12/1983		6.8	IM	238	12.6	
		5/19/1983	415					
		6/22/1983	434	7	7.9	228	11.3	102
		7/6/1983	429	6.8	7.9	213	12.3	107
		7/27/1983	431	8.8	7.9	201	IM	97
		9/1/1983	442	3.4	7.6	262	13.4	110
		10/27/1983		-0.1	7.6	IM	13.9	110
2	**Trib number 2 above confluence with RCC**	5/12/1983	78					
		6/22/1983	77	5.7	7.4	230	8.6	101
		7/6/1983	72	6.7	7.5	225	10	109
		7/26/1983	75	7.7	7.9	231	EM	105
		9/1/1983	77	3	7.4	268	12	108
		10/27/1983	76	0.9	7.3	273	13	98
3a	**RCC below Tributary number 2**	5/12/1983		5.1	IM	249	10.2	
3	**RCC above Tributary number 2**	5/12/1983	218					
		6/22/1983	256	7.2	8.1	242	10	107
		7/6/1983	259	6.6	7.9	227	10.8	121
		7/26/1983	244	7.5	8	193	IM	102
		9/1/1983	237	3.5	7.7	268	12.8	121
		10/27/1983	238	0.8	7.6	276	13.2	111
4	**Tributary number 2 near headwaters**	6/22/1983	42	8.7	7.7	253	9.2	104
		7/6/1983	43	8.9	8	241	10.7	116
		7/25/1983	42	7	8	210	IM	113
		9/1/1983	43	3.6	7.7	269	12.8	112
		10/27/1983	43	1	7.6	274	13	102

Table E-13
Stream flow and Water Quality Data for Richardson Clearwater Creek (RCC) Compiled by Mauer (1999) (continued)

Site Number	Site	Date	Flow	Water Temperature	pH	Specific Conductance	Dissolved Oxygen	Alkalinity
5	Tributary number 1 near headwaters	5/12/1983	12	5.1	7.6	268	7.4	
		6/22/1983	17	8.7	7.7	264	6.2	123
		7/6/1983	21	9.8	7.7	249	7.8	136
		7/25/1983	23	8.3	7.9	209	IM	125
		9/1/1983	19	4	7.7	276	9.8	134
		10/27/1983	22	1.4	7.5	285	9.1	
6	RCC above Tributary number 1	5/12/1983		5.3	IM	267	8.3	
		6/22/1983	79	7.4	7.4	260	8.5	112
		7/6/1983	81	7.9	7.9	231	9.5	124
		7/26/1983	82	4.3	7.8	239	IM	117
		9/1/1983	84	3.3	7.9	279	12.1	125
		10/28/1983	82	1.3	7.7	266	12.1	152
7	Tanana River Tributary	6/22/1983	61	11.3	8.2	264	9.7	105
		7/6/1983	66	12.4	8	257	10.9	121
		7/25/1983	84	8.9	8	241	IM	116
		9/1/1983	72	4.2	7.9	268	13.8	119
		10/28/1983	59	0.1	7.9	274	15.2	117
8	Delta Creek Tributary	6/22/1983	3.7	7.2	7.7	280	9.4	102
		7/6/1983	4.8	12.4	7.7	257	10	109
		7/25/1983	7.8	8.2	7.8	248	10.7	107
		9/1/1983	8.3	4.9	7.6	278	13.4	110
		10/28/1983	4.3	-0.1	7.3	269	14.3	108
9	Red-Stain Spring along RCC	7/27/1983		2.3	6.9	227	2.8	
10	Big Spring at headwaters	7/25/1983	12	1.9	7.5	212	IM	

Legend: Cubic Feet Per Second=cfs, °C= Degrees Celsius, Potential of Hydrogen= pH, micro-siemens per centimeters =µS/cm, milligrams per liter=mg/L, Calcium=Ca, Carbon=C, Oxygen= O

2005-2007 Field Studies

Surface water quality data was collected by SEA, where possible (at 68 of the 165 field sites), during the 2005, 2006 and 2007 field site locations using a hand held Quanta® water quality meter. Water quality parameters included dissolved oxygen (DO) in mg/L, temperature in °C, turbidity in nephalometric turbidity units (NTUs), pH in standard units, and specific conductance in µS/cm. These in-situ measurements were used to identify trends or similarities associated with the physiographic sub-regions described above and for various stream classifications and water types and are summarized in Table E-14.

The data show some interesting trends, namely that turbidity values and DO concentrations were lowest in the Eielson Flats region, while DO was relatively high in the Tanana River and Tanana Valley Flats streams with moderately high turbidities. Although pH was fairly uniform and tending to slightly basic in most streams, pH was lowest in the Lower Foothills. Because the data was collected in June, July, September and October, the temperature data showed high standard deviations, so there may be no significance to high average temperature in the Lower Foothills and the lower average temperature in the Tanana Valley Flats.

Table E-14
Summary of Water Quality Data Collected by SEA's 2005-2007 Field Crews[1]

Physiographic Province	Number of Samples	Dissolved Oxygen		Temperature		Turbidity		pH		Conductivity	
		mg/L		°C		NTUs		s.u.		µs/cm	
		average	*stdev*	*average*	*stdev*	*average*	*stdev*	*average*	*stdev*	*average*	*stdev*
Delta Wetlands	0	N/A		N/A		N/A		N/A		N/A	
Eielson Flats	17	8.6	2.7	9.8	4.9	163	199	7.62	0.75	0.325	0.073
Lower Foothills	10	9.4	1.8	11.0	2.5	331	495	7.07	0.90	0.160	0.103
Tanana River	18	10.1	2.0	7.6	5.1	665	378	7.69	0.39	0.503	0.677
Tanana Valley Flats	21	10.4	2.8	6.4	3.7	519	370	7.71	0.43	0.301	0.130
Yukon Tanana Uplands	2	11.6	0.4	6.4	1.1	860	156	7.60	0.00	0.175	0.064

[1] Data collected during September 2005, July 2006, October 2006 and June 2007
Legend: °C= Degrees Celsius, Potential of Hydrogen= pH, micro-siemens per centimeters =µS/cm, milligrams per liter=mg/L, nephalometric turbidity units =NTU, Standard Deviation=stdev

E.4 Stream Crossing Inventory

This section provides two sets of tables for each alternative segment. The first table of each set is an inventory of the proposed stream and waterbody crossings and provides a summary of general characteristics that were used in the impacts analysis described in Chapter 4.2 of this document. The second table of each set presents a summary of impacts associated with various water resource elements for that alternative segment.

Table E-15
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for North Common Segment

Crossing Number	Stream Name	Water body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Proposed Conveyance Type	Proposed Conveyance Size (feet)
1	Piledriver Slough	Slough	Clear	-140	Boat	Flow/Nav	Bridge	100
105	un-named	Slough	Clear	-360	None	Flow	Culvert	2x10

*+=upstream of site, -=downstream of site, no value= no field site

Table E-16a
Summary of Impacts for North Common Segment –Construction (Short-Term)
Physiographic Region – Eielson Flats

Type of Waterbody	**Stream**	**Floodplain Slough**	**Adjacent to Streams and Floodplain Sloughs within Riparian Area**				
Name of large waterbody (if applicable)	***Piledriver Slough***						
Activity/Structure	**Bridge**	**Culvert**	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams							
Blockages or Changes in Channel Planform	1	2	1	1	NI	1	1
Disturbances to Permafrost – Thermal Erosion of Streambanks	1	2	1	1	NI	2	1
Altered Flood Hydraulics	1	3	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	3	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	2	1	1	NI	1	1
Stresses on natural water balances	1	1	1	1	NI	1	2
Lakes and Ponds							
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI
Water Quality							
Increased Turbidity and Sediment Loads	1	2	1	2	NI	1	1
Chemically Contaminate Waters	1	1	1	1	NI	2	1
Groundwater							
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	2	NI	2	1
Dewatering of Aquifers	1	1	1	1	NI	1	1
Floodplains							
Increased Potential for Flooding	1	1	1	1	NI	1	1
Reduced Floodplain Area	1	1	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-16b
Summary of Impacts for North Common Segment –Operation (Long-Term)

Activity/Structure	*Bridge*	*Culvert*	*Use of Gravel Roads*	*Presence of Borrow - Gravel Pits*
Rivers and Streams				
Blockages or Changes in Channel Planform	1	2	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	1	1
Altered Flood Hydraulics	1	3	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	2	1	1
Stresses on Natural Water Balances	1	1	1	1
Lakes and Ponds				
Stresses on Natural Water Balances	1	1	1	1
Water Quality				
Increased Turbidity and Sediment Loads	1	1	1	1
Chemically Contaminate Waters	1	1	1	1
Groundwater				
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	1
Dewatering of Aquifers	1	1	1	1
Floodplains				
Increased Potential for Flooding	1	1	1	1
Reduced Floodplain Area	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-17
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Eielson Alternative Segment 1

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
Crossings Unique to the Eielson Alternative Segment 1								
6	un-named	Wetland Flow-way	Mixed		None	Wetland Continuity	Culvert	4
7	un-named	Wetland Flow-way	Mixed		None	Wetland Continuity	Culvert	4
8	un-named	Wetland Flow-way	Mixed	+960	None	Wetland Continuity	Culvert	10
9	un-named	Wetland Flow-way	Mixed	+200	None	Wetland Continuity	Culvert	10
10	Piledriver Slough	Slough	Mixed		None	Flow/Fish	Culvert	3x10
11	un-named	Overflow	Mixed	-130	None	Flow	Culvert	3x10
12	un-named	Overflow	Mixed	+50	None	Flow	Culvert	3x10
317	un-named	Overflow	Glacial		None	Flow	Culvert	2x10
Crossings Common with the Eielson Alternative Segment 2								
2	un-named	Wetland Flow-way	Mixed		None	Wetland Continuity	Culvert	10
3	Twentythreemile Slough	Slough	Mixed	-215	Boat	Flow	Bridge	100
189	un-named	Wetland Flow-way	N/A	+1000	None	Wetland Continuity	Culvert	10
190	un-named	Overflow	Glacial		None	Flow	Culvert	10
191	un-named	Overflow	Glacial		None	Flow	Culvert	10
271	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-18
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Eielson Alternative Segment 2

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
Crossings Common with the Eielson Alternative Segment 1								
2	un-named	Wetland Flow-way	Mixed		None	Wetland Continuity	Culvert	10
3	Twentythreemile Slough	Slough	Mixed	-215	Boat	Flow	Bridge	100
189	un-named	Wetland Flow-way	N/A	+1000	None	Wetland Continuity	Culvert	10
190	un-named	Overflow	Glacial		None	Flow	Culvert	10
191	un-named	Overflow	Glacial		None	Flow	Culvert	10
271	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
Crossings Unique to the Eielson Alternative Segment 2								
313	un-named	Stream	Mixed		None	Flow	Culvert	4
314	Piledriver Slough	Slough	Mixed	+1850	Boat	Flow/Fish	Bridge	330
315	un-named	Overflow	Mixed		None	Flow	Culvert	4x10
316	un-named	Overflow	Mixed		None	Flow	Culvert	4
Crossings Common with the Eielson Alternative Segment 3								
13	un-named	Slough	Mixed	+5000	Boat	Flow	Bridge	60
194	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	2x4
304	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-19
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Eielson Alternative Segment 3

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
Crossings Unique to the Eielson Alternative Segment 3								
5	un-named	Slough	Mixed	onsite	None	Flow	Bridge	130
110	un-named	Slough	Mixed	+42	None	Flow	Culvert	3x10
111	un-named	Slough	Clear	+87	None	Flow	Culvert	3x10
112	un-named	Overflow	Mixed		None	Flow	Culvert	2x10
113	Piledriver Slough	Slough	Mixed	-200	Boat	Flow	Bridge	300
127	un-named	Overflow	Mixed		None	Flow	Culvert	10
129	un-named	Slough	Mixed	+1200	None	Flow	Culvert	3x10
131	un-named	Slough	Mixed	+2300	None	Flow	Culvert	3x10
192	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
193	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
305	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
306	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
307	un-named	Drain-way	N/A		None	Flow	Culvert	4
308	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
Crossings Unique to the Eielson Alternative Segment 2								
13	un-named	Slough	Mixed	+5000	Boat	Flow	Bridge	60
194	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	2x4
304	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-20a
Summary of Impacts for Eielson Alternative Segment 1 – Short-Term Construction
Physiographic Region – Eielson Flats

This table incorporates that portion of Eielson Alternative Segment 2 common with Eielson Alternative Segment 1.

Type of Waterbody	Overflow Channel	Wetland Flow-way	Adjacent to Overflow Channel and Wetlands within Riparian Area				
Activity/Structure	**Culvert**	**Culvert**	***Gravel Roads***	***Borrow/ Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams							
Blockages or Changes in Channel Planform	2	1	1	1	NI	NI	NI
Disturbances to Permafrost - Thermal Erosion Of Streambanks	2	1	1	1	NI	NI	NI
Altered Flood Hydraulics	2	1	1	1	NI	NI	NI
Increased Potential for Overbank Flooding And/Or Ice/Debris Jams	3	1	1	1	NI	NI	NI
Increased Scour, Bank Erosion And/Or Channel Aggradation	3	1	1	1	NI	NI	NI
Stresses on Natural Water Balances	1	1	1	1	NI	NI	NI
Lakes and Ponds							
Stresses on Natural Water Balances	NI	NI	NI	NI	NI	NI	NI
Water Quality							
Increased Turbidity and Sediment Loads	2	2	1	2	NI	NI	NI
Chemically Contaminate Waters	1	1	1	1	NI	NI	NI
Groundwater							
Removal of Surface Soils - Changes In Recharge Potential	1	1	1	2	NI	NI	NI
Dewatering of Aquifers	1	1	1	1	NI	NI	NI
Floodplains							
Increased Potential for Flooding	2	2	1	1	NI	NI	NI
Reduced Floodplain Area	1	1	1	1	NI	NI	NI

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-20b
Summary of Impacts for Eielson Alternative Segment 1 – Long-Term Operation

	Overflow Channel	Wetland Flow-way	Adjacent to Overflow Channel and Wetlands within Riparian Area	
Activity/Structure	***Culvert***	***Culvert***	***Use of Gravel Roads***	***Presence of Burrow/ Gravel Pits***
Rivers and Streams				
Blockages or Changes in Channel Planform	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	1	1	1
Altered Flood Hydraulics	3	1	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	3	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	3	1	1	1
Stresses on Natural Water Balances	1	1	1	1
Lakes and Ponds				
Stresses on Natural Water Balances	1	1	1	1
Water Quality				
Increased Turbidity and Sediment Loads	1	1	1	1
Chemically Contaminate Waters	1	1	1	1
Groundwater				
Removal of Surface Soils – Changes In Recharge Potential	1	1	1	2
Dewatering of Aquifers	1	1	1	1
Floodplains				
Increased Potential for Flooding	1	1	1	1
Reduced Floodplain Area	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-21a
Summary of Impacts for Eielson Alternative Segment 2 - Short-Term Construction
Physiographic Region - Eielson Flats

Type of Waterbody	**Stream**	**Floodplain Slough**	**Wetland Flow-way**	**Overflow Channel**	**Stream**
Name of large waterbody (if applicable)	***Piledriver Slough***	***Twentythreemile Slough***			
Activity/Structure	**Bridge**	**Bridge**	**Culvert**	**Culvert**	**Culvert**
Rivers and Streams					
Blockages or Changes in Channel Planform	1	2	1	2	3
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	1	2	2
Altered Flood Hydraulics	2	2	2	2	3
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	1	3	2
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	1	3	2
Stresses on Natural Water Balances	1	1	1	1	1
Lakes and Ponds					
Stresses on Natural Water Balances	NI	NI	NI	NI	NI
Water Quality					
Increased Turbidity and Sediment Loads	1	1	2	2	2
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of Surface Soils – Changes in Recharge Potential	1	1	1	1	1
Dewatering of Aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	1	1	2	2	2
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-21b
Summary of Impacts for Eielson Alternative Segment 2 – Short-Term Construction
Physiographic Region - Eielson Flats

