ALASKA
PipelineProject

Draft Resource Report 10 – Rev 0
Alternatives

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TransCanada ExxonMobil

DRAFT

Notes:

Yellow highlighting is used throughout this draft resource report to highlight selected information that is pending or subject to change in the final report.

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
§	Section
AFB	Air Force Base
AMP	Alaska Mainline milepost
ANGPA	Alaska Natural Gas Pipeline Act of 2004
APP	Alaska Pipeline Project
ASAP	Alaska Stand Alone Pipeline
bscfd	billion standard cubic feet per day (standard conditions: 14.73 pounds per square inch absolute and 60º Fahrenheit)
C.F.R.	Code of Federal Regulations
CGF	Central Gas Facility
CNG	compressed natural gas
CO_2	carbon dioxide
CRFCP	Chena River Flood Control Project
DH	Dock Head
DOE	U.S. Department of Energy
EIA	U.S. Energy Information Administration
FERC	U.S. Federal Energy Regulatory Commission
FWS	U.S. Fish and Wildlife Service
GTP	Gas Treatment Plant
GWhs	gigawatt hours
LNG	liquefied natural gas
MLBV	mainline block valve
MP	Milepost
N/A	not applicable
NPC	National Petroleum Council
NSA	noise-sensitive area
NWR	National Wildlife Refuge
PBU	Prudhoe Bay Unit
PS	Pump Station
psig	pounds per square inch gauge
PT Pipeline	Point Thomson Gas Transmission Pipeline
PTU	Point Thomson Unit
Put-23	Putuligayuk-23
TAPS	Trans-Alaska Pipeline System
TBD	to be determined
VSM	vertical support members

10.0 RESOURCE REPORT 10 – ALTERNATIVES

The location information, facility descriptions, resource data, construction methods, and mitigation measures presented in this report are preliminary and subject to change. APP is conducting engineering studies, environmental resource surveys, agency consultations, and stakeholder outreach efforts to further refine and define the details of the Project.

The Project described in this resource report is being designed and developed based on estimated volumes of natural gas from projected shipper commitments. If final shipper commitments are significantly different from those estimated, the Project may be adjusted accordingly.

10.1 INTRODUCTION

TransCanada Alaska Company, LLC and Foothills Pipe Lines Ltd., working with ExxonMobil Alaska Midstream Gas Investments LLC, are developing a joint project to treat, transport, and deliver natural gas from the Alaska North Slope (ANS) to pipeline facilities in Alberta, Canada for markets in the contiguous United States and North America. This joint project is referred to as the Alaska Pipeline Project (APP or Project)[1].

As required by Title 18 Code of Federal Regulations (C.F.R.) Section (§) 380.12 and consistent with the Alaska Natural Gas Pipeline Act of 2004 (ANGPA), APP has prepared this draft resource report in support of its application to the U.S. Federal Energy Regulatory Commission (FERC) for a Certificate of Public Convenience and Necessity (CPCN) under Section 7(c) of the Natural Gas Act (NGA) to construct, own, and operate the portion of the Project in Alaska. This draft resource report pertains only to that portion of the Project in Alaska, and unless the context otherwise requires, references in this draft resource report to APP refer only to the Alaska portion of the Project[2].

As shown in Figure 1.1-1 of Resource Report 1, APP will comprise the following major components[3,4]:

- The Point Thomson Gas Transmission Pipeline (PT Pipeline)[5], consisting of approximately 58.4 miles of buried 32-inch-diameter pipeline from the Point Thomson Unit (PTU) to an APP Gas Treatment Plant (GTP) and associated facilities near Prudhoe Bay;
- The GTP, which will have the capacity to process gas received from the Point Thomson Unit and the existing Central Gas Facility (CGF) on the Prudhoe Bay Unit (PBU) in order to deliver an annual average capacity up to 4.5 billion standard cubic feet per day (bscfd)

1 Depending on the context, the term APP refers to the joint project or, collectively, to the sponsoring entities.

2 The Canadian Section refers to the portion of the Project from the Yukon border to the pipeline facilities in Alberta, Canada.

3 In previous FERC filings, the Point Thomson Gas Transmission Pipeline was referred to as Zone 1, the Gas Treatment Plant was referred to as Zone 2, and the Alaska Mainline was referred to as Zone 3 of the Alaska-Canada Pipeline.

4 As part of the Project, APP proposes to construct compressor stations, meter stations, various mainline block valves (MLBVs), pig launcher and receiver facilities, as well as associated ancillary and auxiliary infrastructure, including additional temporary workspace, access roads, helipads, construction camps, pipe storage areas, contractor yards, borrow sites, and dock modifications at Prudhoe Bay.

5 The origin of the PT Pipeline is assumed to be located at an outlet from the PTU. The final length may vary depending on the final gas development plan for the PTU.

(standard conditions: 14.73 pounds per square inch absolute and 60 degrees Fahrenheit [ºF]) of sales quality gas; and

- The Alaska Mainline, consisting of approximately 745.1 miles of 48-inch-diameter pipeline, all of which is buried except as otherwise described in this Resource Report. The Alaska Mainline extends from the GTP to the Alaska-Yukon border east of Tok, Alaska, and includes provisions for intermediate gas delivery points within Alaska.

Table 10.1-1 lists the FERC's filing requirements and additional information applicable to Resource Report 10 taken from FERC's Guidance Manual for Environmental Report Preparation:

TABLE 10.1-1

Alaska Pipeline Project
Resource Report 10 Filing Requirements Checklist

Requirement	Where Found In Document
FERC REQUIREMENTS FROM 18 C.F.R. SECTION (§) 380.12	
1. Address the "no action alternative." (§ 380.12[l][1])	Section 10.2
• Discuss the costs and benefits associated with the alternative.	
2 For large projects, address the effects of energy conservation or energy alternatives to the project. (§ 380.12[l][1])	Section 10.3
3. Identify system alternatives considered during the identification of the project and provide the rationale for rejecting each alternative. (§ 380.12[l][1])	Section 10.4
• Discuss the costs and benefits associated with each alternative.	
4. Identify major and minor route alternatives considered to avoid impact on sensitive environmental areas (e.g., wetlands, parks, or residences) and provide sufficient comparative data to justify the selection of the proposed route. (§ 380.12[l][2][ii])	Section 10.5
• For onshore projects near to offshore areas, be sure to address alternatives using offshore routings.	
5. Identify alternative sites considered for the location of major new Aboveground Facilities and provide sufficient comparative data to justify the selection of the proposed site. (§ 380.12[l][2][ii])	Section 10.6
OTHER INFORMATION OFTEN MISSING AND RESULTING IN DATA REQUESTS PER FERC'S GUIDANCE MANUAL FOR ENVIRONMENTAL REPORT PREPARATION	
• Not applicable (N/A)	N/A

Mileposts (MPs) are commonly used markers along linear projects, such as APP. Where necessary to distinguish the PT Pipeline from the Alaska Mainline, APP has prefixed its MP identifier with a PT Pipeline MP (PMP) or an Alaska Mainline MP (AMP). This convention is used in APP's application and supporting maps and alignment sheets (refer to Appendix 1O of Resource Report 1) to identify resources and features along the respective pipeline routes.

The purpose of Resource Report 10 is to describe APP's route and facility evaluation process and provide the technical rationale and justification for selection of the proposed Project. APP identified and evaluated alternatives to the proposed APP in accordance with the FERC regulations and applicable laws. These alternatives included the No Action Alternative, the energy conservation alternative, energy source alternatives, pipeline system alternatives, different configurations of the proposed facilities, major and minor route alternatives, route variations, and Aboveground Facility[6] site alternatives.

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[6] Aboveground Facilities include the GTP, eight compressor stations, three custody meter stations, various MLBVs, pig launchers, pig receivers, provisions for intermediate gas delivery points, and cathodic protection facilities as discussed in Section 1.3.2 of Resource Report 1.

Each alternative was identified and screened in the following manner: First it was examined to see whether it could meet the Project purpose and need, as described in Resource Report 1. If it could meet the Project purpose and need, it was then analyzed to determine if the alternative was technically and economically feasible and practical, considering existing technology and cost. Those alternatives meeting the Project purpose and need that also appeared technically and economically feasible and practical were then reviewed in greater environmental detail to determine whether the alternative confers a significant environmental advantage without merely transferring impacts from one area or group of people to another. Based on APP's evaluation, the proposed Project as described in Resource Report 1 offers the strongest combination of environmental sensitivity, land access consideration, engineering feasibility, and operational efficiency.

10.2 NO ACTION ALTERNATIVE

Since the discovery of oil in Prudhoe Bay in the late 1960s, there has been the recognition that the extraction and transportation of the natural gas associated with that oil is also in the national interest. It was for this reason that Congress in 1976, and again with ANGPA in 2004, adopted legislative initiatives to encourage a project such as APP.

The No Action Alternative is inconsistent with the goals of ANGPA. In 2004, Congress recognized in ANGPA that construction of a natural gas pipeline from the North Slope to major North American markets is in the national interest, as it would enhance national energy security by providing access to the abundant natural gas reserves in Alaska for meeting anticipated future domestic energy demand.

Moreover, the No Action Alternative is contrary to the objectives of the White House's 2009 New Energy for America plan, which are to promote the responsible domestic production of natural gas and to prioritize the construction of an Alaska natural gas pipeline. The No Action Alternative also is contrary to the findings of the National Petroleum Council (NPC), an advisory body that reports to the Secretary of Energy, supporting development of natural gas from the North Slope to help ensure national energy security (NPC 2003).

Under the "No Action Alternative," APP would not be certificated or constructed, and neither the benefits nor the impacts identified in these resource reports would occur.

10.3 ALTERNATIVE MEANS TO MEET THE PROJECT PURPOSE AND NEED

10.3.1 CONSERVATION

While energy conservation can play a critical role in the future of the U.S. energy sector, growth projections suggest that the demand for energy, including natural gas, will outstrip cost-effective programs designed to stimulate energy conservation. Although it is likely that continued high energy prices may result in some increase in the rate of conservation, the incremental increase would not have a material effect on the regional demand for new sources of natural gas supply, as evidenced by projections for future energy use (U.S. Energy Information Administration [EIA] 2011a).

Energy conservation is not in itself an energy source. It cannot substitute for the vast supply of clean, domestic natural gas on the North Slope that has been the subject of proposed projects to transport that energy to North American markets since the mid-1970s. To address the growing demand for natural gas by industrial, residential, and other customers, additional supply such as that provided by APP is needed along with complementary conservation efforts. Thus, while increased energy conservation may be likely, it is not considered an alternative to the proposed Project.

10.3.2 ENERGY ALTERNATIVES

In 2010, approximately 36 percent of the energy needs of the United States was met by petroleum (oil), 25 percent by natural gas, 21 percent by coal, 9 percent by nuclear power, and 8 percent by renewable energy (EIA 2011a). Table 10.3.2-1 summarizes the projected United States energy consumption by these energy sources for the years 2015 through 2035. A discussion of energy alternatives is provided in the subsections below.

TABLE 10.3.2-1

Alaska Pipeline Project
Projected U.S. Energy Consumption by Energy Source 2015 – 2035

	Energy Consumption each Year (quadrillion British thermal units)				
Energy Source	2015	2020	2025	2030	2035
Petroleum (oil)[a]	39.1	39.4	39.8	40.6	41.7
Natural Gas	25.8	26.0	25.7	26.6	27.2
Coal	19.7	20.9	22.6	23.4	24.3
Nuclear Power	8.8	9.2	9.2	9.2	9.1
Renewable Energy [b]	2.1	2.3	2.5	3.0	3.2
Total	**95.5**	**97.8**	**99.8**	**102.8**	**105.5**

[a] Includes petroleum-derived and non-petroleum fuels, such as ethanol and biodiesel, and coal-based synthetic-liquids
[b] Includes hydropower, geothermal, biomass and grid-connected electricity from landfill gas; biogenic municipal waste; wind; photovoltaic and solar thermal sources, and non-electric energy from renewable sources
Source: Energy Information Agency 2011a

10.3.2.1 Renewable Energy

Over the past decade there has been an increasing focus on renewable energy use in the United States. At the federal level, Congress passed the Energy Policy Act of 2005, which was the first major energy law enacted in more than a decade. One goal of the Energy Policy Act was to increase the role of renewable energy in the U.S. energy portfolio by providing federal tax incentives for renewable energy projects, funding research and development of renewable energy technology, compelling the passage of state permitting requirements for renewable energy, and requiring renewable fuels for automobile fuel mixes. At the state level, a number of states also have adopted renewable portfolio standards or goals as a means of reducing reliance on conventional fossil fuels. However, as discussed below, each renewable energy alternative faces its own challenges and none of them, by themselves or in combination with each other, are expected to be produced in sufficient quantities to meet the growing demand for energy in the markets that APP would serve (refer to Table 10.3.2-1).

Hydropower, or generating electricity from water stored behind dams that is then run through turbines, is expected to remain the largest source of renewable energy generation through 2035 (EIA 2011a). Environmental concerns regarding the technology and the scarcity of available new sites, however, is limiting hydropower's growth. Most feasible hydroelectric facilities have already been developed (Northwest Power and Conservation Council 2010). Existing hydropower facilities are unlikely to be expanded, and few new facilities are expected to be constructed and licensed. As a result, the development of additional hydropower resources is not a viable alternative to APP.

Geothermal resources are naturally occurring sources of heat, such as hot springs, geysers, or volcanoes that could be tapped to generate energy. The main barriers to the development of geothermal resources are the development cost associated with such projects and the lack of proximity of the geothermal potential relative to its end use. Given the physical limits of geothermal sites that have a potential for future exploitation, the lack of interest from investors in developing new potential resources and the minimal amounts of energy that geothermal resources produce, this type of renewable resource is not a feasible, or foreseeable alternative to the proposed Project.

Biomass resources can produce electricity and heat or steam from wood, wood waste, plant and animal waste, or other organic matter. Barriers to further development of biomass resources include its own adverse impacts on the environment, as well as uncertainty in biomass outputs, the high costs associated with the transportation of forest products to an energy conversion facility, and lack of private capital investment in the development of additional biomass facilities. Because of the difficulties for developing biomass resources and the relatively small amount of potential energy generation such resources could produce, biomass resources do not represent a feasible and foreseeable alternative to the proposed Project.

Solar power has not yet made provided a substantial contribution to the U.S. energy mix, and solar technologies in general remain too costly for grid-connected application (EIA 2011a). Current estimates suggest that solar power, not including off-grid photovoltaics, will have produced 6.8 gigawatt hours (GWhs) of electricity in 2011 and 17.3 GWhs by 2020 (EIA 2011a). By 2035, projections show that renewable-generated electricity will account for 14 percent of the total U.S. electricity generation (EIA 2011a). Of that percentage, solar power is expected to contribute 20.8 GWhs of electricity. Conversely, natural gas is predicted to supply 1,002 GWhs for annual consumption in 2020 and 1,288 GWhs in 2035 (EIA 2011a). Despite substantial expected growth in the development of solar power, this energy source does not presently appear to have the capacity to produce the amount of energy that is equivalent or close to the projected 4.5 bscfd (1,312.5 GWhs) capacity of APP. Thus, while solar power is expected to play an important role in future overall domestic energy production, it is appropriate to conclude that alone it is not a feasible alternative to the proposed Project.