Type of Waterbody / ***Name of large waterbody (if applicable)***	**Adjacent to Floodplain Slough, Overflow Channel and Wetlands within Riparian Area**				
Activity/Structure	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams					
Blockages or Changes in Channel Planform	1	1	NI	1	NI
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	NI	1	NI
Altered Flood Hydraulics	1	1	NI	1	NI
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	NI	1	NI
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	NI	1	NI
Stresses on Natural Water Balances	1	1	NI	1	NI
Lakes and Ponds					
Stresses on Natural Water Balances	NI	NI	NI	NI	NI
Water Quality					
Increased Turbidity and Sediment Loads	1	2	NI	1	NI
Chemically Contaminate Waters	1	1	NI	1	NI
Groundwater					
Removal of Surface Soils - Changes in Recharge Potential	1	2	NI	1	NI
Dewatering of Aquifers	1	1	NI	1	NI
Floodplains					
Increased Potential for Flooding	1	1	NI	1	NI
Reduced Floodplain Area	1	1	NI	1	NI

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-21c
Summary of Impacts for Eielson Alternative Segment 2 – Long Term Operation
Physiographic Region - Eielson Flats

Activity/Structure	*Bridge*	*Bridge*	*Culvert*	*Culvert*	*Culvert*	*Use of Gravel Roads*	*Presence of Borrow - Gravel Pits*
Rivers and Streams							
Blockages or Changes in Channel Planform	1	1	2	2	2	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	2	2	2	1	1
Altered Flood Hydraulics	2	2	2	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	2	3	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	2	3	2	1	1
Stresses on Natural Water Balances	1	1	1	1	1	1	1
Lakes and Ponds							
Stresses on Natural Water Balances	1	1	1	1	1	1	1
Water Quality							
Increased Turbidity and Sediment Loads	1	1	1	1	1	1	1
Chemically Contaminate Waters	1	1	1	1	1	1	1
Groundwater							
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	1	1	1	2
Dewatering of Aquifers	1	1	1	1	1	1	1
Floodplains							
Increased Potential for Flooding	2	2	2	2	2	1	1
Reduced Floodplain Area	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-22a
Summary of Impacts for Eielson Alternative Segment 3 – Short-Term Construction
Physiographic Region - Eielson Flats

This table incorporates that portion of Eielson Alternative Segment 2 common with Eielson Alternative Segment 3.

Type of WaterBody	**Stream**	**Floodplain Slough**		**Floodplain Slough**	**Drainageway**	**Overflow Channel**	**Wetland Flow-way**
Name of large waterbody (if applicable)	***Piledriver Slough***						
Activity/Structure	**Bridge**	**Bridge**	**Bridge**	**Culvert**	**Culvert**	**Culvert**	**Culvert**
Rivers and Streams							
Blockages or Changes in Channel Planform	1	1	1	2	2	2	2
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	1	2	2	2	2
Altered Flood Hydraulics	1	2	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	2	2	3	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	2	2	2	2	3	1
Stresses on Natural Water Balances	1	1	1	1	1	1	1
Lakes and Ponds							
Stresses on Natural Water Balances	1	1	1	1	1	1	1
Water Quality							
Increased Turbidity and Sediment Loads	1	1	2	2	2	2	2
Chemically Contaminate Waters	1	1	1	1	1	1	1
Groundwater							
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	1	1	1	1
Dewatering of Aquifers	1	1	1	1	1	1	1
Floodplains							
Increased Potential for Flooding	1	2	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-22b
Summary of Impacts for Eielson Alternative Segment 3 – Short-Term Construction
Physiographic Region - Eielson Flats

This table incorporates that portion of Eielson Alternative Segment 2 common with Eielson Alternative Segment 3.

Type of WaterBody	**Adjacent to Streams, Floodplain Sloughs, Overflow Channels and Wetlands within Riparian Area**				
Activity/Structure	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams					
Blockages or Changes in Channel Planform	1	1	NI	1	NI
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	NI	1	NI
Altered Flood Hydraulics	1	1	NI	1	NI
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	NI	1	NI
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	NI	1	NI
Stresses on Natural Water Balances	1	1	NI	1	NI
Lakes and Ponds					
Stresses on Natural Water Balances	1	1	NI	1	NI
Water Quality					
Increased Turbidity and Sediment Loads	1	2	NI	1	NI
Chemically Contaminate Waters	1	1	NI	1	NI
Groundwater					
Removal of Surface Soils - Changes in Recharge Potential	1	2	NI	1	NI
Dewatering of Aquifers	1	1	NI	1	NI
Floodplains					
Increased Potential for Flooding	1	1	NI	1	NI
Reduced Floodplain Area	1	1	NI	1	NI

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-22c
Summary of Impacts for Eielson Alternative Segment 3 – Long-Term Operation

Activity/Structure	*Bridge*	*Bridge*	*Culvert*	*Culvert*	*Culvert*	*Culvert*	*Use of Gravel Roads*	*Presence of Borrow - Gravel Pits*
Rivers and Streams								
Blockages or Changes in Channel Planform	1	1	2	2	2	2	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	2	2	2	2	1	1
Altered Flood Hydraulics	1	1	2	2	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	2	2	3	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	2	1	1	3	1	1
Stresses on natural Water Balances	1	1	1	1	1	1	1	1
Lakes and Ponds								
Stresses On Natural Water Balances	1	1	1	1	1	1	1	1
Water Quality								
Increased Turbidity and Sediment Loads	1	1	1	1	1	1	1	1
Chemically Contaminate Waters	1	1	1	1	1	1	1	1
Groundwater								
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	1	1	1	1	2
Dewatering of Aquifers	1	1	1	1	1	1	1	1
Floodplains								
Increased Potential for Flooding	1	1	2	2	2	2	1	1
Reduced Floodplain Area	1	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-23
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Salcha Alternative Segment 1

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)[a]	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (ft)
	Tanana River	Stream	Glacial	onsite	Boat	Flow	Bridge	3,600
89	un-named	Slough	Glacial	+460	Boat	Flow	Culvert	3x10[b]
195	un-named	Wetland Flow-way	N/A	+25	None	Wetland Continuity	Culvert	10
295	un-named	Stream	mixed	-1025	None	Flow/Fish	Culvert	125
296	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
297	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
298	un-named	Drainageway	N/A		None	Flow	Culvert	4
299	un-named	Drainageway	N/A		None	Flow	Culvert	4
300	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
301	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
310	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
302	un-named	Drainageway	Glacial		None	Flow	Culvert	4
303	un-named	Drainageway	Glacial		None	Flow	Culvert	4

[a]+=upstream of site, -=downstream of site, no value= no field site
[b]The conveyance size is an estimate by SEA based on proposed lengths of similar crossings. The final conveyance would be determined during final design.

Table E-24
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Salcha Alternative Segment 2

Crossing Number	Stream Name	Water body Type	Water Type	Distance to Surveyed Site (feet)[a]	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
	Tanana River	Stream	Glacial	onsite	Boat	Flow	Bridge	4000
	Salcha River	Stream	Humic	onsite	Boat	Flow	Bridge	2,500
14	un-named	Overflow	Glacial	-260	None	Flow	Culvert	2x10
15	un-named	Overflow	Mixed	+95	None	Flow	Culvert	2x10
16	Little Salcha River	Stream	Mixed	-930	Boat	Flow	Bridge	160
17	un-named	Overflow	Mixed		None	Flow/Fish	Culvert	3x10
18	Un-named	Slough	Glacial	140	Boat	Flow	Bridge	390
22	un-named	Slough	Glacial	onsite	Boat	Flow	Bridge	4000
23	un-named	Slough	Glacial	onsite	None	Flow	Culvert	3x10[b]
124	un-named	Slough	Glacial		Boat	Flow	Bridge	4000
133	un-named	Slough	Mixed		None	Flow	Culvert	3x10
134	un-named	Slough	Mixed		None	Flow	Culvert	10
430	un-named	Slough	Mixed		None	Flow	Culvert	10
188	un-named	Slough	Mixed		None	Flow	Culvert	10
339	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
340	un-named	Stream	Clear		None	Flow/Fish	Culvert	10
341	un-named	Stream	Clear		None	Flow/Fish	Culvert	2x10
428	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4

[a]+=upstream of site, -=downstream of site, no value= no field site
[b]The conveyance size is an estimate by SEA based on proposed lengths of similar crossings. The final conveyance would be determined during final design.

Table E-25a
Summary of Impacts for Salcha Alternative Segment 1 – Short-Term Construction
Physiographic Region - Tanana River Valley

Type of Waterbody	**Stream**	**Drainageway**	**Floodplain Slough**	**Wetland**
Name of large waterbody (if applicable)	***Tanana River***			
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Culvert***
Rivers and Streams				
Blockages or Changes in Channel Planform	2	1	2	
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	2	1
Altered Flood Hydraulics	3	1	3	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	1	3	1
Increased Scour, Bank Erosion and/or Channel Aggradation	3	1	3	1
Stresses on Natural Water Balances	1	1	1	1
Lakes and Ponds				
Stresses on Natural Water Balances	NI	NI	NI	NI
Water Quality				
Increased Turbidity and Sediment Loads	1	2	2	2
Chemically Contaminate Waters	1	1	1	1
Groundwater				
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	1
Dewatering of Aquifers	1	1	1	1
Floodplains				
Increased Potential for Flooding	2	1	2	2
Reduced Floodplain Area	2	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-25b
Summary of Impacts for Salcha Alternative Segment 1 – Short-Term Construction
Physiographic Region Tanana Valley Flats

Type of Waterbody	Drainageway	Stream	Wetland Flow-way
Activity/Structure	***Culvert***	***Culvert***	***Culvert***
Rivers and Streams			
Blockages or Changes in Channel Planform	2	2	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1
Altered Flood Hydraulics	3	3	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	3	3	1
Increased Scour, Bank Erosion and/or Channel Aggradation	3	3	1
Stresses on Natural Water Balances	1	1	1
Lakes and Ponds			
Stresses on Natural Water Balances	NI	NI	NI
Water Quality			
Increased Turbidity and Sediment Loads	2	2	2
Chemically Contaminate Waters	1	1	1
Groundwater			
Removal of Surface Soils - Changes in Recharge Potential	1	1	1
Dewatering of Aquifers	1	1	1
Floodplains			
Increased Potential for Flooding	2	2	2
Reduced Floodplain Area	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-25c
Summary of Impacts for Salcha Alternative Segment 1 – Short-Term Construction
Physiographic Region - *Tanana River Valley and Tanana Valley Flats*

Type of Waterbody / ***Name of large waterbody (if applicable)***	**Adjacent to Streams, Floodplain Sloughs, Drainageways and Wetlands within Riparian Area**				
Activity/Structure	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams					
Blockages or Changes in Channel Planform	1	1	1	1	NI
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	1	1	NI
Altered Flood Hydraulics	1	1	2	1	NI
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	2	1	NI
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	1	1	NI
Stresses on Natural Water Balances	1	1	2	1	NI
Lakes and Ponds					
Stresses on Natural Water Balances	NI	NI	NI	NI	NI
Water Quality					
Increased Turbidity and Sediment Loads	2	2	2	1	NI
Chemically Contaminate Waters	1	1	1	1	NI
Groundwater					
Removal of Surface Soils - Changes in Recharge Potential	2	2	1	1	NI
Dewatering of Aquifers	1	1	1	1	NI
Floodplains					
Increased Potential for Flooding	1	1	2	1	NI
Reduced Floodplain Area	1	1	1	1	NI

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-25d
Summary of Impacts for Salcha Alternative Segment 1 – Long-Term Operations
Physiographic Region - Tanana River Valley

Type of Waterbody	**Stream**	**Drainageway**	**Floodplain Slough**	**Wetland**
Name of large waterbody (if applicable)	***Tanana River***			
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Culvert***
Rivers and Streams				
Blockages or Changes in Channel Planform	2	2	2	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	1
Altered Flood Hydraulics	3	2	3	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	3	
Increased Scour, Bank Erosion and/or Channel Aggradation	3	2	3	1
Stresses on Natural Water Balances	1	1	1	1
Lakes and Ponds				
Stresses on Natural Water Balances	1	1	1	1
Water Quality				
Increased Turbidity and Sediment Loads	1	1	1	1
Chemically Contaminate Waters	1	1	1	1
Groundwater				
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	1
Dewatering of aquifers	1	1	1	1
Floodplains				
Increased Potential for Flooding	1	2	2	2
Reduced Floodplain Area	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-25e
Summary of Impacts for Salcha Alternative Segment 1 – Long-Term Operations
Physiographic Region - Tanana Valley Flats

Type of Waterbody	Drainageway	Stream	Wetland Flow-way
Activity/Structure	***Culvert***	***Culvert***	***Culvert***
Rivers and Streams			
Blockages or Changes in Channel Planform	2	2	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1
Altered Flood Hydraulics	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	1
Stresses on Natural Water Balances	1	1	1
Lakes and Ponds			
Stresses on Natural Water Balances	1	1	1
Water Quality			
Increased Turbidity and Sediment Loads	1	1	1
Chemically Contaminate Waters	1	1	1
Groundwater			
Removal of Surface Soils - Changes in Recharge Potential	1	1	1
Dewatering of aquifers	1	1	1
Floodplains			
Increased Potential for Flooding	2	2	2
Reduced Floodplain Area	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-25f
Summary of Impacts for Salcha Alternative Segment 1 – Long-Term Operations
Physiographic Region - Tanana River Valley and Tanana Valley Flats

Type of Waterbody	Adjacent to Streams, Floodplain Sloughs, Drainageways and Wetland Flow-ways within Riparian Area	
Activity/Structure	***Use of Gravel Roads***	***Borrow - Gravel Extraction***
Rivers and Streams		
Blockages or Changes in Channel Planform	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1
Altered Flood Hydraulics	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1
Stresses on Natural Water Balances	1	1
Lakes and Ponds		
Stresses on Natural Water Balances	1	1
Water Quality		
Increased Turbidity and Sediment Loads	2	1
Chemically Contaminate Waters	1	1
Groundwater		
Removal of Surface Soils - Changes in Recharge Potential	1	2
Dewatering of aquifers	1	1
Floodplains		
Increased Potential for Flooding	1	1
Reduced Floodplain Area	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-26a
Summary of Impacts for Salcha Alternative Segment 2 - Short-Term Construction

Physiographic Region	***Tanana River Valley***							
Type of Waterbody	**Floodplain Slough**	**Stream**	**Overflow**	**Floodplain Slough**	**Overflow Channel**	**Stream**	**Wetland Flow-way**	**Stream**
Name of large waterbody (if applicable)	***Tanana River side channels***	***Tanana River***	***Little Salcha River***					***Salcha River***
Activity/Structure	***Bridge***	***Bridge***	***Bridge***	***Culvert***	***Culvert***	***Culvert***	***Culvert***	***Bridge***
Rivers and Streams								
Blockages or Changes in Channel Planform	2	2	2	2	2	2	2	2
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	2	2	2	2	2
Altered Flood Hydraulics	3	3	2	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	2	2	2	2	2
Increased Scour, Bank Erosion and/or Channel Aggradation	3	3	2	2	2	2	2	2
Stresses on Natural Water Balances	1	1	1	1	1	1	1	1
Lakes and Ponds								
Stresses on Natural Water Balances	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality								
Increased Turbidity and Sediment Loads	1	1	1	2	2	2	2	1
Chemically Contaminate Waters	1	1	1	1	1	1	1	1
Groundwater								
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	1	1	1	1	1
Dewatering of Aquifers	1	1	1	1	1	1	1	1
Floodplains								
Increased Potential for Flooding	2	2	2	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-26b
Summary of Impacts for Salcha Alternative Segment 2 - Short-Term Construction
Physiographic Region - Tanana River Valley

Type of Waterbody	Adjacent to Streams, Floodplain Sloughs, Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area				
Activity/Structure	***Gravel Roads***	***Borrow/ Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams					
Blockages or Changes in Channel Planform	1	1	1	1	NI
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	1	1	NI
Altered Flood Hydraulics	1	1	2	1	NI
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	2	1	NI
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	1	1	NI
Stresses on Natural Water Balances	1	1	2	1	NI
Lakes and Ponds					
Stresses on Natural Water Balances	NI	NI	NI	NI	NI
Water Quality					
Increased Turbidity and Sediment Loads	1	2	2	1	NI
Chemically Contaminate Waters	1	1	1	1	NI
Groundwater					
Removal of Surface Soils - Changes in Recharge Potential	1	2	1	1	NI
Dewatering of Aquifers	1	1	1	1	NI
Floodplains					
Increased Potential for Flooding	1	1	2	1	NI
Reduced Floodplain Area	1	1	1	1	NI

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-26c
Summary of Impacts for Salcha Alternative Segment 2 - Long-Term Operation and Maintenance

Physiographic Region	***Tanana River Valley***							
Type of Waterbody	**Floodplain Slough**	**Stream**	**Overflow**	**Floodplain Slough**	**Overflow Channel**	**Stream**	**Wetland**	**Stream**
Name of large waterbody (if applicable)	***Tanana River Side Channels***	***Tanana River***	***Little Salcha River***					***Salcha River***
Activity/Structure	***Bridge***	***Bridge***	***Bridge***	***Culvert***	***Culvert***	***Culvert***	***Culvert***	***Bridge***
Rivers and Streams								
Blockages or Changes in Channel Planform	2	2	2	2	2	2	1	2
Disturbances to Permafrost - Thermal Erosion of Streambanks		2	2	2	2	2	1	2
Altered Flood Hydraulics	3	3	2	3	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	3	3	2	3	2	2	1	2
Increased Scour, Bank Erosion and/or Channel Aggradation	3	3	2	3	2	2	1	2
Stresses on Natural Water Balances	1	1	1	1	1	1	1	1
Lakes and Ponds								
Stresses on Natural Water Balances	1	1	1	1	1	1	1	1
Water Quality								
Increased Turbidity and Sediment Loads	1	1	1	1	1	1	1	1
Chemically Contaminate Waters	1	1	1	1	1	1	1	1
Groundwater								
Removal of Surface Soils - Changes in Recharge Potential	1	1	1	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1	1	1	1
Floodplains								
Increased Potential for Flooding	2	2	2	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-26d
Summary of Impacts for Salcha Alternative Segment 2 - Long-Term Operation and Maintenance
Physiographic Region - Tanana River Valley

Type of Waterbody	Adjacent to Streams, Floodplain Sloughs, Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area	
Activity/Structure	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams		
Blockages or Changes in Channel Planform	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1
Altered Flood Hydraulics	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1
Stresses on Natural Water Balances	1	1
Lakes and Ponds		
Stresses on Natural Water Balances	1	1
Water Quality		
Increased Turbidity and Sediment Loads	1	1
Chemically Contaminate Waters	1	1
Groundwater		
Removal of Surface Soils - Changes in Recharge Potential	1	1
Dewatering of aquifers	1	1
Floodplains		
Increased Potential for Flooding	1	1
Reduced Floodplain Area	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-27
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Central Alternative Segment 1

Crossing Number	Stream Name	Water Body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
82	un-named	Seep	Clear		None	ice	Culvert	10
83	un-named	Seep	Clear		None	ice	Culvert	10
84	un-named	Stream	Clear	+50	None	flow	Bridge	40
197	un-named	Wetland Flow-way	N/A		None	Wetland continuity	Culvert	4
198	un-named	Stream	Clear		None	Ice	Culvert	4
199	un-named	Wetland Flow-way	N/A		None	Wetland continuity	Culvert	4
200	un-named	Seep	Clear		None	ice	Culvert	10
201	un-named	Wetland Flow-way	N/A		None	Wetland continuity	Culvert	10
347	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
348	un-named	Drainway	N/A		None	Flow	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-28
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Central Alternative Segment 2

Crossing Number	Stream Name	Water Body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
34	un-named	Wetland Flow-way	Glacial	+3100	None	Wetland Continuity	Culvert	10
35	un-named	Overflow	Mixed	+200	None	Flow	Bridge	130
36	un-named	Overflow	Glacial	+325	None	Flow	Culvert	10
37	un-named	Overflow	Glacial	-440	None	Flow	Culvert	10
38	un-named	Overflow	Glacial	+80	None	Flow	Bridge	75
272	un-named	Wetland Flow-way	Glacial		None	Wetland Continuity	Culvert	4
391	un-named	Overflow	Clear		None	Flow	Culvert	10
392	un-named	Overflow	Clear		None	Flow	Culvert	10
393	un-named	Overflow	Clear		None	Flow	Culvert	10
394	un-named	Overflow	Clear		None	Flow	Culvert	10
395	un-named	Overflow	Clear		None	Flow	Culvert	10

*+=upstream of site, -=downstream of site, no value= no field site

Table E-29a
Summary of Impacts for Central Alternative Segment 1 – Short-Term Construction
Physiographic Region - Tanana River Valley

Type of Waterbody	*Overflow Channel*	*Overflow Channel*	*Wetland Flow-way*	Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area				
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams								
Blockages or Changes in Channel Planform	2	2	2	1	1	NI	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	1	1	NI	2	1
Altered Flood Hydraulics	2	3	2	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	2	1	1	NI	1	1
Stresses on natural water balances	1	1	1	1	1	NI	1	2
Lakes and Ponds								
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality								
Increased turbidity and sediment loads	1	2	2	2	2	NI	1	1
Chemically Contaminate Waters	1	1	1	1	1	NI	2	1
Groundwater								
Removal of surface soils - changes in recharge potential	1	1	1	2	2	NI	2	1
Dewatering of aquifers	1	1	1	1	1	NI	1	1
Floodplains								
Increased Potential for Flooding	2	2	2	1	1	NI	1	1
Reduced Floodplain Area	1	1	1	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-29b
Summary of Impacts for Central Alternative Segment 1 – Long-Term Operations and Maintenance
Physiographic Region - Tanana River Valley

Type of Waterbody	*Overflow Channel*	*Overflow Channel*	*Wetland Flow-ways*	Adjacent to Drainageways, Overflow Channels and Wetlands Flow-ways within Riparian Area	
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams					
Blockages or Changes in Channel Planform	2	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1	1
Altered Flood Hydraulics	2	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	1	1	1
Stresses on natural water balances	1	1	1	1	1
Lakes and Ponds					
Stresses on natural water balances	1	1	1	1	1
Water Quality					
Increased turbidity and sediment loads	1	1	1	2	1
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of surface soils - changes in recharge potential	1	1	1	1	2
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	2	2	2	1	1
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-29c
Summary of Impacts for Central Alternative Segment 2 – Short-Term Construction

Physiographic Region	*Tanana River Valley*							
Type of Waterbody	***Overflow Channel***	***Overflow Channel***	***Wetland Flow-ways***	**Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area**				
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams								
Blockages or Changes in Channel Planform	2	2	1	1	1	NI	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1	1	NI	2	1
Altered Flood Hydraulics	2	3	2	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	1	1	1	NI	1	1
Stresses on natural water balances	1	1	1	1	1	NI	1	2
Lakes and Ponds								
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality								
Increased turbidity and sediment loads	1	2	2	2	2	NI	1	1
Chemically Contaminate Waters	1	1	1	1	1	NI	2	1
Groundwater								
Removal of surface soils - changes in recharge potential	1	1	1	2	2	NI	2	1
Dewatering of aquifers	1	1	1	1	1	NI	1	1
Floodplains								
Increased Potential for Flooding	2	2	2	1	1	NI	1	1
Reduced Floodplain Area	1	1	1	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-29d
Summary of Impacts for Central Alternative Segment 2 – Long-Term Operations and Maintenance
Physiographic Region - Tanana River Valley

Type of Waterbody	*Overflow Channel*	*Overflow Channel*	*Wetland Flow-ways*	Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area	
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams					
Blockages or Changes in Channel Planform	2	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1	1
Altered Flood Hydraulics	2	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	1	1	1
Stresses on natural water balances	1	1	1	1	1
Lakes and Ponds					
Stresses on natural water balances	1	1	1	1	1
Water Quality					
Increased turbidity and sediment loads	1	1	1	2	1
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of surface soils - changes in recharge potential	1	1	1	1	2
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	2	2	2	1	1
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-30
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Connector A Segment

Crossing Number	Stream Name	Water Body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
85	un-named	Stream	Clear	+450	None	flow	Bridge	40
180	un-named	Wetland Flow-way	N/A	+400	None	Wetland continuity	Culvert	10
196	un-named	Wetland Flow-way	N/A		None	Wetland continuity	Culvert	4
390	un-named	Drainway	N/A		None	Flow	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-31
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Connector B Segment

Crossing Number	Stream Name	Water Body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
27	un-named	Slough	Clear	-490	None	flow	Culvert	2x10
86	Fivemile Clearwater RIver	Stream	Mixed	-900	Boat	flow	Bridge	160
293	un-named	Drainway	N/A		None	over flow	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-32
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Connector C Segment

Crossing Number	Stream Name	Water Body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
342	un-named	Stream	Clear		None	Fish/Flow	Bridge	90
343	un-named	Slough	Clear		None	Flow	Culvert	2x10
344	un-named	Overflow	Clear	-675	None	Flow/Fish	Culvert	2x10
345	Fivemile Clearwater RIver	Stream	Clear	0	Boat	Flow/Fish	Bridge	135
346	un-named	Stream	Clear		None	Flow/Fish	Culvert	3x10
396	un-named	Stream	Clear	+550	None	Flow/Fish	Bridge	40
397	un-named	Wetland Flow-way	N/A	+450	None	Wetland Continuity	Culvert	10

*+=upstream of site, -=downstream of site, no value= no field site

Table E-33
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Connector D Segment

Crossing Number	Stream Name	Water Body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
501	Un-named	Stream	Clear		None	Flow	Bridge	90
502	un-named	Stream	Clear		None	flow	Culvert	2x10
503	un-named	Stream	Clear		None	flow	Bridge	90
504	un-named	Stream	Clear		None	flow	Bridge	90

*+=upstream of site, -=downstream of site, no value= no field site

Table E-34
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for Connector E Segment

Crossing Number	Stream Name	Water Body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
273	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	10
274	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	10
291	un-named	Drainway	N/A		None	Flow	Culvert	4
350	un-named	Wetland Flow-way	N/A	-640	None	Wetland Continuity	Culvert	4
351	Fivemile Clearwater River	Stream	Clear	+4600	Boat	Flow/Fish	Bridge	115
427	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-35a
Summary of Impacts for Connector A – Short-Term Construction
Physiographic Region - Tanana Valley Flats

Type of Waterbody	*Stream*	*Drainageway*	*Wetland Flow-way*	Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area				
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams								
Blockages or Changes in Channel Planform	2	2	1	1	1	NI	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1	1	NI	2	1
Altered Flood Hydraulics	2	3	2	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	1	1	1	NI	1	1
Stresses on natural water balances	1	1	1	1	1	NI	1	2
Lakes and Ponds								
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality								
Increased turbidity and sediment loads	1	2	2	2	2	NI	1	1
Chemically Contaminate Waters	1	1	1	1	1	NI	2	1
Groundwater								
Removal of surface soils - changes in recharge potential	1	1	1	2	2	NI	2	1
Dewatering of aquifers	1	1	1	1	1	NI	1	1
Floodplains								
Increased Potential for Flooding	2	2	2	1	1	NI	1	1
Reduced Floodplain Area	1	1	1	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-35b
Summary of Impacts for Connector A – Long-Term Operations
Physiographic Region - Tanana Valley Flats

Type of Waterbody	***Stream***	***Drainageway***	***Wetland Flow-way***	**Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area**	
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams					
Blockages or Changes in Channel Planform	2	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1	1
Altered Flood Hydraulics	2	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	1	1	1
Stresses on natural water balances	1	1	1	1	1
Lakes and Ponds					
Stresses on natural water balances	1	1	1	1	1
Water Quality					
Increased turbidity and sediment loads	1	1	1	2	1
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of surface soils - changes in recharge potential	1	1	1	1	2
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	2	2	2	1	1
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-36a
Summary of Impacts for Connector B – Short-Term Construction
Physiographic Region - Tanana River Valley

Type of Waterbody	*Fivemile Clearwater River*	*Drainageway*	*Floodplain Slough*	Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area				
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams								
Blockages or Changes in Channel Planform	2	2	2	1	1	NI	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	1	1	NI	2	1
Altered Flood Hydraulics	2	3	2	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	2	1	1	NI	1	1
Stresses on natural water balances	1	1	1	1	1	NI	1	2
Lakes and Ponds								
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality								
Increased turbidity and sediment loads	1	2	2	2	2	NI	1	1
Chemically Contaminate Waters	1	1	1	1	1	NI	2	1
Groundwater								
Removal of surface soils - changes in recharge potential	1	1	1	2	2	NI	2	1
Dewatering of aquifers	1	1	1	1	1	NI	1	1
Floodplains								
Increased Potential for Flooding	2	2	2	1	1	NI	1	1
Reduced Floodplain Area	1	1	1	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-36b
Summary of Impacts for Connector B – Long-Term Operations
Physiographic Region - Tanana River Valley

Type of Waterbody	*Fivemile Clearwater River*	*Drainageway*	*Floodplain Slough*	Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area	
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams					
Blockages or Changes in Channel Planform	2	2	2	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	1	1
Altered Flood Hydraulics	2	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	2	1	1
Stresses on natural water balances	1	1	1	1	1
Lakes and Ponds					
Stresses on natural water balances	1	1	1	1	1
Water Quality					
Increased turbidity and sediment loads	1	1	1	2	1
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of surface soils - changes in recharge potential	1	1	1	1	2
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	2	2	2	1	1
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-37a
Summary of Impacts for Connector C – Short-Term Construction
Physiographic Region - Tanana River Valley and Tanana Valley Flats

Type of Waterbody	*Stream*	*Floodplain Slough*	*Overflow Channel*	*Wetland Flow-way*	Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area				
Activity/Structure	***Bridges***	***Culvert***	***Culvert***	***Culvert***	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams									
Blockages or Changes in Channel Planform	2	2	2	1	1	1	NI	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	1	1	1	NI	2	1
Altered Flood Hydraulics	2	3	3	2	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	1	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	3	1	1	1	NI	1	1
Stresses on natural water balances	1	1	1	1	1	1	NI	1	2
Lakes and Ponds									
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality									
Increased turbidity and sediment loads	1	2	2	2	2	2	NI	1	1
Chemically Contaminate Waters	1	1	1	1	1	1	NI	2	1
Groundwater									
Removal of surface soils - changes in recharge potential	1	1	1	1	2	2	NI	2	1
Dewatering of aquifers	1	1	1	1	1	1	NI	1	1
Floodplains									
Increased Potential for Flooding	2	2	2	2	1	1	NI	1	1
Reduced Floodplain Area	1	1	1	1	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-37b
Summary of Impacts for Connector C – Long-Term Operations
Physiographic Region - Tanana River Valley and Tanana Valley Flats