The development of wind power has not yet grown to the extent where it can be a reliable alternative to natural gas and other fossil fuels. Some of the limiting factors affecting the growth potential of wind power include fossil fuel costs, state renewable energy programs, technology improvements, access to transmission grids, and public concerns about environmental and other impacts. Generation from wind power is expected to increase from 1.3 percent of total electricity generated in the United States in 2008, to 3.2 percent in 2030 (EIA 2011a). This is not sufficient to reliably displace other energy sources. Due to the variable nature of wind, wind turbines only generate about one-third of their maximum output capacity, on average. In addition, there are numerous barriers to development of wind farms including lack of transmission capacity, potentially adverse impacts on migratory birds and bats, noise impacts, and concerns about aesthetic impacts. Also, clustering effects at wind farms result in spikes and troughs in production that have no relation to demand, and potentially could contribute to transmission congestion. In 2010, the U.S. Department of Energy (DOE) published a report that concludes that there are substantial costs, challenges, and impacts associated with wind energy that are not likely to be overcome in the near-term, especially in light of the global financial crisis

(DOE 2011). Although wind power has the potential to contribute in some measure to the nation's future domestic energy needs, this alternative energy source continues to be confronted by challenges that have yet to be resolved. As a result of these challenges and the present state of development, it is appropriate to conclude that wind power is not a feasible alternative to the proposed Project.

The combination of renewable energy resources, as well as current technological and administrative energy conservation measures, is inadequate to offset the anticipated energy demand.

10.3.2.2 Nuclear Energy

There are currently 104 nuclear power plants operating in the United States, which generate about 20 percent of the nation's electricity (Nuclear Energy Institute 2011). Unlike most non-renewable energy sources that emit carbon dioxide (CO_2), electricity from nuclear power is relatively inexpensive to produce because nuclear plants do not emit regulated air pollutants or greenhouse gases. A 2007 study conducted by Massachusetts Institute of Technology found that nuclear energy costs approximately $0.067 per kilowatt-hour to produce, and has value in terms of reduced CO_2 emissions (World Resources Institute 2011). In spite of the relatively low energy production costs and air quality benefits of nuclear power, there have been only two new nuclear power plants approved since the mid-1980s. One of these, the Watts Bar nuclear power plant in Tennessee, began operation in 1996 and took 23 years to complete at a cost of $6.9 billion. The principal obstacles to development of new nuclear power facilities are the high costs and other environmental and regulatory factors. In particular, nuclear plants are expensive to develop due to concerns about safety and environmental impacts associated with plant accidents and the storage of radioactive wastes. These concerns have resulted in a lengthy, costly, and uncertain regulatory review and approval process that remains a formidable obstacle.

Although nuclear power technology may have progressed considerably in terms of safety, technology, and cost-benefit, the cost, uncertain regulatory framework, and lack of public support remain substantial barriers to new plant development (refer to Table 10.3.2-1). As a result of these challenges and uncertainties, nuclear power is not a viable alternative to the proposed Project.

10.3.2.3 Fossil Fuels

Oil and coal-based energy are commonly found and used throughout the United States. Natural gas, when compared to other fossil fuels such as coal or fuel oil, results in lower emissions of greenhouse gases (e.g., CO_2) and other pollutants (e.g., nitrogen oxide and sulfur dioxide) (U.S. Environmental Protection Agency 2011). Oil and coal-based energy do not provide an environmental advantage over natural gas and, therefore, were not considered as an alternative to the proposed Project (refer to Table 10.3.2-1).

Shale Gas Resources

Natural gas from shale deposits found in the contiguous United States and Canada have been known to exist in abundance for decades, but until recently, these resources have been generally inaccessible due to limitations in drilling technology and cost of recovery. Over the last decade, however, this natural gas resource has become technically recoverable and economically available (Black and Veatch 2010). As a result, the question arises whether natural gas produced from shale should be viewed as an alternative to natural gas transported by this proposed project from the North Slope.

Because the concept of "alternative" in an environmental analysis typically carries the connotation of making a choice among various options in order to select the one that is "preferred," natural gas produced from shale is not an alternative to the proposed action. Both "alternatives", the Project and producing natural gas from shale, will be essential for the long-term energy and environmental security of the nation. Selecting one over the other would pose a false choice, since both have the same benefits to consumers of this product. Over the long-term, the benefits of natural gas provide sufficient attraction to lead to the conclusion that both are necessary, and that neither is an alternative for the other.

10.4 SYSTEM ALTERNATIVES

System alternatives are alternatives to the proposed Project that would make use of other existing, modified, or proposed natural gas transmission systems to meet the stated purpose and need of the Project. A system alternative may also be a substantially different configuration of the proposed pipeline system (such as different endpoints and transportation technologies). A system alternative would make it unnecessary to construct all or part of the proposed Project, although some modifications or additions to one or more existing pipeline systems may be required to increase capacity or accommodate receipt/delivery points, or another entirely new system may need to be constructed. Such modifications or additions would result in environmental impacts, however, the impact could be less than, similar to, or greater than that associated with construction of the proposed Project. The purpose of identifying and evaluating system alternatives is to determine whether potential environmental impacts associated with the construction and operation of the proposed facilities could be avoided or reduced while still allowing the stated purpose and need of the Project to be met. In order to be a viable system alternative to the proposed Project, potential system alternatives must meet the Project purpose and need, be technically and economically viable, and provide a substantial environmental advantage over the proposed Project.

To assist in fulfilling ANGPA's intent, the proposed Alaska Mainline segment of APP will connect to the Canadian Section of the Project at the U.S.-Canada border. The location of the international border interconnect is fixed by the fact that the Project already has a certificated route in Canada and is subject to an international agreement reflecting that certificated route (refer to Figure 10.4-1). The location of this interconnect has resulted in the present routing decisions for the southern end of the Alaska Mainline.

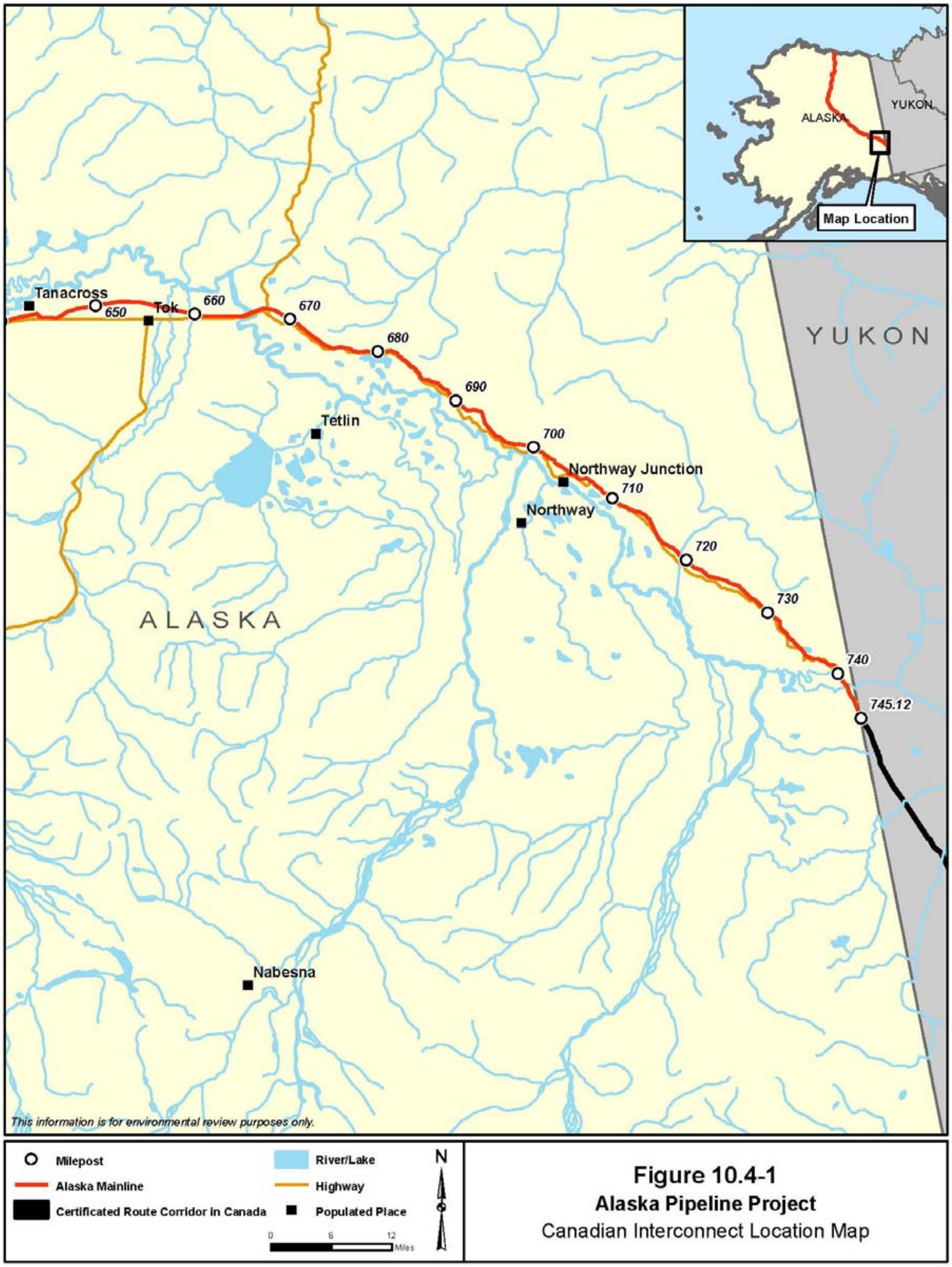

Figure 10.4-1
Alaska Pipeline Project
Canadian Interconnect Location Map

10.4.1 USE OF ALTERNATIVE NEW PIPELINE SYSTEMS

10.4.1.1 Alaska Stand Alone Pipeline System

The State of Alaska is proposing to construct a 24-inch-diameter, 737-mile-long high-pressure natural gas pipeline from the North Slope to Cook Inlet. The purpose of the Alaska Stand Alone Pipeline (ASAP) Project is to provide a long-term, stable supply of up to 500 million standard cubic feet per day of natural gas and natural gas liquids from North Slope gas fields to markets in the Fairbanks and Cook Inlet areas by 2016. North Slope natural gas would be transported to in-state Alaska markets and be accessed from off-take points for the Fairbanks Area and other locations along the route. The ASAP Project would not meet the goals of the ANGPA because it would not deliver gas to the contiguous United States. As a result, the ASAP Project is not a viable alternative to APP.

10.4.2 USE OF EXISTING PIPELINE SYSTEMS, WITH OR WITHOUT SYSTEM UPGRADING

10.4.2.1 Trans-Alaska Pipeline System Alternative

The Trans-Alaska Pipeline System (TAPS) is an 800-mile-long, 48-inch-diameter crude oil pipeline that currently transports crude oil from the North Slope to a tanker terminal in Valdez, Alaska, for shipment to United States markets.

TAPS presently has capacity to accommodate additional crude oil throughput, including crude oil produced from future offshore Beaufort and Chukchi seas (refer to additional discussion provided in Section 5.1.2.2 of Resource Report 5). The potential for future Offshore Continental Shelf and other onshore production likely complicates changing TAPS configuration in the near future. Regardless, considering TAPS as an alternative to APP raises the following issues.

- TAPS could not simultaneously transport oil and natural gas, so an alternative means of transporting oil from the North Slope would need to be developed.
- TAPS would need to be converted from a crude oil pipeline to a natural gas pipeline. This would require a detailed technical analysis to determine the feasibility of converting and certificating TAPS for gas transmission service in compliance with pipeline safety regulations. This would also likely require a reduction in the current Maximum Allowable Operating Pressure for oil service.
- The amount of natural gas transported would likely need to be reduced by approximately two-thirds from the proposed APP annual average capacity up to 4.5 bscfd. Cursory hydraulic simulations indicate a maximum gas flow capability through TAPS of approximately 1.5 bscfd due to the lower Maximum Allowable Operating Pressure after conversion to gas transmission service.

For these reasons, the option of converting TAPS for natural gas use as a portion of the Alaska Mainline was not analyzed in detail and is not considered a viable alternative.

10.4.3 DIFFERENT CONFIGURATION OF PROPOSED FACILITIES

10.4.3.1 Valdez Route Configuration

In its open season filing, APP offered shippers an alternative pipeline system that would transport natural gas from the North Slope to a proposed liquefied natural gas (LNG) facility in Valdez. The approximately 811-mile-long Valdez LNG alternative would consist of a 48-inch-diameter natural gas pipeline, a GTP, two compressor stations, three meter stations, three heater stations, launchers, receivers, mainline block valves, provisions for five intermediate in-state delivery points, and other ancillary and auxiliary facilities. The Valdez LNG alternative would follow the proposed Project route (and TAPS) to Delta Junction. At Delta Junction, the alternative would branch off the proposed Project route (which follows the Alaska Highway southeast for the remainder of its route) and continue to follow TAPS south to the Port of Valdez. The Valdez LNG alternative would have a maximum allowable operating pressure of 2,500 pounds per square inch gauge (psig), and would deliver about 3.0 bscfd to an LNG facility[7]. The LNG facility would liquefy the natural gas and load it onto oceangoing vessels for transportation to market. The LNG facility would be constructed, owned, and operated by a third-party.

The Valdez LNG alternative configuration is an option that was included in APP's initial open season in 2010 and involves ongoing discussions with potential shippers. APP is in the process of negotiating the terms and conditions of precedent agreements with shippers. Commercial discussions are confidential, including details surrounding route selection. While the determination of a route would be finalized only by the signing of precedent agreements with shippers, in order to progress the Project, APP's current work efforts are focused on the proposed Project as described in Resource Report 1.

10.4.3.2 Northern Route Configuration

Another alternative configuration for the proposed Project would be to route the proposed pipeline north from Prudhoe Bay into the Beaufort Sea, then east and south into Inuvik, Canada. A northern route such as this would bypass most of Alaska. In Section 103(d) of ANGPA, Congress prohibited the issuance of approval for the construction of any pipeline to transport natural gas from the Prudhoe Bay oil and gas lease area that follows a route that is laid beneath the navigable waters of, or adjacent to the shoreline of the Beaufort Sea, and enters Canada at any point north of 68 degrees north latitude. Any such alternative was, therefore, eliminated from consideration.

10.4.3.3 Different Pipeline Diameter and Pressure

APP evaluated alternative pipeline diameter and pressures for the proposed facilities to identify the most efficient design to move the design gas volumes. A summary of these evaluations is provided below for the PT Pipeline and Alaska Mainline, respectively.

Point Thomson Gas Transmission Pipeline

The process for determining the diameter and pressure of the PT Pipeline was based on a design that did not require use of intermediate compression. Then, APP identified the minimum pipe size that could provide the expected base flow (i.e., 1.1 bscfd) and delivery pressure to meet the GTP inlet design condition and delivery temperature specifications. The pipe size was reduced for cost and schedule reasons (e.g., smaller diameter pipe is less expensive and typically more readily available than larger pipe). In optimizing the pipe size, the acceptable delivery temperature and pressure were based on a reasonable margin so as to not encroach on the gas dew point of the expected gas composition. Based on these considerations, APP determined that a 32-inch-diameter pipeline is the optimal design size for the PT Pipeline at the lowest cost. A larger diameter pipeline (e.g. 36-inch-diameter) is more expensive to purchase (materials) and construct than the 32-inch-diameter pipeline. A smaller diameter pipeline (e.g. 24-inch-diameter) is less expensive to purchase (materials) and construct, but would require

[7] The volume considered under this alternative was the amount identified by APP based upon market information prior to the Open Season.

intermediate compression to avoid liquid drop-out in the pipeline. Alternatively, it could be designed to operate at a higher pressure requiring an increase in pressure at the PTU and thicker-walled pipe, and depending on the pressure level, either intermediate heating station(s) or a pressure regulating facility at the inlet to the GTP. Each of these options will offset much or all of the capital cost savings of the smaller pipeline and will add to long-term maintenance and operating costs. Therefore, alternative PT Pipeline sizes were eliminated from further consideration.

Alaska Mainline

The process for determining the diameter and pressure of the Alaska Mainline initially involved evaluation of the pipeline pressure that provides the optimum hydraulics for the range of gas compositions specified in the Alaska Gasline Inducement Act. Based on this analysis, APP determined that an operating pressure in the range of between 2,000 and 2,500 psig provides the highest efficiency in transporting gas (i.e., lowest compressibility factor resulting in the lowest actual volumetric flow to standard volumetric flow ratio). Using this optimum pressure range as the guideline, APP modeled various pipe size and pressure combinations to deliver the design volume of natural gas. To assist in the optimization, consideration was made for both the applicable capital and operating cost estimates of the pipeline compared to size and number of compression facilities. The facilities required for each scenario were determined using a computerized compressor station spacing routine, and economic parameters were also input into the simulation. Based on this approach, APP determined that a 48-inch-diameter pipeline operating at 2,500 psig is the optimal diameter and pressure for delivering the proposed natural gas volumes.

There was subsequent analysis comparing the 48-inch-diameter and 52-inch-diameter pipeline design platforms, but in addition to using the theoretical model, compression build-up scenarios were developed for each platform considering the entire Canadian portion of the pipeline, not just the Alaska portion. Once the facilities for the flow scenarios were established for these scenarios, costing and system capabilities were estimated with consideration of fuel requirements, line pack, and construction requirements. Based on the analyses of these criteria, the 48-inch-diameter pipeline showed a distinct advantage for delivery of the proposed gas volumes. Therefore, a 52-inch-diameter alternative pipeline size was eliminated from further consideration.

10.4.3.4 Greater Collocation with Other Rights-of-Way

During project planning, APP attempted to route its pipeline to generally follow existing transportation and pipeline rights-of-way (refer to Appendix 1C of Resource Report 1) as well as to make use of federal- and state-designated utility corridors on public land (refer to Section 8.4 of Resource Report 8). This was done to reduce the development of new corridor areas, maximize use of previously established infrastructure (e.g., roads, yards, camps), and to maximize use of the routing studies and data acquired during TAPS and in planning for a natural gas pipeline from the North Slope. Alternative offsets that are closer to the TAPS and other pipeline rights-of-way were generally evaluated; however, these were determined not to be practical due to operational considerations associated with constructing and operating the new pipelines in close proximity to the existing facilities.

APP has identified and established appropriate offsets where necessary to address select site-specific routing constraints (e.g., where avoiding rugged topography, sensitive resources, or existing infrastructure) as identified in Appendices 1C and 1I of Resource Report 1. Therefore, APP has routed its pipeline as close as practical to follow existing transportation and pipeline rights-of-way.

10.4.3.5 Aboveground Pipeline Configuration

Typically natural gas transmission pipelines are installed belowground. Burying the pipeline enhances operational security and maintainability of the system, and usually has the lowest installed life-cycle cost. The elevated sections on TAPS are to avoid pipeline integrity concerns due to thaw settlement, that would have occurred had the warm oil pipeline been buried in thaw-sensitive soils. APP will address thaw settlement concerns by chilling the gas to a temperature that is generally below freezing point. Therefore, consistent with worldwide industry standards, APP is proposing to install the Pipeline Facilities[8] as a belowground pipeline system.

An aboveground configuration of the PT Pipeline and Alaska Mainline may face significant technical challenges because of the lack of historic industry experience of developing large-diameter, high-pressure natural gas transmission pipelines with long, contiguous aboveground sections in climates as cold as Alaska's. These technical challenges would lead to a significantly increased cost to install the Pipeline Facilities aboveground relative to belowground and could impact the construction schedule. The cost of an aboveground installation has been estimated at 1.5 – 2.0 times the cost of a belowground installation.

The technical challenges of installing the Pipeline Facilities aboveground include:

- Construction: The additional materials and labor required to construct the vertical support members (VSMs), including insulation and thermo siphons add significantly to the complexity of installation and to the cost of aboveground installation.
- Materials: Pipe materials that are qualified for the low ambient temperatures that the pipeline would experience during outage conditions (-49°F versus 5°F for the proposed design) are not currently available. While pipe that would meet the low temperature mechanical property requirements for the PT Pipeline is probably achievable with modest technical developments, the large diameter, thick walled pipe that would be required for the Alaska Mainline could be a significant challenge and a potentially lengthy technology development program would be required. The outcome of such a program is uncertain and the project schedule could be impacted.
- Operations: Designing an aboveground pipeline system to be able to operate at ambient temperatures during shut-in situations would require the addition of facilities to manage cold restarts during the winter and may require additional facilities to modify the gas composition.

APP acknowledges that there are concerns with regard to reclamation and re-vegetation of the right-of way after construction of buried pipelines; however by use of carefully developed construction and reclamation practices, the right-of-way can be successfully reclaimed and re-vegetated.

APP has also considered installing the PT Pipeline aboveground collocated on the VSMs of third-party pipeline systems in development or previously constructed pipeline systems on the North Slope.

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8 The Pipeline Facilities will consist of the PT Pipeline and the Alaska Mainline, as discussed in Section 1.3.1 of Resource Report 1.

Due to VSM design requirements (such as vertical loading) for a 32-inch nominal diameter aboveground pipeline, it is likely infeasible for the PT Pipeline to be collocated on VSMs of previously constructed pipeline systems or third-party pipeline systems in development (such as the 12-inch nominal diameter Point Thomson Export Pipeline) on the North Slope.

As a result of the challenges described above, installing the PT Pipeline and the Alaska Mainline aboveground, in a similar fashion to TAPS, is not considered a feasible alternative and will not be further analyzed.

10.4.3.6 Shipping Natural Gas from the North Slope to the Contiguous United States

Trucking Compressed Natural Gas from the North Slope to Contiguous United States

For APP to truck the proposed volume of natural gas (i.e., 4.5 bscfd) from the North Slope as compressed natural gas (CNG), a facility to compress the natural gas, store the gas, and to load the trucks would need to be constructed on the North Slope, and an exceedingly large number of specialized trucks and trips per day would be required to transport the CNG. Preliminary studies show that the largest CNG tanker trailer model has a capacity of between 200,000 and 355,000 standard cubic feet of CNG at 2,400 psig. This equates to nearly 13,000 truck trips per day to deliver the same volume of gas as the proposed Project. This alternative is not feasible or practical because, in order to meet the Project purpose and need, the trucks, truck loading, and roadway facilities, as well as drivers for the trucks, would need to be available without risk of interruption 365 days per year. This is not practical considering the extended winter weather conditions and the remote nature of the North Slope. Trucking is also more vulnerable to third-party incidents; has substantial fuel requirements, costs, and air emissions; and increases the potential for safety hazards. Therefore, this alternative was eliminated from further consideration.

Shipping Liquefied Natural Gas from the North Slope to Contiguous United States

For APP to transport the proposed volume of natural gas as LNG, the GTP processing facilities would need to be expanded to increase the purity of gas for LNG purposes. In addition, an LNG plant would need to be constructed on the North Slope in order to liquefy the gas for transport. The method for transporting LNG is by ship, and LNG ships are much larger than the typical barges that currently use the West Dock docking facilities. Therefore, to transport the LNG by ships, the planned docking facilities at West Dock would need to be enlarged more than the proposed Project and the navigational channel and maneuvering area would need to be expanded to allow the larger LNG ships to safely enter and dock. Alternatively, a loading facility would need to be constructed offshore at navigable depths in the Beaufort Sea.

There are significant technical and economic risks with shipping LNG out of the North Slope due to the short duration of the open water season each summer. These risks make the viability of this option questionable. This option was not analyzed further as an alternative by the Project sponsors.

10.5 ROUTE ALTERNATIVES

Route alternatives can be divided into three categories:

- Major route alternatives;
- Minor route alternatives; and
- Route variations.

Major and minor route alternatives refer to deviations from the proposed pipeline alignment. Major route alternatives are designed to avoid sensitive features or major terrain obstacles. The end points of major route alternatives are generally the same as the corresponding segments of the proposed pipeline, however, they could have substantially different alignments. Minor route alternatives are smaller in scale and designed to address similar issues. On a smaller scale, route variations are designed to avoid or reduce impacts on specific, localized resources including wetlands, residences, archaeological sites, and terrain constraints.

Point Thomson Gas Transmission Pipeline Routing Process

To route the proposed PT Pipeline, initially a "straight line approach" was taken from the PTU to the proposed GTP, while maintaining separation between the pipeline alignment and the Beaufort Sea shoreline. The route was then aligned to generally parallel the existing Badami liquids pipeline. This adjustment provides greater avoidance of waterbody crossings. The PT Pipeline routing was finalized in fall 2009 and was used as the basis for engineering and cost estimating in support of the Project's open season. Subsequent routing revisions were made primarily to cross and stay to the south of the proposed Point Thomson Project Pipeline (liquids), improve major river crossing locations, avoid pingos (mounds of earth-covered ice found in Arctic and subarctic regions), and provide greater separation from established drill pads and production facilities. No major or minor route alternatives have been evaluated for the PT Pipeline. Four minor route variations for the PT Pipeline are identified in Section 10.5.3.

Alaska Mainline Routing Process

To route the proposed Alaska Mainline, a 2-mile-wide study corridor was established that generally follows the existing TAPS and highway corridor from Prudhoe Bay to connect to the Canadian Section of the Project at the U.S.-Canada border. The proposed route is also aligned with existing transportation corridors. As stated previously, the location of the international border interconnect is fixed by the fact that the Project already has a certificated route in Canada and is subject to an international agreement reflecting that certificated route. Therefore, the border crossing for APP serves as a static endpoint and dictates routing considerations for the southern end of the Alaska portion of the pipeline.

Installation of new pipelines along existing rights-of-way (such as other pipelines and roads) is often environmentally preferable to constructing in a new greenfield right-of-way as impacts can normally be reduced by siting within and/or adjacent to previously disturbed utility rights-of-way and roads. Additionally, existing rights-of-way typically coincide with existing infrastructure, rather than creating a new right-of-way through previously undisturbed areas. However, collocating facilities within a shared right-of-way can be operationally challenging and may not be preferred from an operations and maintenance standpoint.

After establishing a corridor that generally followed existing rights-of-way, a specific route was identified within the corridor using preliminary data from existing literature and field reconnaissance. This preliminary route was finalized in February 2009 and was used as the basis for engineering and cost estimating in support of the Project's 2010 Open Season. Since 2009, project planners and engineers have gathered additional information to further refine the route. A variety of factors were considered in refining the route, including pipeline length, land requirements, affected landowners, accessibility, constructability, and environmental impacts. The proposed Project alignment represents APP's currently preferred route, whereas the alternatives presented here represent segments of the original route that were rejected in favor of the changes. Nine minor route alternatives and 27 route variations have been evaluated for the Alaska Mainline.

10.5.1 MAJOR ROUTE ALTERNATIVES

There are no major route alternatives for the PT Pipeline.

10.5.1.1 Straight Line (Shortest Distance) Route Alternative

APP evaluated an alternative to the Alaska Mainline that would route the pipeline in a straight line directly from Prudhoe Bay (which is the production center on the North Slope) to the proposed Project delivery point at the U.S.-Canada border (refer to Figure 10.5.1-1). The Straight line Route Alternative is approximately 575 miles long, or about 170 miles shorter than the proposed Alaska Mainline, and it consequently would require less pipeline to construct and less permanent pipeline right-of-way to maintain. Following preliminary investigation, APP determined that the straight line route alternative poses noteworthy construction, environmental, and commercial challenges that make it an impractical and infeasible alternative despite its shorter length. In particular, the straight line alternative generally does not follow existing transportation corridors and is not located near existing disturbed areas. This would require APP to establish substantial new roads to get to the new pipeline corridor from the existing road system in Alaska in addition to establishing the new pipeline corridor itself. The alternative also crosses mountainous terrain (i.e., Brooks Range) and major river systems (i.e., Yukon River and Charley River) in locations that are not readily accessible and are not in proximity to other nearby developments. As a result, APP would need to develop substantial new infrastructure (e.g., borrow sources, airstrips, camps, and access roads) to support construction and operation in areas that currently have little to no existing development compared to the proposed Project.

The time that would be required to evaluate, site, design, and construct the pipeline and support infrastructure for this route alternative would be greater than the proposed Project and add substantial costs. In addition, the Straight line Route Alternative crosses approximately 105 miles of the Arctic National Wildlife Refuge (NWR), 80 miles of the Yukon Flats NWR, and 50 miles of the Yukon-Charley Rivers National Preserve, whereas none of these areas are crossed by the proposed Project. Those areas currently have little to no existing developments in the vicinity of the route alternative. APP would have to show compatibility with land management plans. Since there are no existing utility corridors in the area of the Straight line Route Alternative, it is likely that this alternative would be deemed incompatible. APP anticipates that the alternative is likely to have greater environmental impacts and is likely to result in a longer and more uncertain environmental regulatory review and approval process. In addition to these factors, the route alternative would make it more difficult to commercially deliver natural gas to Alaska residents and businesses compared to the proposed Project because the alternative route is located farther from populated areas. The advantages of a shorter route are more than offset by the disadvantages of the greenfield issues and impacts noted above. Therefore, this alternative was eliminated from further consideration.

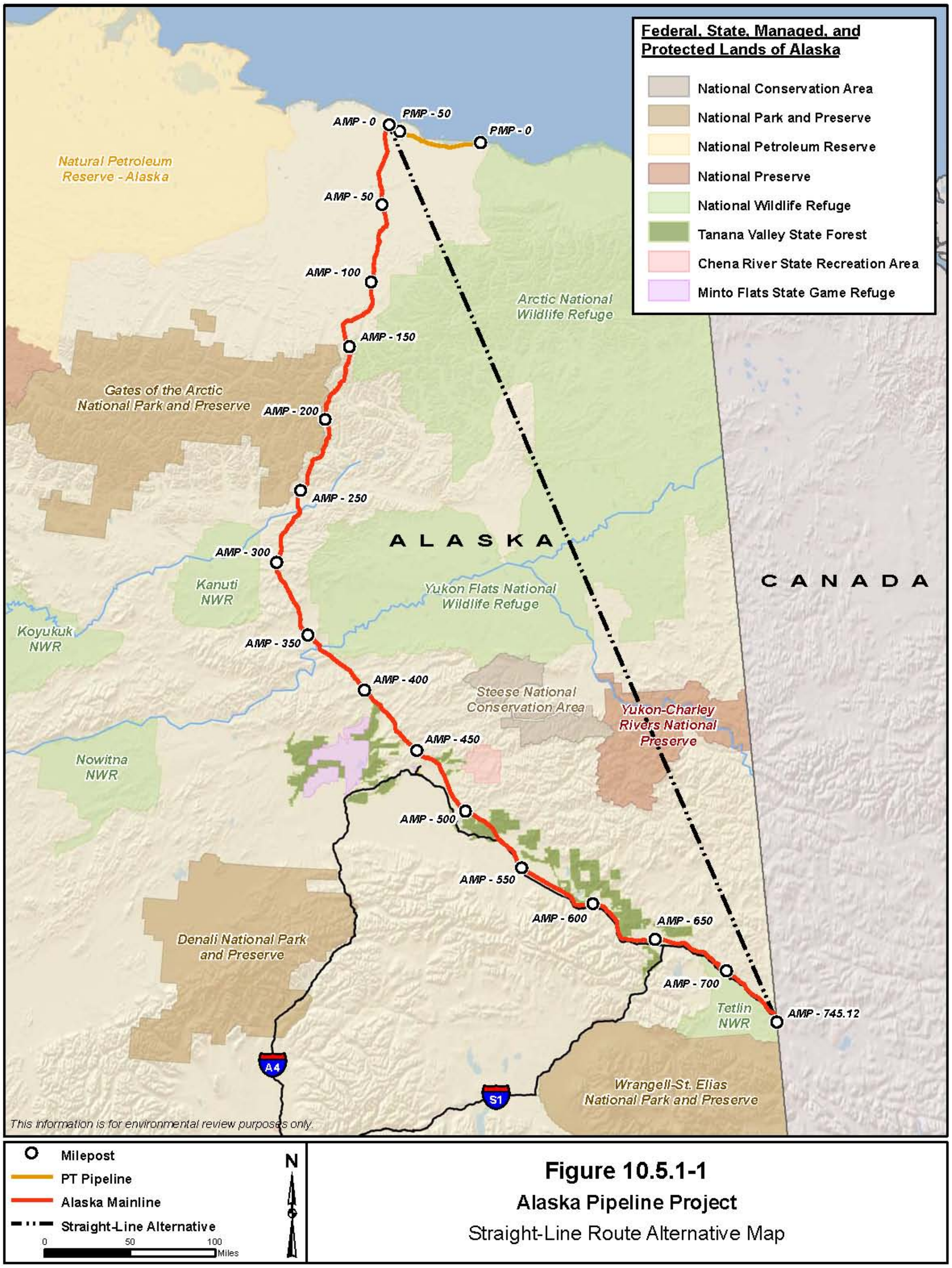

Figure 10.5.1-1
Alaska Pipeline Project
Straight-Line Route Alternative Map

10.5.2 MINOR ROUTE ALTERNATIVES

10.5.2.1 Prudhoe Bay Coastal Plain Route Alternative

The Prudhoe Bay Coastal Plain Route Alternative departs from the proposed route at AMP 5.7 and rejoins the proposed route near AMP 23.4 (refer to Figure 10.5.2-1). The proposed route follows TAPS from the beginning to the end point, whereas the route alternative follows a more irregular route along TAPS and the Dalton Highway. Both routes traverse relatively flat terrain characteristic of the North Slope, with many shallow lakes, polygonal ice wedge formations, pingos, and tundra. Table 10.5.2-1 compares the pertinent environmental features of this alternative and the corresponding segment of the proposed route.