Type of Waterbody	*Stream*	*Floodplain Slough*	*Overflow Channel*	*Wetland*	Adjacent to Drainageways, Overflow Channels and Wetlands within Riparian Area	
Activity/Structure	***Bridges***	***Culvert***	***Culvert***	***Culvert***	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams						
Blockages or Changes in Channel Planform	1	1	1	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	1	1	1	1
Altered Flood Hydraulics	1	1	1	1	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	1	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	1	1	1	1
Stresses on natural water balances	1	1	1	1	1	1
Lakes and Ponds						
Stresses on natural water balances	1	1	1	1	1	1
Water Quality						
Increased turbidity and sediment loads	1	1	1	1	2	1
Chemically Contaminate Waters	1	1	1	1	1	1
Groundwater						
Removal of surface soils - changes in recharge potential	1	1	1	1	1	2
Dewatering of aquifers	1	1	1	1	1	1
Floodplains						
Increased Potential for Flooding	1	1	1	1	1	1
Reduced Floodplain Area	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-38a
Summary of Impacts for Connector D – Short-Term Construction
Physiographic Region - Tanana River Valley

Type of Waterbody	***Stream***	***Stream***	**Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area**				
Activity/Structure	***Bridge***	***Culvert***	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams							
Blockages or Changes in Channel Planform	2	2	1	1	NI	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1	NI	2	1
Altered Flood Hydraulics	2	3	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	1	1	NI	1	1
Stresses on natural water balances	1	1	1	1	NI	1	2
Lakes and Ponds							
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI
Water Quality							
Increased turbidity and sediment loads	1	2	2	2	NI	1	1
Chemically Contaminate Waters	1	1	1	1	NI	2	1
Groundwater							
Removal of surface soils - changes in recharge potential	1	1	2	2	NI	2	1
Dewatering of aquifers	1	1	1	1	NI	1	1
Floodplains							
Increased Potential for Flooding	2	2	1	1	NI	1	1
Reduced Floodplain Area	1	1	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-38b
Summary of Impacts for Connector D – Long-Term Operations and Maintenance
Physiographic Region - Tanana River Valley

Type of Waterbody	***Stream***	***Stream***	**Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area**	
Activity/Structure	***Bridge***	***Culvert***	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams				
Blockages or Changes in Channel Planform	2	2	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1
Altered Flood Hydraulics	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	1	1
Stresses on natural water balances	1	1	1	1
Lakes and Ponds				
Stresses on natural water balances	1	1	1	1
Water Quality				
Increased turbidity and sediment loads	1	1	2	1
Chemically Contaminate Waters	1	1	1	1
Groundwater				
Removal of surface soils - changes in recharge potential	1	1	1	2
Dewatering of aquifers	1	1	1	1
Floodplains				
Increased Potential for Flooding	2	2	1	1
Reduced Floodplain Area	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-39a
Summary of Impacts for Connector E – Short-Term Construction
Physiographic Region - Tanana River Valley and Tanana Valley Flats

Type of Waterbody	*Stream*	*Drainageway*	*Wetland Flow-way*	Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area				
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams								
Blockages or Changes in Channel Planform	2	2	1	1	1	NI	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1	1	NI	2	1
Altered Flood Hydraulics	2	3	2	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	1	1	1	NI	1	1
Stresses on natural water balances	1	1	1	1	1	NI	1	2
Lakes and Ponds								
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality								
Increased turbidity and sediment loads	1	2	2	2	2	NI	1	1
Chemically Contaminate Waters	1	1	1	1	1	NI	2	1
Groundwater								
Removal of surface soils - changes in recharge potential	1	1	1	2	2	NI	2	1
Dewatering of aquifers	1	1	1	1	1	NI	1	1
Floodplains								
Increased Potential for Flooding	2	2	2	1	1	NI	1	1
Reduced Floodplain Area	1	1	1	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-39b
Summary of Impacts for Connector E – Long-Term Operations and Maintenance
Physiographic Region - Tanana River Valley and Tanana Valley Flats

Type of Waterbody	*Stream*	*Drainageway*	*Wetland Flow-way*	Adjacent to Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area	
Activity/Structure	***Bridge***	***Culvert***	***Culvert***	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams					
Blockages or Changes in Channel Planform	2	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1	1
Altered Flood Hydraulics	2	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	1	1	1
Stresses on natural water balances	1	1	1	1	1
Lakes and Ponds					
Stresses on natural water balances	1	1	1	1	1
Water Quality					
Increased turbidity and sediment loads	1	1	1	2	1
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of surface soils - changes in recharge potential	1	1	1	1	2
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	2	2	2	1	1
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-40
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for the Donnelly Alternative Segment 1

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
	Little Delta River	Stream	Glacial	Onsite	Boat	Flow	Bridge	800
	Delta Creek	Stream	Glacial	Onsite	Boat	Flow	Bridge	700
73	un-named	Overflow	Clear	Onsite	None	Flow	Bridge	150
74	Kiana Creek	Stream	Clear		None	Flow	Bridge	65
75	un-named	Wetland Flow-way	Clear		None	Wetland Continuity	Culvert	10
76	West Kiana Creek	Stream	Clear	-275	None	Flow	Bridge	40
78	un-named	Drainway	Clear	Onsite	None	Flow	Culvert	10
79	un-named	Drainway	Clear	Onsite	None	Flow	Culvert	10
81	un-named	Stream	Clear	-2800	None	Flow	Culvert	3x10
137	Un-named	Stream	Clear	-380/-1500	None	Flow	Bridge	40
146	un-named	Drainway	Clear		None	Flow	Culvert	4
147	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	2x4
148	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	2x4
149	un-named	Wetland Flow-way	N/A	Onsite	None	Wetland Continuity	Culvert	4
155	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
156	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
157	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
159	un-named	Drainway	N/A		None	Flow	Culvert	10
166	un-named	Drainway	N/A	Onsite	None	Flow	Culvert	4
167	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
168	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
429	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
275	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
276	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
277	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
278	un-named	Drainway	Clear		None	Flow	Culvert	4
279	un-named	Stream	Clear	+110	None	Flow/Fish	Culvert	2x10
280	un-named	Drainway	N/A		None	Flow	Culvert	4
283	un-named	Drainway	N/A		None	Flow	Culvert	4
284	un-named	Drainway	N/A		None	Flow	Culvert	4
285	un-named	Drainway	N/A		None	Flow	Culvert	4
286	un-named	Drainway	Clear		None	Flow	Culvert	10
287	un-named	Stream	Clear		None	Flow	Culvert	10
288	un-named	Drainway	N/A		None	Flow	Culvert	4

Table E-40
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for the Donnelly Alternative Segment 1 (continued)

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
289	un-named	Drainway	N/A	+1010	None	Flow	Culvert	4
290	un-named	Drainway	N/A		None	Flow	Culvert	4
169	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-41
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for the Donnelly Alternative Segment 2

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
	Little Delta River	Stream	Glacial	onsite	Boat	Flow	Bridge	900
	Delta Creek	Stream	Glacial	onsite	Boat	Flow	Bridge	700
39	un-named	Overflow	Glacial		None	Flow	Culvert	10
40	un-named	Stream	Clear		None	Flow	Culvert	3x10
41	Un-named	Stream	Clear	+500	None	Flow	Bridge	40
42	un-named	Overflow	Glacial	-450	None	Flow	Culvert	10
43	un-named	Overflow	Glacial		None	Flow	Culvert	10
45	un-named	Overflow	Glacial	-220	None	Flow	Culvert	10
46	un-named	Seep	Clear	+400	None	Ice	Culvert	10
49	un-named	Seep	Clear	+575	None	Ice	Culvert	10
51	un-named	Seep	Clear	-150	None	Ice	Culvert	10
52	un-named	Seep	Clear		None	Ice	Culvert	10
54	un-named	Seep	Clear		None	Ice	Culvert	10
100	Kiana Creek	Stream	Clear	0	None	Flow	Bridge	80
101	un-named	Stream	Clear	-100	None	Flow	Culvert	2x10
102	un-named	Stream	Clear	+70	None	Flow	Culvert	10
125	un-named	Seep	Clear	+700	None	Ice	Culvert	10
138	un-named	Stream	Clear	-1400	None	Ice	Culvert	10
139	un-named	Stream	Clear		None	Ice	Culvert	10
141	un-named	Seep	Clear		None	Ice	Culvert	10
205	un-named	Drainway	N/A		None	Ice	Culvert	10
206	un-named	Drainway	N/A		None	Ice	Culvert	10
207	un-named	Drainway	N/A		None	Ice	Culvert	10
252	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4

Table E-41
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for the Donnelly Alternative Segment 2 (continued)

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
253	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
254	un-named	Seep	Clear		None	Wetland continuity	Culvert	10
255	un-named	Seep	Clear		None	Ice	Culvert	10
256	un-named	Seep	Clear		None	Ice	Culvert	10
257	un-named	Seep	Clear		None	Ice	Culvert	10
258	un-named	Seep	Clear		None	Ice	Culvert	10
259	un-named	Seep	Clear		None	Ice	Culvert	10
292	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
349	un-named	Wetland Flow-way	N/A	-1500	None	Wetland Continuity	Culvert	4
354	un-named	Drainway	N/A		None	Flow	Culvert	10
360	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
361	un-named	Wetland	N/A		None	Wetland Continuity	Culvert	4
362	un-named	Drainway	N/A		None	Flow	Culvert	4
363	un-named	Drainway	N/A		None	Flow	Culvert	4
364	un-named	Drainway	N/A		None	Flow	Culvert	4
365	un-named	Drainway	N/A		None	Flow	Culvert	4
366	un-named	Drainway	N/A		None	Flow	Culvert	4
367	un-named	Drainway	N/A		None	Flow	Culvert	4
368	un-named	Stream	Clear		None	Flow	Culvert	10
369	un-named	Drainway	N/A		None	Flow	Culvert	4
370	un-named	Drainway	N/A		None	Flow	Culvert	4
371	un-named	Drainway	N/A		None	Flow	Culvert	4
372	un-named	Drainway	N/A		None	Flow	Culvert	4
428	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	10

*+=upstream of site, -=downstream of site, no value= no field site

Table E-42a
Summary of Impacts for Donnelly Alternative Segment 1 – Short-Term Construction

Physiographic Region	Delta Moraine Wetlands		Lower Foothills						
Type of Waterbody	Drainageway	Wetland Flow-way	Overflow	Stream			Drainageway	Wetland Flow-way	Stream
Name of large waterbody (if applicable)			*un-named*	*Little Delta River*	*Delta Creek*	*Kiana Creek*			
Activity/Structure	Culvert	Culvert	Bridge	Bridge			Culvert	Culvert	Culvert
Rivers and Streams									
Blockages or Changes in Channel Planform	2	1	2	2	2	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	1	2	2	2	2	1	1	1
Altered Flood Hydraulics	2	1	2	2	2	2	1	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	1	2	2	2	2	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	1	2	2	2	3	1	1	1
Stresses on natural water balances	1	1	1	1	1	1	1	1	1
Lakes and Ponds									
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality									
Increased turbidity and sediment loads	1	2	1	1	1	1	1	2	2
Chemically Contaminate Waters	1	1	1	1	1	1	1	1	1
Groundwater									
Removal of surface soils - changes in recharge potential	1	1	1	1	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1	1	1	1	1
Floodplains									
Increased Potential for Flooding	2	2	2	2	2	2	1	1	1
Reduced Floodplain Area	1	1	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-42b
Summary of Impacts for Donnelly Alternative Segment 1 – Short-Term Construction

Physiographic Region	**Tanana Valley Flats**				**Tanana River Valley**
Type of Waterbody	**Stream**	**Drainageway**	**Stream**	**Wetland Flow-way**	**Wetland Flow-way**
Name of large waterbody (if applicable)	***Unnamed***				
Activity/Structure	**Bridge**	**Culvert**	**Culvert**	**Culvert**	**Culvert**
Rivers and Streams					
Blockages or Changes in Channel Planform	2	2	2	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	1	1
Altered Flood Hydraulics	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	2	1	1
Stresses on natural water balances	1	1	1	1	1
Lakes and Ponds					
Stresses on natural water balances	NI	NI	NI	NI	NI
Water Quality					
Increased turbidity and sediment loads	1	1	2	2	2
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of surface soils - changes in recharge potential	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-42c
Summary of Impacts for Donnelly Alternative Segment 1 – Short-Term Construction

Physiographic Region	**Delta Moraine Wetlands, Lower Foothills, Tanana Valley Flats and Tanana River Valley**				
Type of Waterbody	**Adjacent to Streams, Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area**				
Activity/Structure	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams					
Blockages or Changes in Channel Planform	1	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	1	2	1
Altered Flood Hydraulics	1	1	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	1	1	1
Stresses on natural water balances	1	1	2	1	2
Lakes and Ponds					
Stresses on natural water balances	NI	NI	NI	NI	NI
Water Quality					
Increased turbidity and sediment loads	2	3	2	1	1
Chemically Contaminate Waters	1	1	1	2	1
Groundwater					
Removal of surface soils - changes in recharge potential	2	2	1	2	1
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	1	1	2	1	1
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-42d
Summary of Impacts for Donnelly Alternative Segment 1 – Long-Term Operations and Maintenance

Physiographic Region	Delta Moraine Wetlands		Lower Foothills						
Type of Waterbody	Drainageway	Wetland Flow-way	Overflow	Stream			Drainageway	Wetland Flow-way	Stream
Name of large waterbody (if applicable)			*Un-named*	*Little Delta River*	*Delta Creek*	*Kiana Creek*			
Activity/Structure	Culvert	Culvert	Bridge	Bridge			Culvert	Culvert	Culvert
Rivers and Streams									
Blockages or Changes in Channel Planform		1		2	2	2	2	2	2
Disturbances to Permafrost - Thermal Erosion of Streambanks		1		2	2	2	2	1	2
Altered Flood Hydraulics				2	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams		1		2	2	2	2	1	2
Increased Scour, Bank Erosion and/or Channel Aggradation		1		2	2	2	2	1	2
Stresses on natural water balances	1	1	1	1	1	1	1	1	1
Lakes and Ponds									
Stresses on natural water balances	1	1	1	1	1	1	1	1	1
Water Quality									
Increased turbidity and sediment loads	1	1	1	1	1	1	1	1	1
Chemically Contaminate Waters	1	1	1	1	1	1	1	1	1
Groundwater									
Removal of surface soils - changes in recharge potential	1	1	1	1	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1	1	1	1	1
Floodplains									
Increased Potential for Flooding	2	2	2	2	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-42e
Summary of Impacts for Donnelly Alternative Segment 1 – Long-Term Operations and Maintenance

Physiographic Region	Tanana Valley Flats				Tanana River Valley
Type of Waterbody	Stream	Drainageway	Stream	Wetland Flow-way	Wetland Flow-way
Activity/Structure	Bridge	Culvert	Culvert	Culvert	Culvert
Rivers and Streams					
Blockages or Changes in Channel Planform	2	2	2	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	1	1
Altered Flood Hydraulics	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	2	1	1
Stresses on natural water balances	1	1	1	1	1
Lakes and Ponds					
Stresses on natural water balances	1	1	1	1	1
Water Quality					
Increased turbidity and sediment loads	1	1	1	1	1
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of surface soils - changes in recharge potential	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-42f
Summary of Impacts for Donnelly Alternative Segment 1 – Long-Term Operations and Maintenance

Physiographic Region	Delta Moraine Wetlands, Lower Foothills, Tanana Valley Flats and Tanana River Valley		
Type of Waterbody	Adjacent to Streams, Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area		
Activity/Structure	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***
Rivers and Streams			
Blockages or Changes in Channel Planform	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1	1
Altered Flood Hydraulics	1	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	1
Stresses on natural water balances	1	1	1
Lakes and Ponds			
Stresses on natural water balances	1	1	1
Water Quality			
Increased turbidity and sediment loads	2	1	1
Chemically Contaminate Waters	1	1	1
Groundwater			
Removal of surface soils - changes in recharge potential	1	1	1
Dewatering of aquifers	1	1	1
Floodplains			
Increased Potential for Flooding	1	1	1
Reduced Floodplain Area	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-43a
Summary of Impacts for Donnelly Alternative Segment 2 – Short-Term construction

Physiographic Region	Delta Moraine Wetlands		Lower Foothills				
Type of Waterbody	Stream	Drainageway	Stream			Drainageway	Overflow Channel
Name of large waterbody (if applicable)			*Little Delta River*	*Delta Creek*	*Kiana Creek*		
Activity/Structure	Culvert	Culvert	Bridge			Culvert	Culvert
Rivers and Streams							
Blockages or Changes in Channel Planform	2	2	2	2	2	2	2
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	2	2	2	2
Altered Flood Hydraulics	2	2	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	2	2	2	2
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	2	2	3	2	2
Stresses on natural water balances	1	1	1	1	1	1	1
Lakes and Ponds							
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI
Water Quality							
Increased turbidity and sediment loads	2	1	1	1	1	1	2
Chemically Contaminate Waters	1	1	1	1	1	1	1
Groundwater							
Removal of surface soils - changes in recharge potential	1	1	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1	1	1
Floodplains							
Increased Potential for Flooding	2	2	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-43b
Summary of Impacts for Donnelly Alternative Segment 2 – Short-Term Construction

Physiographic Region					**Tanana Valley Flats**			
Type of Waterbody	**Seep**	**Overflow Channel**	**Drainageway**	**Wetland Flow-way**	**Stream**	**Drainageway**	**Seep**	**Wetland Flow-way**
Name of large waterbody (if applicable)					***Unnamed***			
Activity/Structure	**Culvert**	**Culvert**	**Culvert**	**Culvert**	**Bridge**	**Culvert**	**Culvert**	**Culvert**
Rivers and Streams								
Blockages or Changes in Channel Planform	2	2	2	1	2	2	2	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	1	2	2	2	1
Altered Flood Hydraulics	2	2	2	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	1	2	2	2	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	2	1	2	2	2	1
Stresses on natural water balances	1	1	1	1	1	1	1	1
Lakes and Ponds								
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality								
Increased turbidity and sediment loads	2	2	1	2	2	1	1	1
Chemically Contaminate Waters	1	1	1	1	1	1	1	1
Groundwater								
Removal of surface soils - changes in recharge potential	1	1	1	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1	1	1	1
Floodplains								
Increased Potential for Flooding	2	2	2	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-43c
Summary of Impacts for Donnelly Alternative Segment 2 – Short Tem Construction

Physiographic Region	**Delta Moraine Wetlands, Lower Foothills, Tanana Valley Flats and Tanana River Valley**				
Type of Waterbody	**Adjacent to Streams, Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area**				
Name of large waterbody (if applicable)					
Activity/Structure	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams					
Blockages or Changes in Channel Planform	1	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	1	1	2	1
Altered Flood Hydraulics	1	1	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	1	1	1
Stresses on natural water balances	1	1	2	1	2
Lakes and Ponds					
Stresses on natural water balances	NI	NI	NI	NI	NI
Water Quality					
Increased turbidity and sediment loads	2	3	2	1	1
Chemically Contaminate Waters	1	1	1	2	1
Groundwater					
Removal of surface soils - changes in recharge potential	2	2	1	2	1
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	1	1	2	1	1
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-43d
Summary of Impacts for Donnelly Alternative Segment 2 – Long-Term Operations and Maintenance

Physiographic Region	**Delta Moraine Wetlands**		**Lower Foothills**				
Type of Waterbody	**Stream**	**Drainageway**	**Stream**			**Drainageway**	**Overflow Channel**
Name of large waterbody (if applicable)			***Little Delta River***	***Delta Creek***	***Kiana Creek***		
Activity/Structure	**Culvert**	**Culvert**	**Bridge**			**Culvert**	**Culvert**
Rivers and Streams							
Blockages or Changes in Channel Planform	2	2	2	2	2	2	2
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	2	2	2	2	2
Altered Flood Hydraulics	2	2	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	2	2	2	2	2
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	2	2	2	2	2
Stresses on natural water balances	1	1	1	1	1	1	1
Lakes and Ponds							
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI
Water Quality							
Increased turbidity and sediment loads	1	1	1	1	1	1	1
Chemically Contaminate Waters	1	1	1	1	1	1	1
Groundwater							
Removal of surface soils - changes in recharge potential	1	1	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1	1	1
Floodplains							
Increased Potential for Flooding	2	2	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-43e
Summary of Impacts for Donnelly Alternative Segment 2 – Long-Term Operations and Maintenance

Physiographic Region	Tanana River Valley						Tanana Valley Flats			
Type of Waterbody	Wetland Flow-ways	Stream	Seep	Overflow Channel	Drainageway	Wetland Flow-way	Stream	Drainageway	Seep	Wetland Flow-way
Name of large waterbody (if applicable)							*Unnamed*			
Activity/Structure	Culvert	Culvert	Culvert	Culvert	Culvert	Culvert	Bridge	Culvert	Culvert	Culvert
Rivers and Streams										
Blockages or Changes in Channel Planform	1	2	2	2	2	1	2	2	2	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	2	2	2	2	1	2	2	2	1
Altered Flood Hydraulics	2	2	2	2	2	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	2	2	2	2	1	2	2	2	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	2	2	2	2	1	2	2	2	1
Stresses on natural water balances	1	1	1	1	1	1	1	1	1	1
Lakes and Ponds										
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Water Quality										
Increased turbidity and sediment loads	1	1	1	1	1	1	1	1	1	1
Chemically Contaminate Waters	1	1	1	1	1	1	1	1	1	1
Groundwater										
Removal of surface soils - changes in recharge potential	1	1	1	1	1	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1	1	1	1	1	1
Floodplains										
Increased Potential for Flooding	1	1	1	1	1	1	1	1	1	1
Reduced Floodplain Area	1	1	1	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-43f
Summary of Impacts for Donnelly Alternative Segment 2 – Long-Term Operations and Maintenance

Physiographic Region	**Delta Moraine Wetlands, Lower Foothills, Tanana Valley Flats and Tanana River Valley**	
Type of Waterbody	**Adjacent to Streams, Drainageways, Overflow Channels and Wetland Flow-ways within Riparian Area**	
Activity/Structure	***Use of Gravel Roads***	***Presence of Borrow - Gravel Pits***
Rivers and Streams		
Blockages or Changes in Channel Planform	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	1	1
Altered Flood Hydraulics	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1
Stresses on natural water balances	1	1
Lakes and Ponds		
Stresses on natural water balances	NI	NI
Water Quality		
Increased turbidity and sediment loads	2	1
Chemically Contaminate Waters	1	1
Groundwater		
Removal of surface soils - changes in recharge potential	1	1
Dewatering of aquifers	1	1
Floodplains		
Increased Potential for Flooding	1	1
Reduced Floodplain Area	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-44
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for South Common Segment

Crossing Number	Stream Name	Water Body Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
103	un-named	Stream	Clear	+920	None	Fish	Bridge	65
104	un-named	Stream	Clear	onsite	None	Fish	Bridge	40
136	un-named	Stream	Clear	-200	None	Flow	Bridge	50
170	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	10
171	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	10
184	un-named	Wetland Flow-way	N/A	+200	None	Wetland Continuity	Culvert	4
249	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
250	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
251	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
281	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
282	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4
379	un-named	Drainway	N/A		None	Flow	Culvert	4
385	un-named	Drainway	N/A		None	Flow	Culvert	4
426	un-named	Wetland Flow-way	N/A		None	Wetland Continuity	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-45a
Summary of Impacts for South Common Segment – Short-Term Construction

Physiographic Region	**Delta Moraine Wetlands**				
Type of Waterbody	**Stream**	**Drainageway**	**Wetland Flow-way**	**Stream**	**Wetland Flow-way**
Name of large waterbody (if applicable)	***Headwaters of Richardson Clearwater River***			***Headwaters of Richardson Clearwater River***	
Activity/Structure	**Bridge**	**Culvert**	**Culvert**	**Bridge**	**Culvert**
Rivers and Streams					
Blockages or Changes in Channel Planform	2	2	1	2	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	3	2	1	3	1
Altered Flood Hydraulics	2	2	2	2	2
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	2	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	1	2	1
Stresses on natural water balances	1	1	1	1	1
Lakes and Ponds					
Stresses on natural water balances	NI	NI	NI	NI	NI
Water Quality					
Increased turbidity and sediment loads	1	2	2	1	2
Chemically Contaminate Waters	1	1	1	1	1
Groundwater					
Removal of surface soils - changes in recharge potential	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1
Floodplains					
Increased Potential for Flooding	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-45b
Summary of Impacts for South Common Segment – Short-Tem Construction
Physiographic Region - Delta Moraine Wetlands

Type of Waterbody	Adjacent to Streams, Drainageways and Wetland Flow-ways within Riparian Area				
Activity/Structure	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams					
Blockages or Changes in Channel Planform	1	1	NI	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	1	NI	2	1
Altered Flood Hydraulics	1	1	NI	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	1	1	NI	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	1	1	NI	1	1
Stresses on natural water balances	1	1	NI	1	2
Lakes and Ponds					
Stresses on natural water balances	NI	NI	NI	NI	NI
Water Quality					
Increased turbidity and sediment loads	2	2	NI	1	1
Chemically Contaminate Waters	1	1	NI	2	1
Groundwater					
Removal of surface soils - changes in recharge potential	2	2	NI	2	1
Dewatering of aquifers	1	1	NI	1	1
Floodplains					
Increased Potential for Flooding	1	1	NI	1	1
Reduced Floodplain Area	1	1	NI	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-45c
Summary of Impacts for South Common Segment – Long-Term Operations

Physiographic Region	Delta Moraine Wetlands						
Type of Waterbody	Stream	Drainageway	Wetland Flow-way	Stream	Wetland Flow-way	Adjacent to Streams, Drainageways and Wetland Flow-ways within Riparian Area	
Name of large waterbody (if applicable)	*Headwaters of Richardson Clearwater River*			*Headwaters of Richardson Clearwater River*			
Activity/Structure	Bridge	Culvert	Culvert	Bridge	Culvert	*Use of Gravel Roads*	*Presence of Borrow - Gravel Pits*
Rivers and Streams							
Blockages or Changes in Channel Planform	2	2	1	2	1	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	2	1	1	1
Altered Flood Hydraulics	2	2	2	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	2	1	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	2	1	2	1	1	1
Stresses on natural water balances	1	1	1	1	1	1	1
Lakes and Ponds							
Stresses on natural water balances	1	1	1	1	1	1	1
Water Quality							
Increased turbidity and sediment loads	1	1	1	1	1	2	1
Chemically Contaminate Waters	1	1	1	1	1	1	1
Groundwater							
Removal of surface soils - changes in recharge potential	1	1	1	1	1	1	1
Dewatering of aquifers	1	1	1	1	1	1	1
Floodplains							
Increased Potential for Flooding	2	2	2	2	2	2	2
Reduced Floodplain Area	1	1	1	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-46
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for the Delta Alternative Segment 1

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)*	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
Delta Alternative Segment 1								
	Delta River	Stream	Glacial	onsite	Boat	Flow	Bridge	2,000
386	un-named	Drainway	N/A		None	Flow	Culvert	4

*+=upstream of site, -=downstream of site, no value= no field site

Table E-47
Stream Crossing Types, Controlling Factors and Conveyance Characteristics for the Delta Alternative Segment 2

Crossing Number	Stream Name	Waterbody Type	Water Type	Distance to Surveyed Site (feet)	Navigation	Controlling Factor	Conveyance Type	Conveyance Size (feet)
Delta Alternative Segment 1								
	Delta River	Stream	Glacial	onsite	Boat	Flow	Bridge	2,000

Table E-48a
Summary of Impacts for Delta Alternative Segment 1 – Short-Term Construction

Physiographic Region	Delta Moraine Wetlands	Lower Foothills	Delta Moraine Wetlands and Lower Foothills				
Type of Waterbody	Drainageway	Stream	Adjacent to Streams, Drainageways and Wetland Flow-ways within Riparian Area				
Name of large waterbody (if applicable)		*Delta River*					
Activity/Structure	Culvert	Bridge	*Gravel Roads*	*Borrow - Gravel Extraction*	*Ice Roads/ Bridges*	*Staging Areas and Camps*	*Camp Well Water Supply Extraction*
Rivers and Streams							
Blockages or Changes in Channel Planform	2	3	1	2	1	1	NI
Disturbances to Permafrost - Thermal Erosion of Streambanks		2	1	1	1	1	NI
Altered Flood Hydraulics	2	3	1	1	2	1	NI
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1	2	1	NI
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	1	1	1	1	NI
Stresses on natural water balances	1	1	1	1	2	1	NI
Lakes and Ponds							
Stresses on natural water balances	NI	NI	NI	NI	NI	NI	NI
Water Quality							
Increased turbidity and sediment loads	2	1	2	3	2	1	NI
Chemically Contaminate Waters	1	1	1	1	1	1	NI
Groundwater							
Removal of surface soils - changes in recharge potential	1	1	2	2	1	1	NI
Dewatering of aquifers	1	1	1	1	1	1	NI
Floodplains							
Increased Potential for Flooding	2	2	1	1	2	1	NI
Reduced Floodplain Area	1	1	1	1	1	1	NI

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-48b
Summary of Impacts for Delta Alternative Segment 1 – Long-Term Operations and Maintenance

Physiographic Region	**Delta Moraine Wetlands**	**Lower Foothills**	**Delta Moraine Wetlands and Lower Foothills**	
Type of Waterbody	**Drainageway**	**Stream**	**Adjacent to Streams, Drainageways and Wetland Flow-ways within Riparian Area**	
Name of large waterbody (if applicable)		***Delta River***		
Activity/Structure	**Culvert**	**Bridge**	***Use of Gravel Roads***	***Presence of Burrow/ Gravel Pits***
Rivers and Streams				
Blockages or Changes in Channel Planform	2	3	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	2	1	1
Altered Flood Hydraulics	2	2	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	3	1	1
Stresses on natural water balances	1	1	1	1
Lakes and Ponds				
Stresses on natural water balances	1	1	1	1
Water Quality				
Increased turbidity and sediment loads	1	1	2	1
Chemically Contaminate Waters	1	1	1	1
Groundwater				
Removal of surface soils - changes in recharge potential	1	1	1	1
Dewatering of aquifers	1	1	1	1
Floodplains				
Increased Potential for Flooding	2	2	1	1
Reduced Floodplain Area	1	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-49a
Summary of Impacts for Delta Alternative Segment 2 – Short-Term Construction

Physiographic Region	**Tanana River Valley**					
Type of Waterbody	**Stream**	**Adjacent to Streams within Riparian Area**				
Name of large waterbody (if applicable)	***Delta River***					
Activity/Structure	**Bridge**	***Gravel Roads***	***Borrow - Gravel Extraction***	***Ice Roads/ Bridges***	***Staging Areas and Camps***	***Camp Well Water Supply Extraction***
Rivers and Streams						
Blockages or Changes in Channel Planform	2	1	2	1	1	NI
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	1	1	1	1	NI
Altered Flood Hydraulics	3	1	1	2	1	NI
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	1	1	2	1	NI
Increased Scour, Bank Erosion and/or Channel Aggradation	2	1	1	1	1	NI
Stresses on natural water balances	1	1	1	2	1	NI
Lakes and Ponds						
Stresses on natural water balances	NI	NI	NI	NI	NI	NI
Water Quality						
Increased turbidity and sediment loads	1	1	3	2	1	NI
Chemically Contaminate Waters	1	1	1	1	1	NI
Groundwater						
Removal of surface soils - changes in recharge potential	1	1	2	1	1	NI
Dewatering of aquifers	1	1	1	1	1	NI
Floodplains						
Increased Potential for Flooding	2	1	1	2	1	NI
Reduced Floodplain Area	1	1	1	1	1	NI

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

Table E-49b
Summary of Impacts for Delta Alternative Segment 2 – Long-Term Operations and Maintenance
Physiographic Region – Tanana River Valley

Activity/Structure	Bridge	*Use of Gravel Roads*	*Presence of Borrow - Gravel Pits*
Rivers and Streams			
Blockages or Changes in Channel Planform	2	1	1
Disturbances to Permafrost - Thermal Erosion of Streambanks	2	1	1
Altered Flood Hydraulics	3	1	1
Increased Potential for Overbank Flooding and/or Ice/Debris Jams	2	1	1
Increased Scour, Bank Erosion and/or Channel Aggradation	2	1	1
Stresses on natural water balances	1	1	1
Lakes and Ponds			
Stresses on natural water balances	1	1	1
Water Quality			
Increased turbidity and sediment loads	1	1	1
Chemically Contaminate Waters	1	1	1
Groundwater			
Removal of surface soils - changes in recharge potential	1	1	1
Dewatering of aquifers	1	1	1
Floodplains			
Increased Potential for Flooding	2	1	1
Reduced Floodplain Area	1	1	1

Key: NI: No Impact 1: low impact 2: moderate impact 3: high impact

E.5 Wetlands

The project area, defined as the area within 500 feet of the proposed alternative segments for the purposes of the wetlands evaluation (HDR, 2007a), is about 33 percent wetlands. About a third of the project area wetlands are forested, composed of 1 percent broadleaf forested wetlands, 96 percent needleleaf forested wetlands, and 3 percent mixed forest wetlands. Nearly half of the wetlands within the project area are scrub/shrub wetlands, composed of 26 percent broadleaf scrub/shrub wetlands, 24 percent needleleaf scrub/shrub wetlands and 50 percent mixed and other scrub/shrub wetlands. Emergent and aquatic bed wetlands are relatively rare within the project area, comprising about 3 percent of project area wetlands. About an eighth of the project area is classified as other waters; comprised primarily of riverine waters (11 percent), with some palustrine waters (1 percent). The following sections describes the wetland classification or the vegetation communities, soils, and hydrology patters for wetlands within the project area (HDR, 2007a); functional capacities identified for project area wetland classes (HDR, 2007b); and brief descriptions of wetlands within the 200-foot right-of-way (ROW) for alternative segments and ancillary facilities.