TABLE 10.5.2-1

Alaska Pipeline Project
Comparison of the Prudhoe Bay Coastal Plain Route Alternative to the Alaska Mainline Proposed Route

Factor	Unit	Route Alternative	Proposed Route
Length of route	miles	18.3	17.7
Permanent right-of-way area	acres	222.1	215.3
Parallel to existing rights-of-way [a]	miles	4.7	17.1
TAPS/other utility crossings	no./no.	2/2	0/0
Highway and road crossings	no.	2	0
Potential blasting required [b]	miles	0	0
Active geological fault crossings	no.	0	0
Waterbody crossings	no.	4	2
Wetlands crossed	miles	16.9	17.8
Federal land affected	miles	0.0	0.0
State land affected	miles	16.9	17.7
Private land affected	no./miles	0/0.0	0/0.0

[a] Within 500 feet of the proposed centerline.
[b] For shallow bedrock or permafrost.

The primary advantage of the proposed route over this alternative is that it avoids crossing TAPS (twice), the Dalton Highway (twice), and waterbodies (twice). Also, the alternative would be approximately 0.5 mile longer and would impact more land. For these reasons, this alternative is not preferable and was eliminated from further consideration.

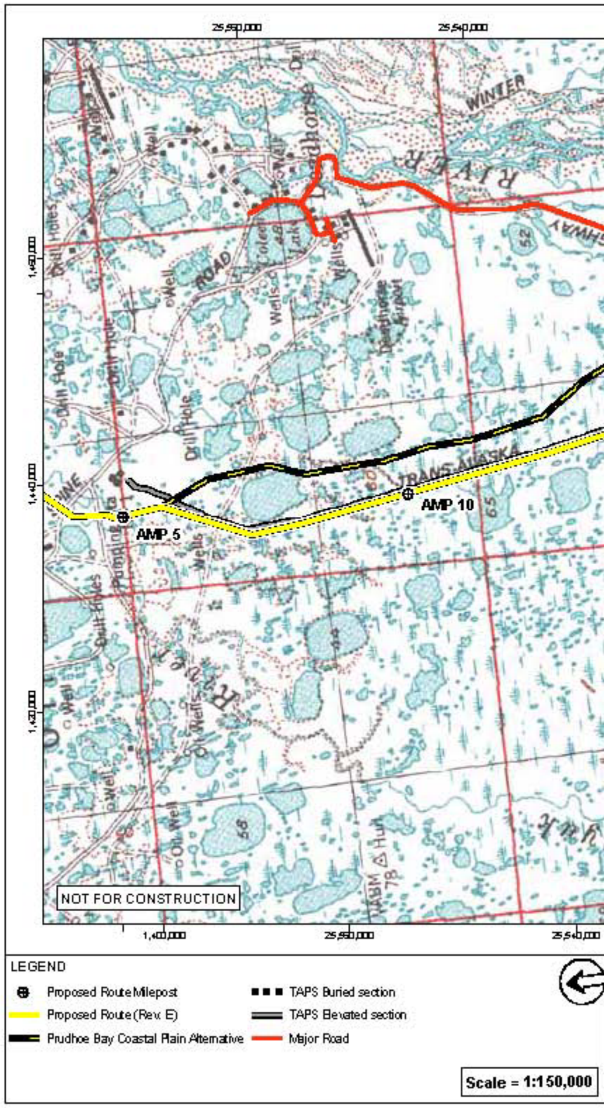

Figure 10.5.2-1
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Alaska Pipeline Project
Prudhoe Bay Coastal Plain Route Alternative

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10.5.2.2 Brooks Range Foothills (North Side) Route Alternative

The Brooks Range Foothills (North Side) Route Alternative departs from the proposed route at AMP 109.0 and rejoins the proposed route near AMP 136.1 (refer to Figure 10.5.2-2, which is filed under separate cover marked: **"CONTAINS CRITICAL ENERGY INFRASTRUCTURE INFORMATION – DO NOT RELEASE"**. This route alternative generally follows a "straight line" approach between the beginning and end points, whereas the proposed route follows a more irregular route along TAPS and the Dalton Highway. The alternative extends generally west of and parallel to TAPS and the Dalton Highway from AMP 109.0 to approximately AMP 132.0, where it and TAPS cross the Dalton Highway and extend to AMP 136.1. The alternative traverses generally flat terrain associated with a tributary of the Sagavanirktok River between approximate AMPs 109.0 and 119.5, and then crosses more rolling terrain characteristic of the Brooks Range Foothills through AMP 136.1. Table 10.5.2-2 compares the pertinent environmental features of this alternative and the corresponding segment of the proposed route.

TABLE 10.5.2-2

Alaska Pipeline Project
Comparison of the Brooks Range Foothills (North Side) Route Alternative to the Alaska Mainline Proposed Route

Factor	Unit	Route Alternative	Proposed Route
Length of route	miles	25.5	27.1
Permanent right-of-way area	acres	302.2	328.9
Parallel to existing rights-of-way [a]	miles	3.1	16.9
TAPS/other utility crossings	no./no.	0/1	2/1
Highway and road crossings	no.	4	6
Potential blasting required [b]	miles	0	0
Active geological fault crossings	no.	0	0
Waterbody crossings	no.	29	9
Wetlands crossed	miles	24.9	23.9
Federal land affected	miles	12.4	12.8
State land affected	miles	13.1	14.3
Private land affected	no./miles	0/0.0	0/0.0

[a] Within 500 feet of the proposed centerline.
[b] For shallow bedrock or permafrost.

Although the Brooks Range Foothills Route Alternative is approximately 1.6 miles shorter than the proposed route, it parallels existing rights-of-way for 13.8 fewer miles. In addition, this alternative deviates up to 0.7 mile from TAPS, and up to 1.6 miles away from the Dalton Highway, whereas the proposed route is more closely aligned with TAPS and the Dalton Highway. Aligning the proposed pipeline with the existing corridors, where practical, reduces new disturbance and provides better access to the Project area[9] during construction and operation. This alternative avoids two crossings of TAPS and has two fewer road crossings than the proposed route. Additionally the Brooks Range Foothills Route Alternative crosses 20 waterbodies that are not crossed by the proposed route and would cross slightly more wetlands. Therefore, this alternative is not preferable and was eliminated from further consideration.

[9] The terms "Project area" and "Project footprint" are defined to include the project facilities and land requirements for construction and operation. The term "Project vicinity" is used to mean the area or region near or surrounding the Project area, and is subject to the context in which the term is used.

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Alaska Pipeline Project
Figure 10.5.2-2
Brooks Range Foothills (North Side) Route Alternative

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10.5.2.3 Atigun Pass Route Alternative

The Atigun Pass Route Alternative departs from the proposed route at AMP 165.4 and rejoins the proposed route near AMP 174.5 (refer to Figure 10.5.2-3, which is filed under separate cover marked **"CONTAINS CRITICAL ENERGY INFRASTRUCTURE INFORMATION – DO NOT RELEASE"**). The route alternative was considered due to its proximity to the highway on both sides of the continental divide where it was located on the high (mountain) side of the highway in or adjacent to the highway ditch. The proposed route and the Atigun Pass Route Alternative each traverse mountainous terrain with significant cross- and longitudinal-slopes within the Atigun River Valley. This alternative follows a slightly straighter alignment at certain points along the route, whereas the proposed route follows a more irregular route along TAPS and the Dalton Highway. Table 10.5.2-3 compares the pertinent environmental features of this alternative and the corresponding segment of the proposed route.

TABLE 10.5.2-3

Alaska Pipeline Project
Comparison of the Atigun Pass Route Alternative to the Alaska Mainline Proposed Route

Factor	Unit	Route Alternative	Proposed Route
Length of route	miles	9.2	9.1
Permanent right-of-way area	acres	111.27	109.94
Parallel to existing rights-of-way [a]	miles	8.8	7.9
TAPS/other utility crossings	no./no.	1/0	3/0
Highway and road crossings	no.	3	4
Active geological fault crossings	no.	0	0
Waterbody crossings	no.	9	12
Wetlands crossed	miles	3.4	3.4
Federal land affected	miles	6.1	6.4
State land affected	miles	3.0	2.7
Private land affected	no./miles	0/0.0	0/0.0

[a] Within 500 feet of the proposed centerline.

This route alternative is approximately the same length (0.1 mile longer) and parallels approximately equal portions of existing rights-of-way as the proposed route. The principal advantage of this route alternative is that it avoids two crossings of TAPS and crosses three fewer waterbodies. However, field reconnaissance has determined that the Atigun Pass Route Alternative is not feasible from a design and construction perspective between approximate AMPs 171.3 and 174.5 due to steep slopes and constraints associated with other existing utilities (i.e., TAPS, Dalton Highway, fiber optic line). For these reasons, this alternative was eliminated from further consideration.

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Alaska Pipeline Project
Figure 10.5.2-3
Atigun Pass Route Alternative

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10.5.2.4 Yukon River Route Alternative

The Yukon River Route Alternative departs from the proposed route at AMP 355.0 and rejoins the proposed route near AMP 375.1 (refer to Figure 10.5.2-4, which is filed under separate cover marked **"CONTAINS CRITICAL ENERGY INFRASTRUCTURE INFORMATION – DO NOT RELEASE"**) and was considered as another option for crossing the Yukon River. This alternative deviates substantially from the proposed route, which generally follows TAPS and the Dalton Highway, and follows the Dalton Highway until it reaches the Yukon River. At the Yukon River, this alternative follows the river east for approximately 2.8 miles, at which point it turns southeast to cross the Yukon River. After crossing the river, the route alternative follows a generally straight course southeast for approximately 11.8 miles to realign with the proposed route. This alternative traverses relatively flat terrain north of, and hilly terrain south of, the Yukon River. Table 10.5.2-4 compares the pertinent environmental features of this alternative and the corresponding segment of the proposed route.

TABLE 10.5.2-4

Alaska Pipeline Project
Comparison of the Yukon River Route Alternative to the Alaska Mainline Proposed Route

Factor	Unit	Route Alternative	Proposed Route
Length of route	miles	19.7	20.1
Permanent right-of-way area	acres	239.5	243.2
Parallel to existing rights-of-way [a]	miles	3.7	9.5
TAPS/other utility crossings	no./no.	2/0	2/0
Highway and road crossings	no.	3	5
Waterbody crossings	no.	11	9
Wetlands crossed	miles	15.9	11.8
Federal land affected	miles	5.3	2.0
State land affected	miles	12.7	17.6
Private land affected	no./miles	4/1.7	1/0.5

[a] Within 500 feet of the proposed centerline.

This route alternative is approximately 0.4 miles shorter and has two fewer road crossings, however, it parallels existing rights-of-way for 5.8 fewer miles, crosses two more waterbodies and 4.1 more miles of wetlands. This route alternative deviates up to 3.5 miles away from TAPS and up to 2.5 miles away from the Dalton Highway, whereas the proposed route is more closely aligned with TAPS and the Dalton Highway. Aligning the proposed pipeline with the existing corridors, where practical, reduces new disturbance and provides better access to the Project area during construction and operation. For these reasons, this alternative is not preferable and was eliminated from further consideration.

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Alaska Pipeline Project
Figure 10.5.2-4
Yukon River Route Alternative

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10.5.2.5 Fairbanks Bypass Route Alternative

The Fairbanks Bypass Route Alternative departs from the proposed route at AMP 462.5 and rejoins the proposed route near AMP 484.3 (refer to Figure 10.5.2-5, which is filed under separate cover marked **"CONTAINS CRITICAL ENERGY INFRASTRUCTURE INFORMATION – DO NOT RELEASE"**). The route alternative was considered because the terrain along the route alternative is relatively flat, the route does not deviate as far to the east before turning to the south, and it shifts back to parallel TAPS as soon as practical at the south-end when entering the Eielson Air Force Base (AFB). The route alternative is approximately 22.0 miles long and follows a slightly more irregular route between the beginning and end points than does the proposed route. Both routes traverse various waterbodies and relatively flat terrain, with the proposed route encountering slightly more rolling terrain than the route alternative. Table 10.5.2-5 compares the pertinent environmental features of this alternative and the corresponding segment of the proposed route.

TABLE 10.5.2-5

Alaska Pipeline Project
Comparison of the Fairbanks Bypass Route Alternative to the Alaska Mainline Proposed Route

Factor	Unit	Route Alternative	Proposed Route
Length of route	miles	22.0	21.8
Permanent right-of-way area	acres	266.8	264.9
Parallel to existing rights-of-way [a]	miles	1.1	0.2
TAPS/other utility crossings	no./no.	0/0	0/0
Highway and road crossings	no.	7	4
Waterbody crossings	no.	8	13
Wetlands crossed	miles	21.3	14.8
Federal land affected	miles	5.3	9.1
State land affected	miles	11.4	8.8
Local land affected	miles	1.4	1.6
Private land affected	no./miles	16/3.9	7/2.3

[a] Within 500 feet of the proposed centerline.

This route alternative is approximately the same length (0.2-mile longer) and would impact a similar amount of land as the proposed route, and has a slightly greater amount (0.9 mile) of its route that is parallel to existing rights-of-way. It also crosses five fewer waterbodies. However, this alternative crosses approximately 6.5 miles more of wetlands and three more roadways. The principal disadvantage of this route alternative is that it involves crossing the residential development near Chena Hot Springs Road. For these reasons, this alternative is not preferable and was eliminated from further consideration.

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Alaska Pipeline Project
Figure 10.5.2-5
Fairbanks Bypass Route Alternative

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10.5.2.6 Eielson Air Force Base Alternatives

APP evaluated alternatives to avoid crossing Eielson AFB including routes to the east and west. Eielson AFB is bordered to the north and east by the Fort Wainwright Maneuver Area (Maneuver Area) and the Chena River Flood Control Project (CRFCP). The Maneuver Area extends about 5 miles to the north and over 20 miles to the east of Eielson AFB. The CRFCP extends about 8 miles to the northeast of Eielson AFB. Eielson AFB is bordered to the west by developed residential/commercial areas that are wedged into a relatively narrow strip of land between the Tatalina River and the Eielson AFB. To the west of the Tanana River is Fort Wainwright, another military facility (refer to Figure 10.5.2-6, which is filed under separate cover marked **"CONTAINS CRITICAL ENERGY INFRASTRUCTURE INFORMATION – DO NOT RELEASE"**). [Note: The locations of rangelands within Eielson AFB are being verified APP and will be updated in the final report.]

In order to avoid Eielson AFB to the north and east, APP identified two routes including one designated as Alternative A that passes just east of Eielson AFB, passing through the Maneuver Area and the CRFCP. Alternative A is depicted on Figure 10.5.2-6 and in Appendix 10A. This alternative would enter a military restricted area, and thus was eliminated from further consideration.

The other route, designated as Alternative B, passes to the north and east sides of the Maneuver Area and the CRFCP (refer to Figure 10.5.2-6). Conceptually, this is a feasible alternative, however, it would be substantially longer than the proposed route and subsequently result in more ground disturbance, tree clearing, stream crossings, landowner impacts (including potential conflicts with other proposed land developments), and potentially other sensitive-resource impacts than the proposed route. This alternative was eliminated from further consideration as it would include routing along or near the Fairbanks-Chena Hot Springs Trail for about 5 miles, a new crossing of Chena River State Recreation Area, and potentially routing through or near commercial and residential developments east of Fairbanks.

In order to avoid Eielson AFB on the west side, APP identified a route, designated as Alternative C, that would cross developed areas and sensitive water resources that are not crossed by the proposed route (refer to Figure 10.5.2-6). The commercial and residential developed areas are immediately south of the town of North Pole and may require a change in the pipe class location and increase the length of high consequence areas crossed by the Project. In addition, Alternative C also adds two crossings of the Richardson Highway and crosses wetland areas and oxbow lakes associated with the Tanana River floodplain. This alternate was eliminated from further consideration because of the proximity to developed commercial and residential areas, crossings of sensitive water resources, and two additional crossings of a major highway.

In addition to these alternates, smaller reroutes are being considered based on consultation with Eielson AFB. APP has met with representatives of Eielson AFB on several occasions, most recently on August 3, 2011, (refer to Appendix 1L of Resource Report 1), to discuss routing through their facility site, and APP is evaluating site-specific information provided by Eielson AFB in order to finalize routing through this area. These reroutes would be expected to have minimal impact on total route length. [Note: Because this alternative is in early evaluation stage, APP will update this information in the final report]

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Alaska Pipeline Project
Figure 10.5.2-6
Eielson Air Force Base Route Alternative

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10.5.2.7 Delta Junction Route Alternative

The Delta Junction Route Alternative departs from the proposed route at AMP 539.1 and rejoins the proposed route near AMP 566.2 (refer to Figure 10.5.2-7, which is filed under separate cover marked **"CONTAINS CRITICAL ENERGY INFRASTRUCTURE INFORMATION – DO NOT RELEASE"**). This route alternative was considered mainly because it took a straight line approach through farmland and property on the east side of Delta Junction. The route alternative is approximately 26.2 miles long and generally parallels the proposed route on its northeast side. Both routes traverse a number of creeks and relatively flat terrain. Table 10.5.2-6 compares the pertinent environmental features of this alternative and the corresponding segment of the proposed route.

TABLE 10.5.2-6

Alaska Pipeline Project
Comparison of the Delta Junction Route Alternative to the Alaska Mainline Proposed Route

Factor	Unit	Route Alternative	Proposed Route
Length of route	miles	26.2	26.9
Permanent right-of-way area	acres	314.2	327.9
Parallel to existing rights-of-way [a]	miles	1.1	3.4
TAPS/other utility crossings	no./no.	0/0	0/0
Highway and road crossings	no.	14	15
Potential blasting required [b]	miles	0	0
Active geological fault crossings	no.	0	0
Waterbody crossings	no.	5	7
Wetlands crossed	miles	25.3	4.5
Federal land affected	miles	0.0	0.3
State land affected	miles	1.3	8.3
Local land affected	miles	0.0	0.2
Private land affected	no./miles	58/24.9	56/18.1

[a] Within 500 feet of the proposed centerline.
[b] For shallow bedrock or permafrost.

The proposed route appears to have an environmental advantage over the route alternative. The alternative route involves crossing multiple parcels of farmland, a developed residential subdivision, substantially more wetlands, and strays from existing linear corridors more than the proposed route. For these reasons, this alternative is not preferable and was eliminated from further consideration.

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Alaska Pipeline Project
Figure 10.5.2-7
Delta Junction Route Alternative

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10.5.2.8 Tetlin Ridge Route Alternative

The Tetlin Ridge Route Alternative departs from the proposed route at AMP 681.2 and rejoins the proposed route near AMP 721.9 (refer to Figure 10.5.2-8). The route alternative is approximately 40.5 miles long and generally parallels the proposed route on its northeast side. Table 10.5.2-7 compares the pertinent environmental features of this alternative and the corresponding segment of the proposed route.

TABLE 10.5.2-7

Alaska Pipeline Project
Comparison of the Tetlin Ridge Route Alternative to the Alaska Mainline Proposed Route

Factor	Unit	Route Alternative	Proposed Route
Length of route	miles	40.5	40.7
Permanent right-of-way area	acres	490.3	493.2
Parallel to existing rights-of-way [a]	miles	0	16.3
TAPS/other utility crossings	no./no.	0	1
Highway and road crossings	no.	0	2
Waterbody crossings	no.	9	20
Wetlands crossed	miles/miles	18.6	12.1
Recreation or designated uses [c]	miles	1 (trail)	1 (trail)
Residences/Structure [d]	no.	0	1
Federal land affected	miles	7.5	0.2
State land affected	miles	15.3	5.9
Private land affected	no./miles	23/17.7	67/34.5

[a] Within 500 feet of the proposed centerline.

The Tetlin Ridge Route Alternative was considered mainly because it avoids two crossings of the Alaska Highway and also avoids side hill topography along the Alaska Highway near the Tetlin NWR and avoids routing the pipeline on small tract private lands.

[Note: APP has not completed its alternative route review of the Tetlin Ridge Route Alternative and will further summarize its findings as appropriate in the final report once this analysis is more complete.]

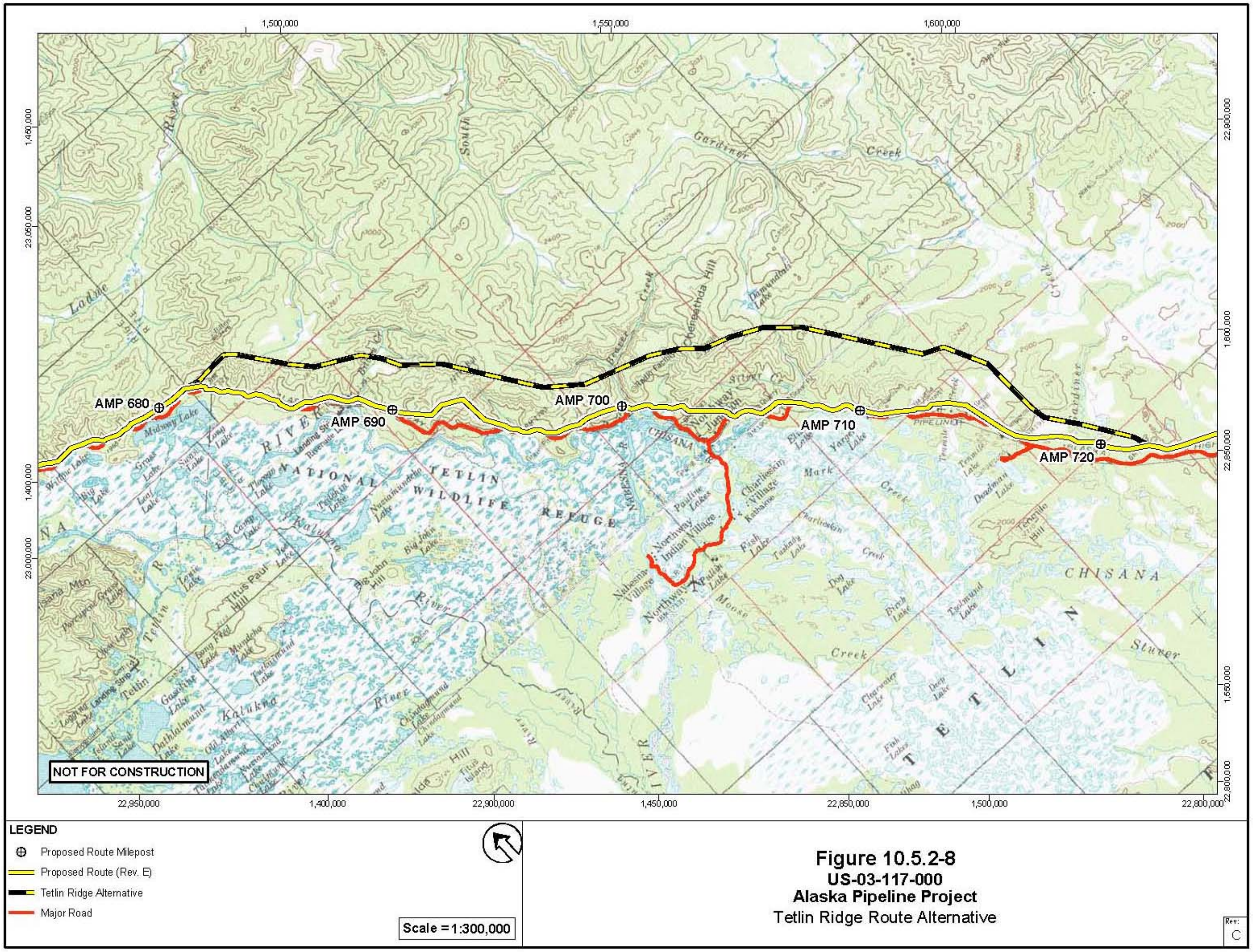

Figure 10.5.2-8
US-03-117-000
Alaska Pipeline Project
Tetlin Ridge Route Alternative

Rev: C

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10.5.2.9 Upper Tanana Route Alternative

The Upper Tanana Route Alternative departs from the proposed route at AMP 603.8 and rejoins the proposed route near AMP 724.7 (refer to Figure 10.5.2-9). The route alternative is approximately 117.9 miles long and generally parallels the proposed route on its southwest and northeast side. Table 10.5.2-8 compares the pertinent environmental features of this alternative and the corresponding segment of the proposed route.

TABLE 10.5.2-8

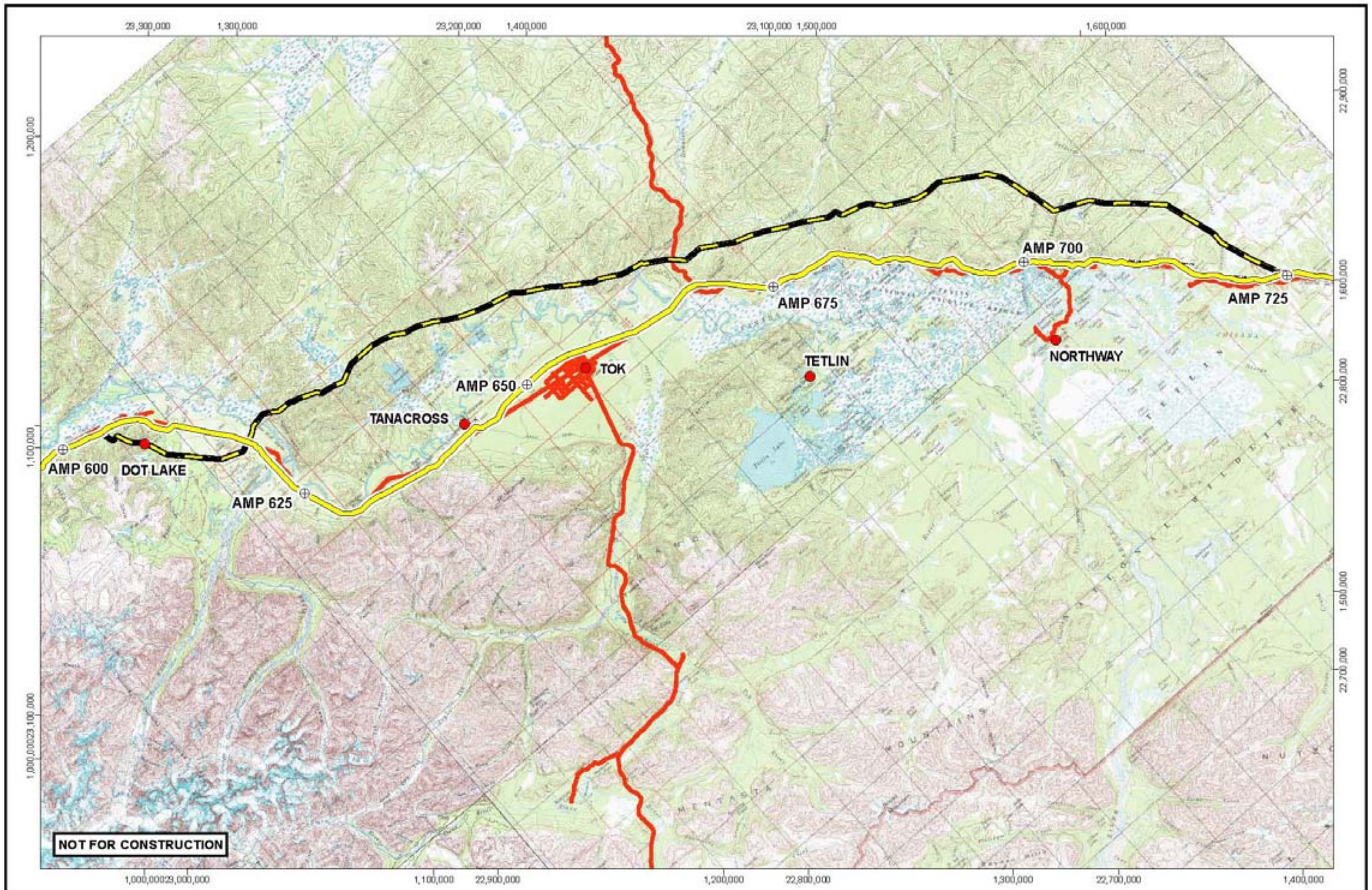
Alaska Pipeline Project
Comparison of the Upper Tanana Route Alternative to the Alaska Mainline Proposed Route

Factor	Unit	Route Alternative	Proposed Route
Length of route	miles	117.9	120.9
Permanent right-of-way area	acres	1,429.0	1,465.6
Parallel to existing rights-of-way [a]	miles	0	44.8
TAPS/other utility crossings	no./no.	0	1
Highway and road crossings	no.	2	16
Waterbody crossings	no.	43	50
Wetland crossings	miles	TBD	TBD
Federal land affected	miles	3.8	0.2
State land affected	miles	109.4	32.1
Private land affected	no./miles	6/4.1	140 / 88.6

[a] Within 500 feet of the proposed centerline.

The Upper Tanana Route Alternative was considered mainly because it avoids side hill topography along the Alaska Highway near the Tetlin NWR and maximizes routing of the pipeline on public land avoiding most private land.

[Note: APP has not completed its alternative route review of the Upper Tanana Route Alternative and will further summarize its findings as appropriate in the final report once this alternative analysis is more complete.]