E.5.1 Wetland Classifications

Forested Wetlands

Broadleaf forested wetlands are uncommon within the project area and are primarily associated with streams, small drainages, and the Tanana River floodplain (Figure E-1). A site next to the Tanana River contains an overstory of paper birch (*Betula papyrifera*) with a mixed understory of thin-leafed alder (*Alnus tenuifolia*) and bluejoint reedgrass (*Calamagrostis canadensis*) (Figure E-1). Soils are mineral with faint mottles in the B horizon. Wetland hydrology indicators include drainage patterns in wetlands and water marks on tree trunks (HDR, 2007a).

Figure E-1 – Example of a Broadleaf Forested Wetland (left) and an Aerial Plan View of Broadleaf Forested Wetland Distribution (right) in the Project Area (HDR, 2007a).

Needleleaf forest wetlands are common in the project area across a wide range of landscape positions, including broad flat areas, depressions, and along stream corridors (Figure E-2). These wetlands generally include an overstory dominated by black spruce (*Picea mariana*)

greater than 20 feet tall, with an understory of Labrador tea (*Ledum groenlandicum*), lowbush cranberry (*Vaccinium vitis-idaea*), field horsetail (*Equisetum arvense*), bluejoint reedgrass, and Bigelow's sedge (*Carex bigelowii*). Most needleleaf forested wetlands are located either on histosols (soils composed primarily of organic material) or on mineral soils with histic epipedons. Some soil test pits exhibit a strong sulfidic odor, indicating anaerobic conditions, and most of these sites have saturated soils within the top 12 inches. Other wetland hydrology indicators are wetland drainage patterns, wet swales and surface water in low-lying depressions, and a shallow aquitard (HDR, 2007a).

Figure E-2 – Example of a Needleleaf Forested Wetland (left) and an Aerial Plan View of Needleleaf Forested Wetland (right) in the Project Area (HDR, 2007a).

Mixed broadleaf and needleleaf forested wetlands are uncommon in the project area and are generally associated with slopes and drainages and other broadleaf or needleleaf forested wetlands. The most prominent area of mixed forested wetland occurs on the north-facing hillside between the Little Delta River and Delta Creek (HDR, 2007a).

Scrub/Shrub Wetlands

Broadleaf scrub/shrub wetlands are common in the project area generally occurring within bogs and along streams or open-water fringes (Figure E-3). Bog-type scrub/shrub wetlands extend across broad flat areas, are saturated, and have an open canopy of resin birch (*Betula gladulosa*), tussock-forming cottongrass (*Eriophorum brachyantherum*), bluejoint reedgrass, and bog blueberry (*Vaccinium uliginosum*). Riparian fringe scrub/shrub wetlands occur in floodplains and around lakes and ponds. Riparian scrub/shrub wetlands are seasonally flooded or semi-permanently flooded with a closed canopy dominated by willows or alder and ground cover of sedges, bluejoint reedgrass, and horsetail (HDR, 2007a). Many broadleaf scrub/shrub wetlands have either histosols or mineral soils with histic epipedons. Some sites are inundated, and test pits exhibit a strong hydrogen sulfide odor in the top 12 inches, or both. Other signs of wetland hydrology include reduced iron, oxidized root channels, wetlands drainage, sediment deposits, and water marks on vegetation (HDR, 2007a).

Figure E-3 – Example of a Bog-type Broadleaf Scrub/Shrub Wetland (left) and an Aerial Plan View of Bog-type Broadleaf Scrub/Shrub Wetland (right) in the Project Area (HDR, 2007a).

Needleleaf scrub/shrub wetlands are common in the project area and generally occur on broad flat expanses with associated permafrost (Figure E-4). This wetland type includes an open or closed canopy of shrub-height black spruce (less than 20 feet tall), lowbush cranberry, Labrador tea, bog blueberry, polar grass (*Arctagrostis latifolia*), and tussock cottongrass. Histosols or mineral soils with histic epipedons are the predominant soils within this wetland type, permafrost is frequent, and most soils are saturated in the upper 12 inches (HDR, 2007a).

Figure E-4 – Example of a Needleleaf Scrub/Shrub Wetland (left) and an Aerial Plan View of Needleleaf Scrub/Shrub Wetland (right) in the Project Area (HDR 2007a).

Mixed scrub/shrub wetlands are common in the project area and occur generally on large flat expanses and within floodplains (Figure E-5). Dominant plant species include shrub-height black spruce, less than 20 feet tall, resin birch, bog blueberry, lowbush cranberry, paper birch, tussock cottongrass, and bluejoint reedgrass. Soils include histosols or mineral soils with histic epipedons, and are frequently associated with permafrost and saturated in the upper 12 inches (HDR, 2007a).

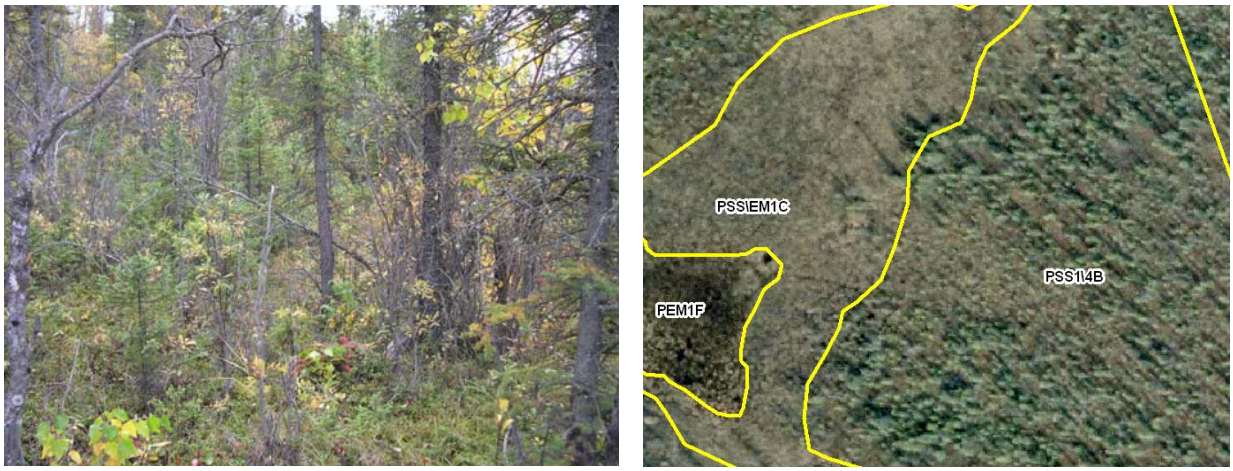

Figure E-5 – Example of a Mixed Broadleaf-Needleleaf Scrub/Shrub Wetland (left) and Aerial Plan View of Mixed Broadleaf-Needleleaf Scrub/Shrub Wetland (right) in the Project Area (HDR, 2007a).

Emergent Wetlands

Emergent wetlands are uncommon in the project area, generally extending across wide, flat, poorly drained areas or in depressions (Figure E-6). Most emergent wetlands are dominated by graminoid (grass or grasslike) vegetation, although some patterned bogs contain mounds with shrubby vegetation. Graminoid vegetation includes bluejoint reedgrass, water sedge (*Carex aquatilis*), russet sedge (*Carex saxatilis*), other sedges (*Carex spp.*), and narrow-leaf cottongrass (*Eriophorum angustifolium*). Mounds with shrubby vegetation include diamondleaf willow (*Salix pulchra*), Bebb's willow (*Salix bebbiana*), and little-tree willow (*Salix arbusculoides*) (HDR, 2007a). Hydric soils, histosols, or histic epipedons generally have a strong hydrogen sulfide odor in the top 12 inches and are either inundated or saturated in the upper 12 inches. Other wetland hydrology indicators include geomorphic position, wetland drainage patterns, and water-stained leaves (HDR, 2007a).

Figure E-6 – Example of an Emergent Wetland (left) and Aerial Plan View of Emergent Wetland (right) in the Project Area (HDR 2007a).

Other Wetlands and Waters

Other wetlands and waters of the United States in the project area include ponds, streams, and rivers as discussed above (Figure E-7, HDR, 2007a). Ponds include both unvegetated open water and water with visible floating or submerged vegetation such as aquatic bed vegetation. Ponds with aquatic beds were generally shallower than unvegetated ponds. Some perennial and all intermittent streams are mapped as linear features because they are too narrow to map effectively using polygonal regions (HDR, 2007a).

Figure E-7 – Examples of Pond Wetland (top left), Aerial Plan of Pond Wetland (top right), Stream Wetland (above left), and Stream Wetland Distribution (above right) in the Project Area (HDR, 2007a).

E.5.2 Wetland Functions and Values

The functional values of each vegetated wetland type within 500 feet or proposed rail line are presented in Table E-50 Functional capacities are evaluated as an index from 0 to 1, with 0 equivalent to providing no function and 1 providing full function. Functions for wetlands within the project area that would most likely be affected by construction and operation of the rail line include:

- high functional capacity of all wetlands to modify of water quality,

- high functional capacity of all wetlands to contribute to the abundance and diversity of wetland vegetation,
- high functional capacity of all wetlands to contribute to the abundance and diversity of wetland fauna,
- high functional capacity of permanently and semi-permanently flooded emergent wetlands to perform groundwater discharge,
- high functional capacity of wetlands with an outlet to export detritus,
- moderate functional capacity of wetlands with an outlet to store storm and floodwaters,
- moderate functional capacity of wetlands with an outlet to modify stream flow, and
- high functional capacity of wetlands without an outlet to store storm and floodwaters (HDR, 2007b).

E.5.3 Wetland Assessment Methodology

Wetland types and areas within 500 feet of the alternative segments were identified by ARRC through implementation of the U.S. Army Corps of Engineers (USACE) wetlands jurisdictional determination methodology during August 23-31, 2005; July 20-27, 2006; and August 14-20, 2006 (HDR, 2007a; HDR, 2007b). The methodology for establishing wetland boundaries and types is contained in the U.S. Army Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual Alaska Region (USACE, 2007). The Wetland boundaries and types presented herein are under review by the USACE and will require their approval prior to initiation of the USACE wetland permit process for the project.

The aerial extent of wetlands that would be directly impacted by the proposed rail project was calculated by Geographic Information System (GIS) analysis of delineated wetland areas within the 200-foot wide rail ROW. Areas outside the 200-foot ROW proposed for ancillary facilities, such as communication towers, large bridge staging areas, access roads, highway relocations, river gravel areas and passenger terminals were also analyzed. Wetland types and areas for these ancillary facilities were estimated from National Wetland Inventory (NWI) data in instances where their locations were not included within the areas delineated by ARRC. Results of these GIS analyses are presented for each alternative segment by individual wetland class. Class data were summarized by categories of needleleaf forested wetlands, broadleaf forested wetlands, mixed broadleaf/needleleaf forested wetlands, broadleaf scrub/shrub wetlands, needleleaf scrub/shrub wetlands, mixed and other scrub/shrub wetlands, emergent wetlands, aquatic bed wetlands, and other waters in Chapter 4. Brief descriptions of wetlands within the 200-foot ROW for the alternative segments are presented in Tables E-51 through E-63.

Table E-50
Average Functional Capacities for Project Area Wetlands (Magee and Hollands, 1998; HDR, 2007b).

Vegetated Wetland Type	Area[1] (acres)	Storm and Flood-Water Storage (wetlands with outlets)	Modification of Stream Flow (wetlands with outlets)	Modification of Groundwater Discharge	Modification of Groundwater Recharge	Modification of Water Quality	Export of Detritus (wetlands with outlets)	Abundance and Diversity of Wetland Vegetation	Contribution to Abundance and Diversity of Wetland Fauna
Broadleaf (BL) Forest	16.6	0.56	0.52	0.47	0.61	0.83	0.82	0.87	0.73
Needleleaf (NL) Forest	1,816.8	0.52	0.52	0.43	0.54	0.86	0.83	0.82	0.72
Mixed Forest	62.8	0.52	0.52	0.43	0.54	0.86	0.83	0.82	0.72
BL Shrub Semipermanently Flooded	27.3	0.47	0.67	1	0	0.53	0.83	0.87	0.88
BL Shrub Seasonally Flooded	376.9	0.56	0.44	0.53	0.51	0.78	0.82	0.87	0.80
BL Shrub Saturated	159.2	0.60	0.50	0.53	0.52	0.79	0.77	0.85	0.75
BL Shrub Temporarily Flooded	28.2	0.60	0.50	0.53	0.52	0.79	0.77	0.85	0.75
NL Shrub Seasonally Flooded	33.4	0.53	0.44	0.25	0.73	0.73	0.79	0.53	0.79
NL Shrub Saturated	683.3	0.53	0.44	0.42	0.56	0.82	0.79	0.83	0.73
Mixed Shrub Seasonally Flooded	67.4	0.53	0.44	0.40	0.64	0.80	0.83	1.00	0.79
Mixed Shrub Saturated	707.8	0.53	0.44	0.47	0.51	0.81	0.83	0.85	0.76
Emergent Permanently Flooded	0.5	0.49	0.64	0.76	0.24	0.84	0.68	0.73	0.83
Emergent Semipermanently Flooded	43.4	0.49	0.64	0.74	0.32	0.75	0.68	0.78	0.82
Emergent Seasonally Flooded	75.8	0.57	0.44	0.52	0.55	0.73	0.78	0.78	0.73
Emergent Saturated	2.6	0.67	0.52	0.50	0.54	0.84	0.71	0.80	0.66

Notes: [1] Area within 500 feet of all alternative segments, collectively. If the STB authorizes construction and operation of the rail line, that authority would only extend to a subset of the alternatives. Therefore, the acreages above do not represent a range or even maximum value of potential wetland impacts. Furthermore, the proposed ROW would be 200-feet wide and the wetland acreages presented here are for a 1,000-foot wide project area defined for wetland delineation purposes.