LEGEND

- Proposed Route Milepost
- City/Town
- Proposed Route (Rev. E)
- Upper Tanana Alternative
- Major Road

Scale = 1:750,000

Figure 10.5.2-9
US-03-116-000
Alaska Pipeline Project
Upper Tanana Route Alternative

Rev: E

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10.5.3 ROUTE VARIATIONS

Route variations differ from route alternatives in that they are typically shorter in length and do not deviate as far from the proposed route as route alternatives, and they are identified to resolve or reduce construction impacts on localized specific resources, such as cultural resource sites, wetlands, recreational lands, residences, and terrain conditions. Because route variations are identified in response to specific local concerns or engineering constraints, they may not always clearly display an environmental advantage other than reducing or avoiding impacts on specific features. Table 10.5.3-1 summarizes the route variations and the figures provided in Appendix 10A depict route variations identified by project planners and engineers as they refined the proposed route and that may still be under consideration for future route refinement. The currently proposed route, therefore, represents APP's preliminary preferred route. The variations summarized in Table 10.5.3-1 represent segments of the original route that were rejected in favor of the proposed route. In select cases, variations are still under consideration for the final route.

TABLE 10.5.3-1

Alaska Pipeline Project
Comparison of the Route Variations to the Proposed Route

Route Variation Name	Milepost Begin [a]	Milepost End [a]	Difference in Length	Distance From Proposed Route (feet)	Reason for Rejection/Consideration
POINT THOMSON GAS TRANSMISSION PIPELINE					
North Slope Borough					
Foggy Island Bay	36.9	38.7	(0.1)	650	More waterbody crossings; impacts two pingos
Sagavanirktok River	43.8	48.3	0.1	350	Close to two deep lakes
Prudhoe Bay	50.4	55.5	(0.4)	3,200	Impacts closely spaced drill pads and other utilities
Putuligayuk River/GTP Tie-in	57.2	58.4	(0.1)	1,300	Poor alignment across river; construction through mouth of tributary; does not match latest GTP tie-in location
ALASKA MAINLINE					
North Slope Borough					
GTP Tie-In	0.0	0.7	0.0	3,200	Does not match latest GTP meter station tie-in location
Yukon-Koyukuk Census Area					
Nutirwik Creek	189.9	196.4	(0.4)	3,200	Farther from TAPS; worse access; more rugged terrain
Dietrich Camp	205.0	211.1	0.2	2,200	Farther from TAPS; worse access; more rugged terrain
Sukakpak Mountain	213.3	216.9	0.0	700	Hits old river oxbow; more rugged terrain; adds two Dalton Highway crossings
Nugget Creek	223.0	224.5	(0.2)	1,700	Avoids crossing private land (still under consideration for final route)
Grayling Lake	268.3	270.1	0.1	400	Poor road crossing locations; impacts parking lot
Fort Hamlin Hills	345.3	349.2	0.0	2,300	More rugged terrain; poor TAPS crossing location; poor waterbody crossing location
Slate Creek	409.3	423.0	0.2	6,850	Worse access and TAPS crossing; less collocation with existing rights-of-way
Rock Bluff	423.7	424.4	(0.1)	200	Steep terrain crossing
Fairbanks North Star Borough					
Tungsten Hill Fairbanks	451.8	459.1	0.2	4,400	Worse alignment across highway, commercial area, and rugged terrain; close to federal facility
Eielson AFB	484.2	486.4	0.2	2,100	Adds two creek crossings including an overflow creek channel; impacts shooting range and is closer to Eielson AFB fuel storage tanks, runway and administration buildings
Eielson AFB South	487.0	488.8	0.0	400	Located on edge of bluff and drainage
South Fairbanks Census Area					
Little Gerstle South Side	580.0	583.1	(0.1)	700	Impacts private land and creates highway pinch point
Sears Creek Fault	593.1	594.3	0.0	600	Alignment does not incorporate required fault crossing configuration or routing

TABLE 10.5.3-1

Alaska Pipeline Project
Comparison of the Route Variations to the Proposed Route

Route Variation Name	Milepost Begin [a]	Milepost End [a]	Difference in Length	Distance From Proposed Route (feet)	Reason for Rejection/Consideration
Berry Creek	596.7	599.2	0.0	1,650	Worse constructability near creek in steep topography; impacts potential archaeological sites near Berry Creek
Dot T Johnson Fault	599.4	604.4	0.0	1,500	Alignment does not incorporate required fault crossing configuration or routing
Bear Creek Fault	611.8	612.1	0.0	300	Alignment does not incorporate required fault crossing configuration or routing
Robertson River	618.8	619.9	0.0	600	Impacts two private land parcels
Cathedral Rapids West Fault	631.7	633.2	(0.1)	400	Alignment does not incorporate required fault crossing configuration or routing
Cathedral Rapids East	638.2	639.5	(0.1)	900	Alignment does not incorporate required fault crossing configuration or routing and impacts private land
Tanana Cross East	645.9	647.1	0.0	400	Avoids crossing private land (still under consideration for final route)
Midway Lake	682.1	684.4	0.1	900	Less collocation with highway right-of-way
West of Bitters Creek	685.1	686.4	0.3	1,200	Less collocation with highway right-of-way
West of Beaver Creek	695.6	697.7	0.0	650	Less collocation with highway right-of-way
Beaver Creek	698.1	701.8	0.0	2,800	More rugged terrain
Northway Junction	702.1	711.0	0.5	1,600	Less collocation with highway right-of-way
Scottie Creek	741.3	742.2	0.0	440	Worse creek crossing location; closer to tributary; less collocation with existing rights-of-way

[a] PT Pipeline MP 0.0 begins at the PTU; Alaska Mainline MP 0.0 begins at the GTP.

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10.6 ABOVEGROUND FACILITY SITE ALTERNATIVES

10.6.1 GAS TREATMENT PLANT SITE ALTERNATIVES

In determining the potential site locations for the GTP, APP first conducted a regional analysis, and subsequently performed an evaluation of site alternatives within the chosen region.

The regional analysis was based on identifying site locations that met the following criteria:

- Geographically close to feed gas sources (i.e., CGF and PTU) and CO_2 injection points;
- Avoids existing contaminated sites;
- Safely distant from existing operating facilities;
- Reducing environmental impacts; and
- Utilizing existing infrastructure to the extent possible.

In particular, four geographical areas were evaluated (refer to Figure 10.6.1-1):

- PBU: In the vicinity of the developed area of the PBU, including Deadhorse;
- West of PBU: Beginning outside the developed area of the PBU and extending westward, the western boundary of this area is not specifically defined;
- South of PBU: Beginning south of Deadhorse and extending southward, the southern boundary of this area is the Brooks Range; and
- East of PBU: Beginning outside the developed area of the PBU and extending eastward, the eastern boundary is defined by the Arctic NWR.

Siting criteria that APP considered consisted of several specific technical, economic, and operational criteria required to accommodate a GTP and its related facilities. Table 10.6.1-1 summarizes these criteria and identifies whether the geographical areas fulfilled the initial criteria.

TABLE 10.6.1-1

Alaska Pipeline Project
Alternative Gas Treatment Plant Site Geographical Areas Comparison

Preferred Criteria for a Gas Treatment Plant Site	PBU (Currently proposed GTP location)	East of PBU	South of PBU	West of PBU
Near feed gas source (CGF and/or PTU)	Yes	Yes	No	No
Near CO_2 injection points	Yes	No	No	No
Proper safety distance from existing operating facilities and public/private infrastructure	Yes	Yes	Yes	Yes
Reduce total footprint (i.e., near existing infrastructure that could be used by APP)	Yes	No	No	No
Reduce total impact (i.e., near existing resources/services for both construction and operation use)	Yes	No	No	No

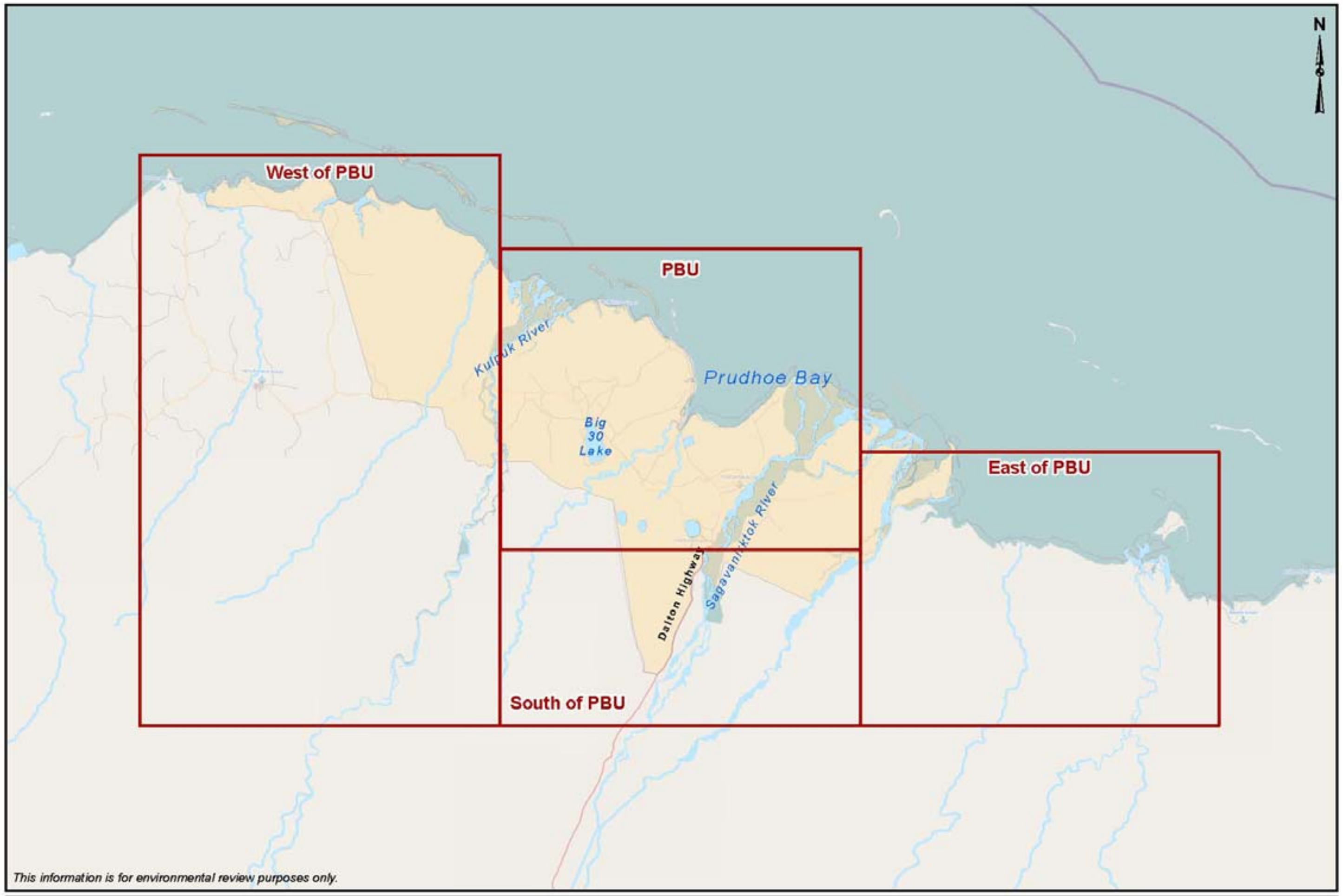

Figure 10.6.1-1
Alaska Pipeline Project
Geographical Areas Reviewed for the Gas Treatment Plant Site

As illustrated in Table 10.6.1-1, none of the three alternative areas were able to fulfill the siting criteria. Therefore, these alternative areas were not evaluated further.

Once APP identified that the PBU was its preferred regional area to construct the GTP, APP identified the proposed GTP site and three alternative sites within the preferred regional area. As shown on Figure 10.6.1-2, these included the following:

- Proposed site: Located approximately 3,000 feet west of the existing CGF;
- GTP Site Alternative 1: Located north of the Putuligayuk-23 mine (Put-23), between Put-23 and the CGF;
- GTP Site Alternative 2: Located approximately 3 miles southwest of the Deadhorse Airport and 1 mile west of the Dalton Highway; and
- GTP Site Alternative 3: Located north of the CGF/Central Compression Plant area on the Prudhoe Bay shoreline approximately 2,500 feet southeast of the West Dock staging pad.

GTP Site Alternative 1 was assumed to have an identical pad footprint to the proposed site and a similar logistical execution plan consisting of using Dock Head (DH) 2 to offload the modules and transport them to the site, primarily using existing roads. Infrastructure differences between these alternatives were primarily the length of road upgrades, pipeline crossings, and new transfer line lengths. GTP Site Alternative 2 has a similar pad footprint and logistical execution plan except that the alternative pad size would likely be greater than the proposed pad size in order to accommodate additional compression needed for this alternative. GTP Site Alternative 3 had a unique pad footprint that included a newly built dock extending out into Prudhoe Bay. As a result, GTP Site Alternative 3 modules would not need to be transported over existing roadways.

The following subsections provide a comparative analysis of the three alternative sites to the proposed site, and the rationale for selection of the proposed site. In addition, the following subsections provide an overview of alternatives considered for the proposed GTP site infrastructure, module delivery, dock facilities, and dredging and dredge disposal alternatives.

10.6.1.1 Site Alternatives Analysis

APP developed specific site requirements to assist in evaluating site differences for the GTP. These included several critical environmental, land, development, and operational factors that APP considers relevant to successful siting, construction, and operation of the facility. Each individual factor was considered relative to the merits of the proposed site. Potential impacts associated with a given factor were quantified, where possible, or otherwise defined in comparative terms to evaluate the merits of each site.

The following subsections summarize APP's analysis for each alternative site and Table 10.6.1-2 summarizes the specific results for all sites compared together.

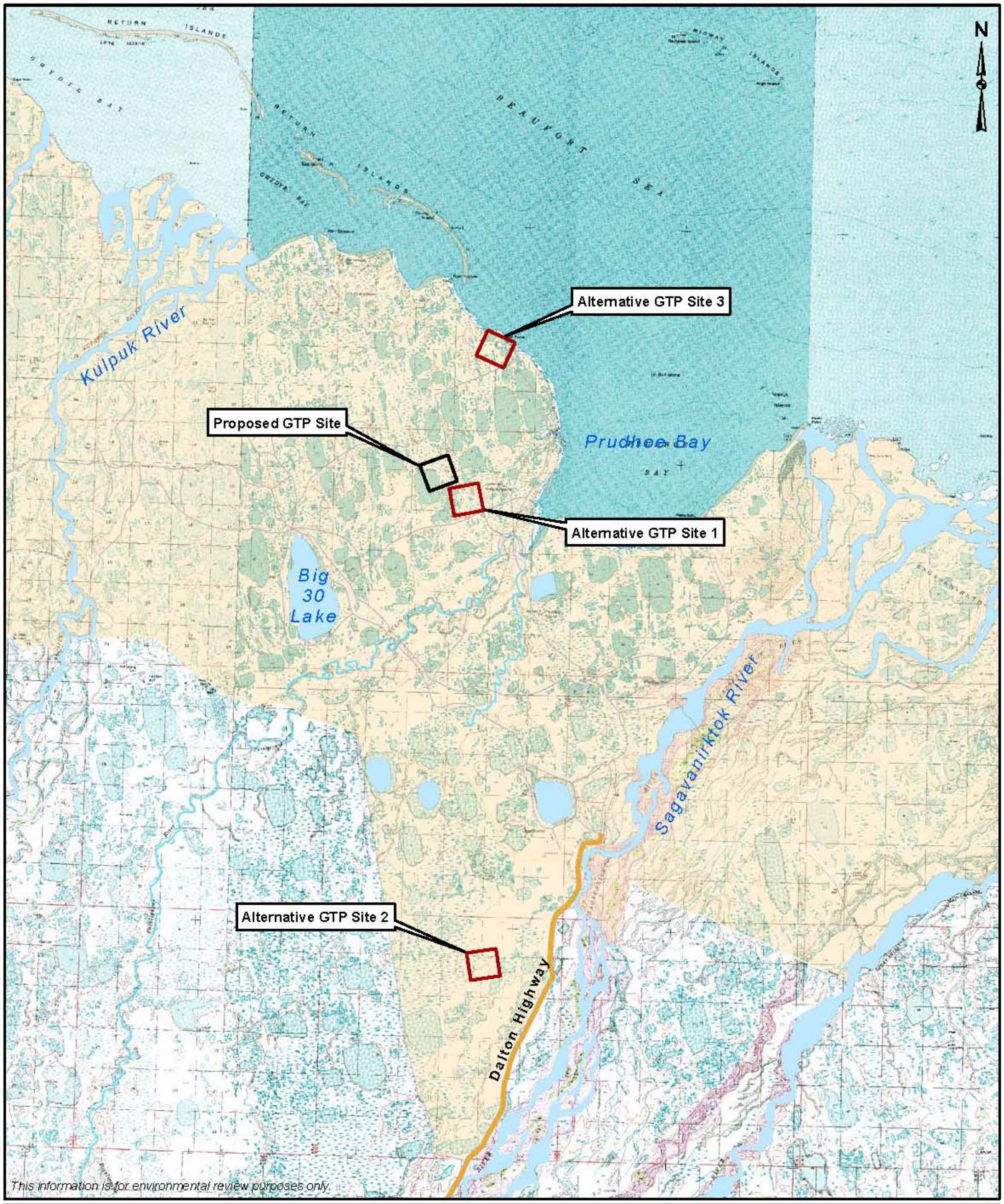

Figure 10.6.1-2
Alaska Pipeline Project
Proposed and Alternative Gas Treatment Plant Site Locations

TABLE 10.6.1-2

Alaska Pipeline Project
Comparison of the Gas Treatment Plant Site Alternatives

Factors Considered	Proposed Site	Site Alternative 1 (North of Put-23 Mine)	Site Alternative 2 (South of Deadhorse)	Site Alternative 3 (Onshore)
GTP SITE CHARACTERISTICS				
Pad Footprint Inclusive of Flare Area (acres)	235	235	>235 (For additional compression.)	>235 (For additional compression.)
Site Design Complexity (Relative Complexity)	Low.	Low.	Moderate. Additional compression needed. Location near Deadhorse Airport may impact design of the facility (building/stack height.)	Moderately High. (Structural support of large modules (i.e., piles, footings, etc.) more complex due to increased potential for gravel subsidence in nearshore area.)
Operational and Safety Considerations	Acceptable.	Acceptable.	Less Acceptable (Some concern with proximity to nearby Deadhorse Airport.)	Least Acceptable. (Maintenance impacted by salt spray. Operations impacted by higher wind speeds, additional wind-driven snow, and safety concerns relative to polar bears. Plant egress is constrained on shore side.)
Land Use/Zoning	Locations with evidence of previous disturbance are present in close proximity to the site (e.g., pads, pilings). This location and surrounding area are located within the PBU. Land within the PBU is designated for industrial development.	Pipelines and Elevated Electrical cross site area. This location and surrounding area are located within the PBU near Put 23 Mine. Land within the PBU is designated for industrial development.	Site is located within 5 miles of the Deadhorse Airport. Outside of the PBU. (North Slope Borough development permit would be required.)	Site is located on previously undeveloped coastal land but is located within close proximity to West Dock, roads, and other industrial development. This location and surrounding area are located within the PBU. Land within the PBU is designated for industrial development.
MODULE DELIVERY ISSUES				
Route Length (Miles)	6.7	6.7	20	0
Foreign Utility Line Crossings (Relative Complexity)	Minor. (Both existing and new crossings would require minor improvements to cross-over.)	Moderately Significant. (One large [~60-inch-diameter] elevated pipeline and one high-voltage powerline would need to be crossed.)	Significant. (Numerous crossings would require significant upgrades.)	None.
Route Transit Conflicts	Low. (Haul route issues on the spine road from Dock Head [DH] 2.)	Low. (Haul route issues on the spine road from DH2. Good access to site during operations.)	Significant. (Modules must pass through highly developed and highly traveled areas to reach site from DH2.)	None.

TABLE 10.6.1-2

Alaska Pipeline Project
Comparison of the Gas Treatment Plant Site Alternatives

Factors Considered	Proposed Site	Site Alternative 1 (North of Put-23 Mine)	Site Alternative 2 (South of Deadhorse)	Site Alternative 3 (Onshore)
Channel Dredging Volume (Million Cubic Yards)	2.5	2.5	2.5	3.5 (Greater than others because of the need to bring modules all the way to shoreline through shallower waters.)
CENTRAL GAS FACILITY FEED GAS AND CARBON DIOXIDE RETURN PIPELINE CONSIDERATIONS				
Length (Miles)	0.9	1.3	12.5	4.5
Foreign Pipeline Crossings (Number)	None.	2	2	3
Road Crossings (Number)	None.	1	4	1
GENERAL ENVIRONMENTAL CONSIDERATIONS				
Air Quality and Noise	Site is located in an industrial area. GTP is expected to meet applicable ambient air and noise quality standards. Noise emissions resulting from pile driving and other in-water construction activities would have the potential to affect fish and marine mammals.	Site is located in an industrial area and would be expected to meet applicable ambient air and noise quality standards. Noise emissions resulting from pile driving and other in-water construction activities would have the potential to affect fish and marine mammals.	Site would be expected to meet applicable ambient air and noise quality standards. Noise emissions resulting from pile driving and other in-water construction activities would have the potential to affect fish and marine mammals.	Site is located in an industrial area and would be expected to meet applicable ambient air and noise quality standards. Because pile driving and other in-water construction activities would be of longer duration, of greater magnitude, and cover a larger area, the potential risk that noise emissions resulting from these activities would impact fish and marine mammals is also increased.
Visual Impact	Site is located within developed area of the PBU. The potential for visual impacts would be minor due to existing developments.	Site is located within developed area of the PBU. The potential for visual impacts would be minor due to existing developments.	Site area would be just outside of developed area and extend the developed footprint. The potential for visual impacts would be greater than Proposed Site and Alternate 1.	Site is located along the coast and just outside of developed area. The potential for visual impacts would be greater than other sites.
Cultural Resources	Site is located to avoid historical landmark (original discovery well).[a]	No known cultural resource issues.	No known cultural resource issues.	No known cultural resource issues.

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TABLE 10.6.1-2

Alaska Pipeline Project
Comparison of the Gas Treatment Plant Site Alternatives

Factors Considered	Proposed Site	Site Alternative 1 (North of Put-23 Mine)	Site Alternative 2 (South of Deadhorse)	Site Alternative 3 (Onshore)
Soil Contamination	No known sites identified.	No known sites identified but located adjacent to North Slope Borough Oxbow landfill.	Site is located in undeveloped area and probability of encountering contamination is low.	Site is located in undeveloped area and probability of encountering contamination is low.
Affected Habitat Type	Palustrine emergent wetlands, tundra lakes/ponds, and estuarine intertidal and tidal wetlands	Palustrine emergent wetlands, tundra lakes/ponds and estuarine intertidal and tidal wetlands	Palustrine emergent wetlands, tundra lakes/ponds, and estuarine intertidal and tidal wetlands	Estuarine fringe, intertidal and tidal wetlands
PRESENCE OF CRITICAL HABITAT OR FEDERALLY ENDANGERED SPECIES OR PROXIMITY TO SPECIAL WILDLIFE AREAS				
Polar Bear	Located within critical denning habitat but outside of no disturbance zones.	Located within critical denning habitat and abuts the no disturbance zone.	Located outside of designated critical habitat.	Located within critical denning habitat and adjacent to critical feeding habitat.
Spectacled and Steller's Eiders	Located within potential nesting areas.	Located within potential nesting areas.	Located within potential nesting areas.	Located within potential nesting areas.
Bowhead Whale	Studies indicate that bowhead whales are generally not present in the Project area during July-September when the construction activities would occur.	Studies indicate that bowhead whales are generally not present in the Project area during July-September when the construction activities would occur.	Studies indicate that bowhead whales are generally not present in the Project area during July-September when the construction activities would occur.	Studies indicate that bowhead whales are generally not present in the Project area during July-September when the construction activities would occur.

[a] During the later portion of 2011, the GTP pad was shifted west from the location presented in the April 2011 Preliminary Resource Report 1 to ensure sufficient proximity was being maintained to the Prudhoe Bay Discovery Well Historical Site. As a result of the adjustment to the GTP pad location, the footprints of the GTP pad and the Alaska Mainline route from the interconnection point with the GTP overlap. Modifications to the Alaska Mainline and the GTP in this area will be provided.in the final report to address the overlapping footprint.

Gas Treatment Plant Site Alternative 1 Analysis

GTP Site Alternative 1 is located north of the Put-23 mine, between Put-23 and the CGF. Access to the site would be via a 6.7-mile-long module haul route from the West Dock. GTP Site Alternative 1 would require more road and pipeline crossings than the proposed site, and additional work would be needed to avoid an electric transmission line near the site.

Specifically, the Site Alternative 1 module haul route would cross both existing and new pipeline crossings, one of which is an existing large-diameter elevated pipeline crossing that would be moderately difficult to cross. The proposed site module haul access road would also cross existing and new pipeline crossings, but only minor issues are anticipated with completing those crossings. Both haul routes are the same length.

The required infrastructure at GTP Site Alternative 1 would not be noticeably different from that needed for the proposed site, and the engineering complexity would be similar for the two sites. Both sites would require the same quantity of dredging.

The CGF feed gas transfer line and CO_2 return line would be approximately 0.4 mile longer for Site Alternative 1 compared to the proposed site, and would require crossing two existing pipelines and one road, whereas the feed and return lines for the proposed site would not require crossings of existing pipelines or roads.

Table 10.6.1-2 provides a comparison of environmental considerations of the proposed site and GTP Site Alternative 1. For the most part, the two sites would have similar impacts. For instance, both sites are presently designated as industrial sites and would require construction of a new facility. Wetland permitting would be required at both sites and the impacts would be similar. No known cultural or paleontological resources would be impacted by either alternative. However, the GTP Site Alternative 1 has two environmental disadvantages compared to the proposed site: the GTP Site Alternative 1 abuts a polar bear critical habitat no disturbance zone and is located in an area identified by U.S. Fish and Wildlife Service (FWS) as having more appropriate topographic and macrohabitat features for terrestrial denning habitat (FWS 2010). As a result, this alternative was eliminated from further consideration.

Gas Treatment Plant Site Alternative 2 Analysis

GTP Site Alternative 2 is located approximately 5 miles southwest of the Deadhorse Airport and 1 mile west of the Dalton Highway. Access to the site would be via a 20-mile-long module haul route from the West Dock, which is about 14 miles longer than the haul route for the proposed site. Modules on the haul route would pass through highly developed and highly traveled areas to reach the site from West Dock. GTP Site Alternative 2 would also require substantially longer pipelines for the feed gas from the CGF, and the CO_2 transfer lines compared to the proposed site.

Due to the length and route of the haul road, and its proximity to the airport, PBU operators and other Deadhorse activities would likely encounter potential conflicts during transport of GTP modules from DH2. All pipeline crossings between DH2 and the location south of the airport are existing crossings, and would likely need to be significantly upgraded to handle module loads.

Additional compression would be needed with GTP Site Alternative 2, which would require a larger pad footprint than the proposed site, and proximity to the Deadhorse Airport may be of concern for building and stack heights. Both sites would require the same quantity of dredging, however, and the GTP itself would be located outside of designated polar bear critical habitat.

From an economic standpoint, GTP Site Alternative 2 and the proposed site are both considered feasible, however, GTP Site Alternative 2 is considered less economically attractive and more logistically complicated.

Table 10.6.1-2 provides a comparison of environmental considerations for the proposed site and GTP Site Alternative 2. The GTP Site Alternative 2 would require a larger footprint in a undeveloped non-industrial area and due to the need for increased compression, would also produce increased air emissions. GTP Site Alternative 2 is not preferable for the economic and environmental reasons stated above. As a result, this site was eliminated from further consideration.

Gas Treatment Plant Site Alternative 3 Analysis

GTP Site Alternative 3 is located north of the CGF area on the Prudhoe Bay shoreline approximately 2,500 feet southeast of the West Dock staging pad. GTP Site Alternative 3 presents the greatest ease of site access during construction and operations. The site would require development of dockface for offloading of modules directly onto the pad. In addition, because flares cannot be installed onshore due to conflicts with existing roads and infrastructure; flares would need to be installed in the ocean, potentially increasing costs for installation and flare line routing. This would result in a greater pad footprint but would eliminate the need for expanding DH2. Installation of piles would be deeper and more complicated because Adfreeze piles (standard North Slope piling method of surrounding piles with a water/sand slurry that subsequently freezes to secure the piles) could not be assumed at nearshore locations. In addition, more gravel would be needed for filling in low-lying areas.

Due to its location away from PBU processing facilities, construction and operation of GTP Site Alternative 3 would have minimal impacts on existing PBU operations. The complexity of integrating module movement with other West Dock users is also eliminated. In addition, developing this site avoids issues associated with crossing pipelines and developing access roads for module transport that would need to be addressed for the proposed site.

The disadvantages of GTP Site Alternative 3 compared to the proposed site are that it would require dredging substantially more material in Prudhoe Bay and is the most complex to design due to the additional module structural support and possible gravel subsidence. Due to its location and increased dredging and dockface footprint, this alternative would also have a greater potential to affect nearshore intertidal and sub-tidal habitats, polar bear habitats, and marine mammals relative to the proposed site. Maintenance at GTP Site Alternative 3 would also be affected by salt spray, higher wind speeds, and wind-driven snow associated with the coastal area. Additional compression would also be required, as well as additional space required for the compression.

Table 10.6.1-2 provides a comparison of environmental considerations of the proposed site and GTP Site Alternative 3. GTP Site Alternative 3 is not preferable due to the disadvantages described above. As a result this site was eliminated from further consideration.

10.6.1.2 Module Delivery Alternatives

APP currently estimates that approximately 114 modules would be required to construct the GTP and Associated Infrastructure[10] based on a minimum three-year open-water season sealift

[10] Associated Infrastructure and land required to construct and operate APP include additional temporary workspace (ATWS), access roads, helipads, airstrips, construction camps, pipe storage areas, contractor yards, borrow sites, and dock modifications, as discussed in Section 1.3.3 of Resource Report 1.

delivery schedule. These modules would be approximately 90 feet wide, 150 feet high, and 350 feet long, with the largest modules weighing up to 9,000 short tons. The large modules sizes provide for reduced North Slope transportation, interconnect and labor, which all correspond to reduced cost, risk, and impact. Alternative transportation options for GTP module delivery to the North Slope are summarized in the following subsections, including transport via truck, railroad, and on-site fabrication.

APP determined that the largest modules would need to be shipped by sealift because the size and weight of the modules exceeded the capacity of either truck or rail transportation. APP conducted a secondary study to determine the feasibility of breaking up the larger modules into smaller pieces for transport by either truck and/or rail transportation, however, the labor cost and time associated with reassembling these pieces made these options not viable.

Consequently, modules will be transported to the GTP construction area primarily utilizing sealifts.

On-Site Fabrication

On-site fabrication of the GTP would require substantial equipment, material, and workforce increases in the Prudhoe Bay area. Fabricating on-site would substantially increase the cost of the GTP (by approximately double). To-date, no significant oil and gas facilities have been fabricated on the North Slope due to Arctic conditions and the cost. This option was determined to be the most cost-intensive option of fabrication, and on-site fabrication was eliminated from further consideration.