Table E-51
Wetlands within the Proposed Eielson and Delta Construction Staging Areas (USFWS, 2005).

NWI Code	Description	Regions (number)	Area (acres)	Wetland Proportion (percent)
PFO4/1B	Saturated needleleaf evergreen/broadleaf deciduous forest	2	5.6	30
PSS1A	Temporarily flooded broadleaf deciduous scrub/shrub	3	12.9	70
Wetland			**18.5**	
Upland			**161.5**	

Note: National Wetland Inventory (NWI) classifications for riverine habitat R5UBH and R5USC are presented as R3UBH and R3USA for consistency with ARRC wetland data (USFWS, 2005, HDR, 2007a). Regions are individual contiguous wetland areas as mapped by USFWS (2005).

Table E-52
Estimated Borrow Area Wetland Areas for 33 Borrow Areas at 2.5-Mile Intervals Along 80 miles of Rail ROW Based on the Proportional Distribution of Wetland Types Within 500 Feet of Proposed Alternatives (HDR, 2007a).

NWI Code	Definition	Estimated Area (acres)	Wetland Proportion (percent)
PFO4/SS4B	Saturated needleleaf evergreen forest with needleleaf scrub/shrub understory	18.5	10
PFO4/1B	Saturated needleleaf evergreen/broadleaf deciduous forest	1.8	1
PFO4/EM1C	Seasonally flooded needleleaf evergreen forest with persistent emergent understory	1.3	1
PFO4/SS1B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub under story	8.7	5
PFO4/SS3B	Saturated needleleaf evergreen forest with broadleaf evergreen scrub/shrub understory	7.9	4
PFO4B	Saturated needleleaf evergreen forest	24.0	13
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent understory	4.3	2
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent understory	10.2	6
PSS1/4B	Saturated broadleaf deciduous scrub-shrub\needleleaf evergreen scrub-shrub	1.1	1
PSS1B	Saturated broadleaf deciduous scrub/shrub	1.3	1
PSS1C	Seasonally flooded broadleaf deciduous scrub/shrub	2.8	2
PSS3/4B	Saturated broadleaf evergreen/needleleaf evergreen scrub/shrub	2.6	1
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous scrub/shrub	20.3	11
PSS4/1C	Seasonally flooded needleleaf evergreen/broadleaf deciduous scrub/shrub	1.8	1
PSS4/3B	Saturated needleleaf evergreen/broadleaf evergreen scrub/shrub	22.2	12

Table E-52
Estimated Borrow Area Wetland Areas for 33 Borrow Areas at 2.5-Mile Intervals Along 80 miles of Rail ROW Based on the Proportional Distribution of Wetland Types Within 500 Feet of Proposed Alternatives (HDR, 2007a). (continued)

NWI Code	Definition	Estimated Area (acres)	Wetland Proportion (percent)
PSS4/EM1C	Seasonally flooded needleleaf evergreen scrub/shrub with persistent emergent understory	1.3	1
PSS4B	Saturated needleleaf evergreen scrub/shrub	22.4	12
PEM1C	Seasonally flooded persistent emergent	2.6	1
PEM1F	Semipermanently flooded persistent emergent	1.5	1
PUBHx	Excavated pond –unconsolidated bottom	1.7	1
R3UBH	Upper perennial stream – unconsolidated bottom	11.1	6
R3USA	Temporarily flooded upper perennial stream – unconsolidated shore	12.9	7
U/R3USA	Mosaic of upland and temporarily flooded upper perennial stream – unconsolidated shore	2.6	1
Upland		**375.2***	
Wetland		**184.9***	

Legend: National Wetland Inventory=NWI

* assumes distribution of 33 borrow areas at 2.5 mile intervals. Acreages could change based upon specific site selection.

Table E-53
Wetlands Within 200-foot ROW for the North Common Segment (HDR, 2007a).

NWI Code	Description	Regions (number)	Area (acres)	Wetland Proportion (percent)
PSS1A	Temporarily flooded broadleaf deciduous scrub/shrub	4	1.1	30
PSS1B	Saturated broadleaf deciduous scrub/shrub	1	0.9	24
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent under story	4	0.7	20
PEM1C	Seasonally flooded persistent emergent	1	0.3	7
PEM1F	Semi-permanently flooded persistent emergent	1	0.1	2
R3UBH	Upper perennial stream – unconsolidated bottom	2	0.6	16
Wetland			**3.7**	
Upland			**60.3**	

Note: Regions are individual contiguous wetland areas as mapped by HDR (2007a).
Legend: National Wetland Inventory=NWI, Right-of-Way=ROW

Table E-54
Wetlands Within 200-foot ROW for the Eielson Alternative Segments (HDR, 2007a).

		Eielson Alternative Segment 1			Eielson Alternative Segment 2			Eielson Alternative Segment 3		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO4/SS4B	Saturated needleleaf evergreen forest with needleleaf scrub/shrub under story	1	0.5	3	3	3.7	5	3	4.7	5
PFO4/1B	Saturated needleleaf evergreen/broadleaf deciduous forest	-	-	-	-	-	-	1	0.1	0
PFO4/EM1B	Saturated needleleaf evergreen forest with persistent emergent under story	-	-	-	1	1.2	2	-	-	-
PFO4/SS1B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub under story	6	5.3	32	7	12.6	18	7	15.2	15
PFO4/SS3B	Saturated needleleaf evergreen forest with broadleaf evergreen scrub/shrub under story	-	-	-	-	-	-	1	11.4	11
PFO4B	Saturated needleleaf evergreen forest	1	1.1	7	12	5.8	8	11	5.2	5
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent under story	1	0.1	0	4	7.1	10	4	7.8	8
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent under story	7	4.1	24	18	6.3	9	24	7.8	8
PSS1/EM1F	Semi-permanently flooded broadleaf deciduous scrub/shrub with persistent emergent under story	-	-	-	1	0.4	1	1	0.4	0

Table E-54
Wetlands Within 200-foot ROW for the Eielson Alternative Segments (HDR, 2007a). (continued)

		Eielson Alternative Segment 1			Eielson Alternative Segment 2			Eielson Alternative Segment 3		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PSS1/4B	Saturated broadleaf deciduous scrub-shrub\needleleaf evergreen scrub-shrub	-	-	-	-	-	-	1	0.2	0
PSS1B	Saturated broadleaf deciduous scrub/shrub	1	0.7	4	3	0.7	1	4	0.7	1
PSS1C	Seasonally flooded broadleaf deciduous scrub/shrub	1	1.3	8	3	1.7	2	1	0.2	0
PSS1F	Semi-permanently flooded broadleaf deciduous scrub/shrub	1	0.0	0	1	0.0	0	-	-	-
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous scrub/shrub	1	0.7	4	10	19.0	27	9	24.1	24
PSS4/1C	Seasonally flooded needleleaf evergreen/broadleaf deciduous scrub/shrub	-	-	-	1	0.6	1	-	-	-
PSS4/3B	Saturated needleleaf evergreen/broadleaf evergreen scrub/shrub	-	-	-	3	3.9	5	3	1.1	1
PSS4/EM1B	Saturated needleleaf evergreen scrub/shrub with persistent emergent under story	1	0.2	1	2	1.1	2	1	1.3	1
PSS4/EM1C	Seasonally flooded needleleaf evergreen scrub/shrub with persistent emergent under story	-	-	-	4	0.6	1	4	0.3	0
PSS4B	Saturated needleleaf evergreen scrub/shrub	-	-	-	8	1.7	2	7	4.7	5
PEM1B	Saturated persistent emergent	1	0.4	2	1	0.4	1	1	0.4	0

Table E-54
Wetlands Within 200-foot ROW for the Eielson Alternative Segments (HDR, 2007a). (continued)

		Eielson Alternative Segment 1			Eielson Alternative Segment 2			Eielson Alternative Segment 3		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PEM1C	Seasonally flooded persistent emergent	1	0.1	0	9	1.7	2	13	2.4	2
PEM1F	Semi-permanently flooded persistent emergent	4	1.0	6	8	1.3	2	9	3.0	3
PABH	Aquatic bed pond	-	-	-	-	-	-	1	0.0	0
PABHx	Excavated aquatic bed pond	-	-	-	-	-	-	2	0.8	1
PUBH	Pond	-	-	-	-	-	-	1	0.1	0
PUBHx	Excavated pond	1	0.1	1	-	-	-	7	6.6	7
R3UBH	Upper perennial stream – unconsolidated bottom	5	1.2	7	4	0.8	1	4	1.9	2
R3USC	Seasonally flooded upper perennial stream – unconsolidated shore	-	-	-	1	0.1	0	-	-	-
Wetland			**16.8**			**70.8**			**100.3**	
Upland			**230.9**			**171.2**			**143.2**	

Note: Regions are individual contiguous wetland areas as mapped by HDR (2007a).
Legend: National Wetland Inventory=NWI, Right-of-Way=ROW

Table E-55
Wetlands within 200-foot ROW for the Salcha Alternative Segments (HDR, 2007a).

		Salcha Alternative Segment 1			Salcha Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO4/SS4B	Saturated needleleaf evergreen forest with needleleaf scrub/shrub understory	1	1.4	2	5	10.1	9
PFO4/EM1C	Seasonally flooded needleleaf evergreen forest with persistent emergent understory	-	-	-	1	4.5	4
PFO4/SS1B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub understory	6	5.8	9	7	5.4	5
PFO4/SS3B	Saturated needleleaf evergreen forest with broadleaf evergreen scrub/shrub understory	-	-	-	1	0.0	0
PFO4B	Saturated needleleaf evergreen forest	-	-	-	9	27.3	25
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent understory	-	-	-	3	6.1	6
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent understory	4	1.1	2	8	2.3	2
PSS1A	Temporarily flooded broadleaf deciduous scrub/shrub	3	0.3	0	8	1.2	1
PSS1C	Seasonally flooded broadleaf deciduous scrub/shrub	7	1.5	2	9	9.3	8
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous scrub/shrub	4	16.9	25	2	2.1	2
PSS4/3B	Saturated needleleaf evergreen/broadleaf evergreen scrub/shrub	6	7.3	11	-	-	-
PSS4B	Saturated needleleaf evergreen scrub/shrub	5	12.4	18	8	8.1	7
PEM1C	Seasonally flooded persistent emergent	1	0.2	0	11	2.7	2
PEM1F	Semi-permanently flooded persistent emergent	-	-	-	2	0.2	0
PABH	Aquatic bed pond	-	-	-	1	0.0	0

Table E-55
Wetlands within 200-foot ROW for the Salcha Alternative Segments (HDR, 2007a). (continued)

		Salcha Alternative Segment 1			Salcha Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PUBH	Pond	-	-	-	1	0.0	0
R3UBH	Upper perennial stream – unconsolidated bottom	6	14.2	21	18	20.4	18
R3USA	Temporarily flooded upper perennial stream – unconsolidated shore	17	6.9	10	15	10.8	10
R3USC	Seasonally flooded upper perennial stream – unconsolidated shore	-	-	-	2	0.3	0
Wetland			**68.0**			**110.9**	
Upland			**215.7**			**222.1**	

Note: Regions are individual contiguous wetland areas as mapped by HDR (2007a).
Legend: National Wetland Inventory=NWI, Right-of-Way=ROW

Table E-56
Wetlands within the Salcha Alternative Segments 1 and 2 bridge staging areas, levees, riprap areas, gravel extraction sites, access roads, and highway relocations (USFWS, 2005).

		Salcha Alternative Segment 1			Salcha Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1A	Temporarily flooded broadleaf deciduous forest	-	-	-	6	11.2	7%
PFO4B	Saturated needleleaf evergreen forest	1	25.0	22%	-	-	-
PSS1A	Temporarily flooded broadleaf deciduous scrub/shrub	2	17.3	16%	6	11.5	8%
PSS1B	Saturated broadleaf evergreen scrub/shrub	-	-	-	1	1.5	1%
PSS4B	Saturated needleleaf evergreen scrub/shrub	-	-	-	1	<0.1	0%
PSS1/EM1C	Temporarily flooded broadleaf deciduous scrub/shrub/ Seasonally flooded persistent emergent	-	-	-	9	21.2	14%
PSS4/2B	Saturated needleleaf evergreen/needleleaf deciduous scrub/shrub	-	-	-	1	53.0	35%
PSS4/3B	Saturated needleleaf evergreen/broadleaf evergreen scrub/shrub	-	-	-	1	3.8	3%

Table E-56
Wetlands within the Salcha Alternative Segments 1 and 2 bridge staging areas, levees, riprap areas, gravel extraction sites, access roads, and highway relocations (USFWS, 2005). (continued)

		Salcha Alternative Segment 1			Salcha Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
R3UBH	Upper perennial stream – unconsolidated bottom	7	38.5	34%	13	48.1	32%
R3USA	Temporarily flooded upper perennial stream – unconsolidated shore	23	24.7	22%	-	-	-
R3USC	Seasonally flooded upper perennial stream – unconsolidated shore	1	6.4	6%	17	1.1	1%
Wetland			**111.9**			**151.4**	
Upland			**137.7**			**155.7**	

Note: NWI classifications for riverine habitat R5UBH and R5USC are presented as R3UBH and R3USA for consistency with ARRC wetland data (USFWS 2005, HDR 2007a). Regions are individual contiguous wetland areas as mapped by USFWS (2005).
Legend: National Wetland Inventory=NWI

Table E-57
Wetlands within 200-foot ROW for the Central Alternative Segments (HDR, 2007a).

		Central Alternative Segment 1			Central Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO4/EM1C	Seasonally flooded needleleaf evergreen forest with persistent emergent understory	2	0.1	0	-	-	-
PFO4/SS1B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub understory	7	3.1	6	-	-	-
PFO4/SS1C	Seasonally flooded needleleaf evergreen forest with broadleaf deciduous scrub/shrub understory	1	0.2	0	-	-	-
PFO4/SS3B	Saturated needleleaf evergreen forest with broadleaf evergreen scrub/shrub understory	2	4.1	8	-	-	-
PFO4B	Saturated needleleaf evergreen forest	17	15	29	-	-	-
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent understory	9	3.0	6	-	-	-
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent understory	11	13.2	26	4	3.3	51
PSS1/EM1F	Semipermanently flooded broadleaf deciduous scrub/shrub with persistent emergent understory	2	1.5	3	1	0.4	6
PSS1/4B	Saturated broadleaf deciduous/needleleaf evergreen scrub/shrub	6	3.8	7	-	-	-
PSS1/4C	Seasonally flooded broadleaf deciduous/needleleaf evergreen scrub/shrub	1	0.0	0	-	-	-
PSS1B	Saturated broadleaf deciduous scrub/shrub	1	0.1	0	-	-	-
PSS4/EM1B	Saturated needleleaf evergreen scrub/shrub with persistent emergent understory	1	0.5	1	-	-	-
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous scrub/shrub	7	2.1	4	3	2.8	43
PSS4B	Saturated needleleaf evergreen scrub/shrub	2	0.1	0	1	0.0	0

Table E-57
Wetlands within 200-foot ROW for the Central Alternative Segments (HDR, 2007a). (continued)

		Central Alternative Segment 1			Central Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PEM1B	Saturated persistent emergent	5	1.6	3	-	-	-
PEM1C	Seasonally flooded persistent emergent	7	0.8	2	-	-	-
PEM1F	Semi-permanently flooded persistent emergent	8	1.8	4	-	-	-
R3UBH	Upper perennial stream – unconsolidated bottom	1	0.2	0	-	-	-
Wetland			**51.1**			**6.5**	
Upland			**71.5**			**80.5**	

Note: Regions are individual contiguous wetland areas as mapped by HDR (2007a).
Legend: National Wetland Inventory=NWI, Right-of-Way=ROW

Table E-58
Wetlands within 200-foot ROW for the Connector Segments (HDR, 2007a).

		Connector A			Connector B			Connector C			Connector D			Connector E		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1/EM1C	Seasonally flooded broadleaf deciduous forest with persistent emergent understory	1	0.1	0	-	-	-	-	-	-	-	-	-	-	-	-
PFO1/SS4B	Saturated broadleaf deciduous forest with needleleaf evergreen scrub/shrub understory	2	4.9	9	-	-	-	1	1.9	7	-	-	-	2	0.8	22
PFO1/SS4C	Seasonally flooded broadleaf deciduous forest with needleleaf evergreen scrub/shrub understory	-	-	-	-	-	-	1	0.0	0	-	-	-	-	-	-
PFO2/SS1B	Saturated needleleaf deciduous forest with broadleaf deciduous scrub/shrub understory	1	1.5	3	-	-	-	-	-	-	-	-	-	-	-	-
PFO4/EM1C	Seasonally flooded needleleaf evergreen forest with persistent emergent understory	4	0.4	1	-	-	-	4	0.4	1	-	-	-	-	-	-
PFO4/SS1B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub understory	5	6.3	11	1	0.3	18	-	-	-	-	-	-	-	-	-
PFO4/SS1C	Seasonally flooded needleleaf evergreen forest with broadleaf scrub/shrub understory	-	-	-	-	-	-	1	0.2	1	-	-	-	-	-	-

Table E-58
Wetlands within 200-foot ROW for the Connector Segments (HDR, 2007a). (continued)

		Connector A			Connector B			Connector C			Connector D			Connector E		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO4/SS3B	Saturated needleleaf evergreen forest with broadleaf evergreen scrub/shrub understory	5	5.3	9	-	-	-	3	2.1	8	-	-	-	-	-	-
PFO4B	Saturated needleleaf evergreen forest	13	13.5	24	-	-	-	7	5.8	22	-	-	-	-	-	-
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent understory	6	1.9	3	-	-	-	4	1.9	7	2	0.1	5	2	0.1	3
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent understory	10	12.6	22	2	0.2	11	12	6.0	23	12	1.3	47	-	-	-
PSS1/4C	Seasonally flooded broadleaf deciduous scrub-shrub\needleleaf evergreen scrub-shrub	2	2.9	5	-	-	-	2	3.5	13	-	-	-	-	-	-
PSS1C	Seasonally flooded broadleaf deciduous scrub/shrub	-	-	-	1	0.2	13	-	-	-	-	-	-	-	-	-
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous scrub/shrub	12	3.0	5	-	-	-	9	1.6	6	-	-	-	8	2.0	-
PSS4/1C	Seasonally flooded needleleaf evergreen/broadleaf deciduous scrub/shrub	1	0.0	0	-	-	-	3	0.2	1	-	-	-	-	-	0

Table E-58
Wetlands within 200-foot ROW for the Connector Segments (HDR, 2007a). (continued)

		Connector A			Connector B			Connector C			Connector D			Connector E		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PSS4/3B	Saturated needleleaf evergreen/broadleaf evergreen scrub/shrub	3	2.4	4	-	-	-	-	-	-	-	-	-	-	-	-
PSS4/EM1B	Saturated needleleaf evergreen scrub/shrub with persistent emergent understory	1	0.2	0	-	-	-	-	-	-	-	-	-	-	-	-
PEM1C	Seasonally flooded persistent emergent	4	0.8	1	2	0.2	13	15	1.1	4	9	0.2	6	2	0.3	7
PEM1F	Semi-permanently flooded persistent emergent	5	0.4	1	-	-	-	2	0.3	1	-	-	-	-	-	-
PABH	Aquatic bed pond	-	-	-	-	-	-	1	0.0	0	-	-	-	-	-	-
R3UBH	Upper perennial stream – unconsolidated bottom	2	0.2	0	3	0.5	32	7	1.4	5	9	1.2	43	1	0.4	12
R3USA	Temporarily flooded upper perennial stream – unconsolidated shore	-	-	-	2	0.2	13	-	-	-	-	-	-	-	-	-
Wetland			**56.2**			**1.6**			**26.3**			**2.9**			**3.5**	
Upland			**49.4**			**77.8**			**29.6**			**18.3**			**54.9**	

Note: NWI classifications for riverine habitat R5UBH and R5USC are presented as R3UBH and R3USA for consistency with ARRC wetland data (USFWS 2005, HDR 2007a). Regions are individual contiguous wetland areas as mapped by USFWS (2005).
Legend: National Wetland Inventory=NWI, Right-of-Way=ROW

Table E-59
Wetlands within 200-foot ROW for the Donnelly Alternative Segments (HDR, 2007a).

		Donnelly Alternative Segment 1			Donnelly Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1/EM1B	Saturated broadleaf deciduous forest with persistent emergent understory	-	-	-	2	0.1	0
PFO1/EM1C	Seasonally flooded broadleaf deciduous forest with persistent emergent understory	1	0.2	0	5	1.3	1
PFO4/SS4B	Saturated needleleaf evergreen forest with needleleaf scrub/shrub understory	15	46.4	13	9	36.3	14
PFO1/4B	Saturated broadleaf deciduous/needleleaf evergreen forest	-	-	-	2	0.1	0
PFO1/4C	Seasonally flooded broadleaf deciduous/needleleaf evergreen forest	1	0.4	0	-	-	-
PFO4/1B	Saturated needleleaf evergreen/broadleaf deciduous forest	-	-	-	8	10.6	4
PFO4/EM1B	Saturated needleleaf evergreen forest with persistent emergent understory	-	-	-	2	1.9	1
PFO4/EM1C	Seasonally flooded needleleaf evergreen forest with persistent emergent understory	1	1.2	0	6	1.9	1
PFO4/SS1B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub understory	5	8.7	2	18	13.1	5
PFO4/SS1C	Seasonally flooded needleleaf evergreen forest with broadleaf scrub/shrub understory	-	-	-	1	1.7	1
PFO4/SS3B	Saturated needleleaf evergreen forest with broadleaf evergreen scrub/shrub understory	9	27.6	8	5	12.8	5
PFO4B	Saturated needleleaf evergreen forest	24	38.5	11	57	60.0	23
PFO4C	Seasonally flooded needleleaf evergreen forest	2	0.7	0	4	0.2	0
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent understory	-	-	-	4	10.0	4
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent understory	9	2.6	1	20	5.5	2

Table E-59
Wetlands within 200-foot ROW for the Donnelly Alternative Segments (HDR, 2007a). (continued)

		Donnelly Alternative Segment 1			Donnelly Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PSS1/EM1F	Semi-permanently flooded broadleaf deciduous scrub/shrub with persistent emergent understory	-	-	-	6	1.0	0
PSS1/4B	Saturated broadleaf deciduous scrub-shrub\needleleaf evergreen scrub-shrub	-	-	-	2	6.1	2
PSS1/4C	Seasonally flooded broadleaf deciduous scrub-shrub\needleleaf evergreen scrub-shrub	-	-	-	4	2.7	1
PSS1C	Seasonally flooded broadleaf deciduous scrub/shrub	1	0.1	0	6	4.4	2
PSS1F	Semi-permanently flooded broadleaf deciduous scrub/shrub	1	0.5	0	-	-	-
PSS3/4B	Saturated broadleaf evergreen/needleleaf evergreen scrub/shrub	5	15.8	4	3	2.5	1
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous scrub/shrub	1	31.2	0	15	25.3	10
PSS4/1C	Seasonally flooded needleleaf evergreen/broadleaf deciduous scrub/shrub	-	-	-	3	3.2	1
PSS4/2B	Saturated needleleaf evergreen/needleleaf deciduous scrub/shrub	-	-	-	1	0.7	0
PSS4/3B	Saturated needleleaf evergreen/broadleaf evergreen scrub/shrub	18	100.9	28	12	27.1	11
PSS4/EM1B	Saturated needleleaf evergreen scrub/shrub with persistent emergent understory	-	-	-	1	0.1	0
PSS4/EM1C	Seasonally flooded needleleaf evergreen scrub/shrub with persistent emergent understory	8	2.9	1	1	0.0	0
PSS4B	Saturated needleleaf evergreen scrub/shrub	27	84.5	24	18	8.3	3
PSS4C	Seasonally flooded needleleaf evergreen scrub/shrub	-	-	-	1	0.3	0
PEM1B	Saturated persistent emergent	-	-	-	1	0.1	0
PEM1C	Seasonally flooded persistent emergent	6	1.9	1	13	2.2	1

Table E-59
Wetlands within 200-foot ROW for the Donnelly Alternative Segments (HDR, 2007a). (continued)

		Donnelly Alternative Segment 1			Donnelly Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PEM1F	Semi-permanently flooded persistent emergent	2	0.2	0	8	1.9	1
PABH	Aquatic bed pond	1	0.2	0			
R3UBH	Upper perennial stream – unconsolidated bottom	9	2.4	1	8	2.9	1
R3USA	Temporarily flooded upper perennial stream – unconsolidated shore	23	13.9	4	9	12.5	5
U/R3USA	Mosaic of upland and temporarily flooded upper perennial stream – unconsolidated shore	4	5.0	1	-	-	-
Wetland			**356.1**			**257.0**	
Upland			**264.8**			**373.3**	

Regions are individual contiguous wetland areas as mapped by HDR (2007a).
Legend: National Wetland Inventory=NWI, Right-of-Way=ROW

Table E-60
Wetlands within the Donnelly Alternative Segment 1 and Donnelly Alternative Segment 2 Little Delta River and Delta Creek large bridge staging areas and gravel sites (USFWS, 2005).

		Donnelly Alternative Segment 1			Donnelly Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1A	Seasonally flooded broadleaf deciduous forest	1	2.1	5%	1	4.0	9%
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent understory	1	5.1	13%	1	1.7	4%
R3UBH	Upper perennial stream – unconsolidated bottom	2	14.2	34%	3	6.2	13%
R3USA	Temporarily flooded upper perennial stream – unconsolidated shore	5	19.5	48%	3	33.6	74%
Wetland			**40.9**			**45.5**	
Upland			**21.8**			**17.1**	

Note: NWI classifications for riverine habitat R5UBH and R5USC are presented as R3UBH and R3USA for consistency with ARRC wetland data (USFWS 2005, HDR 2007a). Regions are individual contiguous wetland areas as mapped by USFWS (2005).

Table E-61
Wetlands within 200-foot ROW for the South Common Segment (HDR 2007a).

NWI Code	Description	Regions (number)	Area (acres)	Wetland Proportion (percent)
PFO1/SS1B	Saturated broadleaf deciduous forest with broadleaf deciduous scrub/shrub under story	2	0.0	0
PFO4/SS4B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub understory	1	0.4	1
PFO1/4C	Seasonally flooded broadleaf deciduous/needleleaf evergreen forest	1	0.2	0
PFO4/SS1B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub under story	4	5.0	9
PFO4B	Saturated needleleaf evergreen forest	7	5.7	10
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent understory	2	0.9	2
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent under story	10	22.9	41
PSS1B	Saturated broadleaf deciduous scrub/shrub	1	5.9	11
PSS1C	Seasonally flooded broadleaf deciduous scrub/shrub	1	1.2	2
PSS1F	Semi-permanently flooded broadleaf deciduous scrub/shrub	1	1.8	3
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous scrub/shrub	2	3.8	7
PSS4/EM1C	Seasonally flooded needleleaf evergreen scrub/shrub with persistent emergent under story	5	1.2	2
PSS4B	Saturated needleleaf evergreen scrub/shrub	7	5.7	10
PEM1B	Saturated persistent emergent	2	0.0	0
PEM1C	Seasonally flooded persistent emergent	9	0.8	1
R3UBH	Upper perennial stream – unconsolidated bottom	4	0.3	1
Wetland			**55.8**	
Upland			**196.9**	

Regions are individual contiguous wetland areas as mapped by HDR (2007a).
Legend: National Wetland Inventory=NWI

Table E-62
Wetlands within 200-foot ROW for the Delta Alternative Segments (HDR, 2007a).

		Delta Alternative Segment 1			Delta Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO4/SS4B	Saturated needleleaf evergreen forest with needleleaf scrub/shrub under story	4	3.6	5	-	-	-
PFO4/SS1B	Saturated needleleaf evergreen forest with broadleaf scrub/shrub under story	4	0.2	0	3	0.6	2
PFO4/SS3B	Saturated needleleaf evergreen forest with broadleaf evergreen scrub/shrub under story	2	7.5	11	-	-	-
PFO4B	Saturated needleleaf evergreen forest	1	0.3	0	-	-	-
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent understory	4	0.7	1	2	1.0	3
PSS1/EM1C	Seasonally flooded broadleaf deciduous scrub/shrub with persistent emergent under story	-	-	-	8	2.5	7
PSS1/EM1F	Semi-permanently flooded broadleaf deciduous scrub/shrub with persistent emergent under story	-	-	-	2	2.1	6
PSS1/4B	Saturated broadleaf deciduous scrub-shrub\needleleaf evergreen scrub-shrub	4	0.4	1	-	-	-
PSS1B	Saturated broadleaf deciduous scrub/shrub	1	0.1	0	-	-	-
PSS1C	Seasonally flooded broadleaf deciduous scrub/shrub				2	0.7	2
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous scrub/shrub	5	31.0	45	9	7.5	21
PSS4/1C	Seasonally flooded needleleaf evergreen/broadleaf deciduous scrub/shrub	-	-	-	4	4.5	13
PSS4/EM1C	Seasonally flooded needleleaf evergreen scrub/shrub with persistent emergent under story	20	0.7	1	11	0.7	2
PEM1C	Seasonally flooded persistent emergent	4	0.1	0	5	1.1	3
PEM1F	Semi-permanently flooded persistent emergent	1	0.0	0	1	0.0	0
R3UBH	Upper perennial stream – unconsolidated bottom	4	2.3	3	1	1.4	4
R3USA	Temporarily flooded upper perennial stream – unconsolidated shore	11	12.5	18	3	13.8	38
U/R3USA	Mosaic of upland and temporarily flooded upper perennial stream – unconsolidated shore	2	10.1	15	1	0.0	0
Wetland			**69.5**			**35.9**	
Upland			**208.8**			**241.1**	

Regions are individual contiguous wetland areas as mapped by HDR (2007a).
Legend: National Wetland Inventory=NWI, Right-of-Way=ROW

Table E-63
Wetlands within the Delta Alternative Segments 1 and Delta Alternative Segment 2 large bridge staging areas, river gravel areas, overpass staging areas, access roads, and passenger terminals (USFWS, 2005).

		Delta Alternative Segment 1			Delta Alternative Segment 2		
NWI Code	**Description**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**	**Regions (number)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1A	Seasonally flooded broadleaf deciduous forest	2	2.4	9			
PFO4/1B	Saturated needleleaf evergreen/broadleaf deciduous forest				1	3.6	13
PSS1/EM1B	Saturated broadleaf deciduous scrub/shrub with persistent emergent understory	1	1.1	5	1	0.6	2
R3UBH	Upper perennial stream – unconsolidated bottom				1	1.8	19
R3USA	Temporarily flooded upper perennial stream – unconsolidated shore	3	21.9	86	1	18.1	66
Wetland			**25.4**			**24.1**	
Upland			**15.2**			**18.7**	

Note: NWI classifications for riverine habitat R5UBH and R5USC are presented as R3UBH and R3USA for consistency with ARRC wetland data (USFWS 2005, HDR 2007a). Regions are individual contiguous wetland areas as mapped by USFWS (2005).
Legend: National Wetland Inventory=NWI

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