Truck Transportation

Truck transportation is the most consistent method to transport freight to the North Slope, with travel times from 4 to 10 days depending on site-of-origin, size, and weight of the module, weather, and other demands for road uses that may be present during transport. Special permits from the Alaska Department of Transportation and Public Facilities are required to transport modules larger than 22-feet-wide, by 15-feet, 6-inches high, by 80-feet-long, and exceeding 100 tons gross weight. The heaviest load that has ever been carried on Alaska roads from Anchorage to Prudhoe Bay to-date was a 20-feet-wide by 14-feet 6-inches high by 76-feet-long with 110-tons gross weight.

Several of the road route segments to Prudhoe Bay have limitations or restrictions, including:

- Nikiski to Anchorage: Weight limitation at the Canyon Creek Bridge;
- Anchorage to Fairbanks: Height restriction of 15-feet, 6-inches at Denali Park's Nenana River Bridge in Rex, and Tanana River Bridge in Nenana;
- Fairbanks to North Slope: Safety standard considerations, in particular, at Atigun Pass, with slopes up to 18 percent. In addition, there is a 110-ton weight restriction for multiple bridges along this segment; and
- All paved and unpaved roads maintained by the Alaska Department of Transportation and Public Facilities allow 100 percent legal axle load with overloads allowed upon application and receipt of written authorization from the Division of Measurement and Standards and Commercial Vehicle Enforcement. Between April 1 and June 1, however, load restrictions may apply due to weather conditions, varying between 50 and 100 percent of legal axle load.

The transportation of over 58,000 tons of equipment and approximately 250,000 tons of material by road is not practical due to the limitations associated with the Dalton Highway, the only road connection to Prudhoe Bay (i.e., 2 lane, 360-mile long, and unpaved highway). Bridge weight restrictions of about 100 tons, road closures due to ice, snow, and break-up all increase safety, schedule, cost, and execution risks. Therefore, this alternative was eliminated from further consideration, other than for transportation of some materials and some small skids and modules.

Rail Transportation

The Alaska Railroad is capable of handling modules or vessels in the 250-ton range and load height generally must be less than width. Smaller modules fabricated in Alaska could be shipped via rail to Fairbanks utilizing the Alaska Railroad Corporation infrastructure, which has undergone improvements over the last 10 years. The Alaska Railroad system does not extend to Prudhoe Bay, and all rail shipments would then have to be transported via highway after reaching Fairbanks, therefore this alternative was eliminated from further consideration.

10.6.1.3 North Slope Dock Alternatives

APP conducted an evaluation that considered several dock configurations and the number of barge berths that would be needed in Prudhoe Bay to accommodate the large number of barges that would be offloaded within the open-water (ice-free) work window and in consideration of concurrent dock usage by non-Project entities and potential weather delays. Based on this evaluation, APP determined that five new berths would be required to offload barges within the estimated 45-day open-water work window. These berths would assist in mitigating potential schedule impacts caused by external constraints such as adverse weather conditions, and/or concurrent activities at West Dock.

While there are numerous dock structures in and around Prudhoe Bay, the West Dock facility is the primary dock facility that could support GTP module transfer. The West Dock structure has two active dock heads, including DH2, which serves heavy loads, and DH3, which is restricted by a relatively low-weight-bearing causeway. West Dock is the closest port facility to the proposed GTP site, with no reasonable alternative available elsewhere. Therefore, the following North Slope dock alternatives are solely focused on options at DH2.

The following dock modifications, which could accommodate a variable number of barges and barge sizes, were considered in this study (refer to Appendix 10B):

1. Improvements to existing dock only;
2. Widening the existing dock face to the east;
3. Building new flat-face dock to the east of the existing dock and extended out into deeper water;
4. Widening existing dock to the east and adding finger piers; and
5. Building a sawtooth dock to the east of existing dock.

These configurations were evaluated based on the following criteria:

- Environmental;
- Safety;

- Schedule;
- Impact on/from Prudhoe Bay operations;
- Cost;
- Land impact;
- Constructability of infrastructure;
- Efficiency of offload operation – water;
- Efficiency of offload operation – land; and
- Benefits to future operations.

The results of this evaluation are summarized in Table 10.6.1-3.

TABLE 10.6.1-3

Alaska Pipeline Project
Comparison of Dock Location and Modification Alternatives

Option	Advantages	Disadvantages
Configuration 1. Improve existing dock with no increase in footprint	• Minimal land impact • Lowest cost • No increase in footprint • Less permitting complexity	• Does not support offload operation schedule • Impacts PBU operations during improvement and during offloading
Configuration 2. (Proposed Configuration) Expand existing dock to the east with 5 new berths	• Flat face provides good efficiency and operational flexibility for marine operations • Lowest land impact of expanded dock options • Lowest cost per berth • Separates APP from non-APP activities • Minimal increase in footprint • Minimal impact to seafloor receptors • Future use potential	• Requires dredging, however, smallest volume of dredged spoils of expanded dock configurations (roughly equal to Configuration 3)
Configuration 3. New dock extending to the north and east of existing dock with 5 new berths	• Flat face provides good efficiency and operational flexibility for marine operations • Future use potential • Separates APP from non-APP activities	• May cause sedimentation at existing dock • Smallest volume of dredged spoils of expanded dock configurations (roughly equal to Configuration 2)
Configuration 4. Widen existing dock to east and add finger pier dock with 5 new berths	• Finger piers allow greater barge and offload access from the sides • Separates APP from non-APP activities • Future use potential	• Sedimentation likely between piers • Increases dredge volume from Configuration 2 and 3 • May complicate docking operation when barges are in place • Highest cost to berth ratio
Configuration 5. Build a sawtooth dock to east of existing dock with 5 new berths	• Reasonable cost to berth ratio • Future use potential • Separates APP from non-APP activities	• Complicates in-water docking operation • Complicates onshore offload operation • Impacts existing dock usage during offload time • Largest volumes of dredged spoils • Highest land impact

Based on this analysis, APP determined that Configuration 2, the flat-faced dock option with five berths, would offer superior operational flexibility, future uses, and good separation from non-Project activities to mitigate potential schedule impacts. These same modifications could be made at DH3, which would reduce dredging requirements; however, this would require the temporary closing of the causeway breach during the three sealift years. As the purpose of the breach was to facilitate the migration of fish from one side of the causeway to the other this option was eliminated from further consideration to avoid any potential fish migration issues.

10.6.1.4 Dredging Alternatives

Several methods of dredging are currently used worldwide, and in a variety of climates. APP has evaluated the following dredging methods and has determined that all the methods are feasible for Prudhoe Bay. These methods may be used independently or in combination. None of these methods have been eliminated from consideration.

Hydraulic Cutterhead Dredging

Cutterhead dredges use rotating cutters and hydraulic means (pumps) to move dredge material from the seafloor into a discharge pipe. The discharge pipe terminates at the disposal locations or within a hopper barge. Booster pumps can be added to increase the discharge pipe length. Cutterhead dredges can achieve very high rates of dredge production and are capable of removing a wide range of soil types, including permafrost. Cutterhead dredges are especially suitable for silty soils.

Mechanical Clamshell Dredging

A mechanical clamshell dredge consists of a barge-mounted machine with a clamshell bucket that cuts sediment from the seafloor and raises it through the water column. The sediment is then transferred to a hopper barge. The hopper barge is towed to a disposal location where the spoils are then dumped onto the ocean floor. Clamshell dredging is a widely used dredging method and works with many soil types, however, it is less suitable to silty soils.

Barge-Mounted Excavator

This method of dredging would be conducted during the open-water season. Excavators would be mounted on barges and dredge to the required depth. Dredged material would be transferred to the disposal site via barge and dumped onto the ocean floor. This method is widely used and works with many soil types, however, it is less suitable to silty soils.

Elevated Excavator

This method of dredging would be conducted during the open-water season. The Project would utilize excavators that can elevate the cab and can motor above the waterline, while the tracks remain underwater. This method would be suitable for the shallower maneuvering basin area in combination with a barge-mounted excavator to dredge the channel in deeper water. The dredged material would be transferred to the disposal site via barge and dumped onto the ocean floor.

Hydraulic Dredging with Integrated Hopper

Hopper dredges use hydraulic means (pumps) to move dredge material from the seafloor to a hopper. The dredge (dredge and hopper) transits from the dredge location to the dredge material disposal location. This method can achieve high rates of dredge production and requires fewer support vessels as it is a self-contained dredger and hopper. As the water depth at DH2 is shallow, this option is the least feasible.

10.6.1.5 Dredge Disposal Site Alternatives

Open-Water Placement in Stefansson Sound

Dredged material is proposed to be disposed of in Stefansson Sound as described in Section 1.3.3 of Resource Report 1. The alternative disposal sites discussed below were also considered for the Project.

Open-Water Placement North (Seaward) of the Barrier Islands

Dredged material may be disposed of beyond the barrier islands in deeper water than the proposed site. Depending on the distance to the disposal site this would reduce the effectiveness of transporting dredge material hydraulically via pipeline from a cutterhead suction dredger. Hopper barges would be the most effective means to transport dredged material beyond five miles. Additional hopper barges and tugs would be required to maintain production rates which would increase dredge costs. Based on these factors, disposal beyond the barrier islands was eliminated from further consideration.

Disposal beyond the continental shelf was also considered but was dismissed due to concerns over floating ice density in summer, which can pose a navigational hazard, and due to the impractical logistics required to move the large volume of material the necessary distance (approximately 50 miles offshore).

Beach Replenishment and Island Building

Dredge spoils worldwide are frequently used for beach replenishment and barrier island building. This disposal method requires that the spoils consist of a high percentage of sand/clay/gravel and a low percentage of silt. Beaches and islands can be built by hydraulically placing the dredged material in the desired location in the summer. Use of hopper barges is less feasible for this method of disposal. Soil type is an important consideration for beach replenishment and island building. If the dredged material has a very high content of silt it may not be appropriate for this disposal method. APP was unable to find a nearby desired location for the dredged material as migratory birds nest in the surrounding area (i.e., Gull Island) during the summer months. Island building specifically for creating new bird habitat was also studied, but dismissed due to concerns over the high potential for migration of the silty material.

Upland Beneficial Reuse

Upland placement of dredging spoils is often used worldwide to dispose of dredge material. This alternative was eliminated due to the potential damage caused by saline-rich spoils deposited on top of permafrost tundra, which may have adverse effects on the wetlands.

Structural Beneficial Reuse along the Causeway and West Dock

APP evaluated using the dredged material as structural fill for the expansion of DH2 and the causeway. APP eliminated this alternative due to the additional cost and schedule impacts. An additional year of construction would be added to the construction schedule to de-water and densify the material sufficiently for structural purposes. Dredging would also have to occur two years prior to the first sealift, which would increase the maintenance dredging quantities, and an alternate disposal site would have to be permitted for the disposal of dredged material from maintenance dredging.

10.6.1.6 Navigational Channel Alternatives

The shape of Prudhoe Bay and the seafloor limit the number of practical navigational channel alternatives to a fan-shaped area extending north to northeast from DH2. While many channel configurations within this fan shape are feasible, the proposed navigational channel was chosen to facilitate tug and barge navigation given the prevailing wind and current, as well as reduce the amount of dredge material generated. Soil testing would be conducted, and if soil contamination is found in the proposed channel, the route would be re-evaluated. APP evaluated placing the channel extending nearly due North from DH2, but eliminated this as it provided less desirable tug and barge movement and may interfere with DH3 activities.

10.6.2 COMPRESSOR STATION SITE ALTERNATIVES

APP utilized an iterative approach to selecting its proposed compressor station locations. Initially, compressor station locations were selected based on a hydraulic analysis of the Alaska Mainline. This analysis was used to identify the number of compressor stations and the approximate locations necessary to operate the pipeline system most efficiently and maximize flow capability considering the defined pipeline diameter and gas delivery volume. APP then conducted a desktop evaluation of each location utilizing topographic maps and aerial imagery to adjust the hydraulically selected locations along the pipeline route, as necessary, considering a number of factors related to engineering, construction, operational, and environmental guidelines, which are listed below. Using this approach, a proposed site and an alternative site were selected for each compressor station location. Hydraulic simulations were checked as site locations were adjusted to confirm the adjusted sites were still hydraulically acceptable and that operating efficiency and pipeline system flow capability were not negatively impacted.

Field investigations were undertaken in Alaska in the summer of 2011 to confirm the suitability of desktop-selected sites or to make further adjustments to the sites if required. In some cases new sites were identified during these investigations that might be preferable to the desktop-selected sites; however, as evaluations of the field input were not completed prior to the time of this resource report's writing, the proposed sites are the desktop-selected sites. The new field-selected sites are included in this section as alternative sites. [Note: APP may update its final report to reflect that these alternatives have been adopted after further evaluating the sites.] In addition, geotechnical assessments, environmental agency consultations, and public and landowner consultations are planned to further confirm the viability of the proposed compressor station sites.

The engineering, construction, operational, and environmental guidelines used to select compressor station sites included:

- Optimize the efficiency of the facility and the pipeline by locating the compressor stations along the pipeline route as close to the hydraulically selected location as feasible;
- Reduce impacts to environmental resources (e.g., noise-sensitive areas [NSAs], wetlands, NWRs, unique or sensitive wildlife habitat or vegetation, known historic or cultural resource sites, visual resources);
- Reduce impacts from geohazards (e.g., fault lines); and
- Reduce construction impacts (e.g., reduce clearing, extensive grading, and surface disturbance, optimize proximity to existing roads, selecting well-drained sites).

The following subsections provide a summary of the alternative sites evaluated for each of the eight proposed compressor stations.

10.6.2.1 Happy Valley Compressor Station

APP identified one alternative to the proposed Happy Valley Compressor Station site, which is depicted on Figure 10.6.2-1. The alternative site is located at AMP 79.8 and is directly adjacent to and south of the proposed site. Both sites are very similar in that they are located directly west of the Dalton Highway near a previously disturbed area, would have a similar access road length, and all of the sites generally meet the siting criteria identified in Section 10.6.2, including avoidance of NSAs. The principal disadvantage of the alternative site compared to the proposed site is that the footprint encroaches within about 500 feet of a minor stream in the southwest corner of the site, whereas the proposed site avoids encroaching within any minor streams. This alternative site offers no advantages over the proposed site and no other alternative sites were identified for consideration. Therefore, this alternative was eliminated from further consideration.

10.6.2.2 Galbraith Lake Compressor Station

APP identified two alternatives to the proposed Galbraith Lake Compressor Station site, which are depicted on Figure 10.6.2-2. The Alternative 1 site is located at AMP 149.6 and is approximately 0.3 mile north of the proposed site. The Alternative 2 site is located at AMP 152.0 and is approximately 2.1 miles southeast of the proposed site. All of the sites generally meet the siting criteria identified in Section 10.6.2, including avoidance of NSAs. Table 10.6.2-1 provides a comparison of key environmental and constructability considerations for the proposed site and the two alternative sites.

TABLE 10.6.2-1

Alaska Pipeline Project
Galbraith Lake Compressor Station Site Alternatives Comparison

Key Comparative Factors	Proposed Site (AMP 149.8)	Alternative 1 Site (AMP 149.6)	Alternative 2 Site (AMP 152.0)
NSAs	No.	No.	No.
Distance to existing road	0.1 mile.	Less than 0.1 mile.	Less than 0.1 mile.
Land use	Undeveloped.	Undeveloped.	Undeveloped.
Drainage	Fair – two watercourses in northwest corner of site.	Fair – seasonal watercourse on northeast side.	Fair – seasonal watercourse from east to west.
Topography	Site abuts a steep slope that includes talus cones. Slope over site is 110 feet from east to west.	40 feet from east to west.	Site abuts a steep slope. Slope over site is 160 feet from east to west.

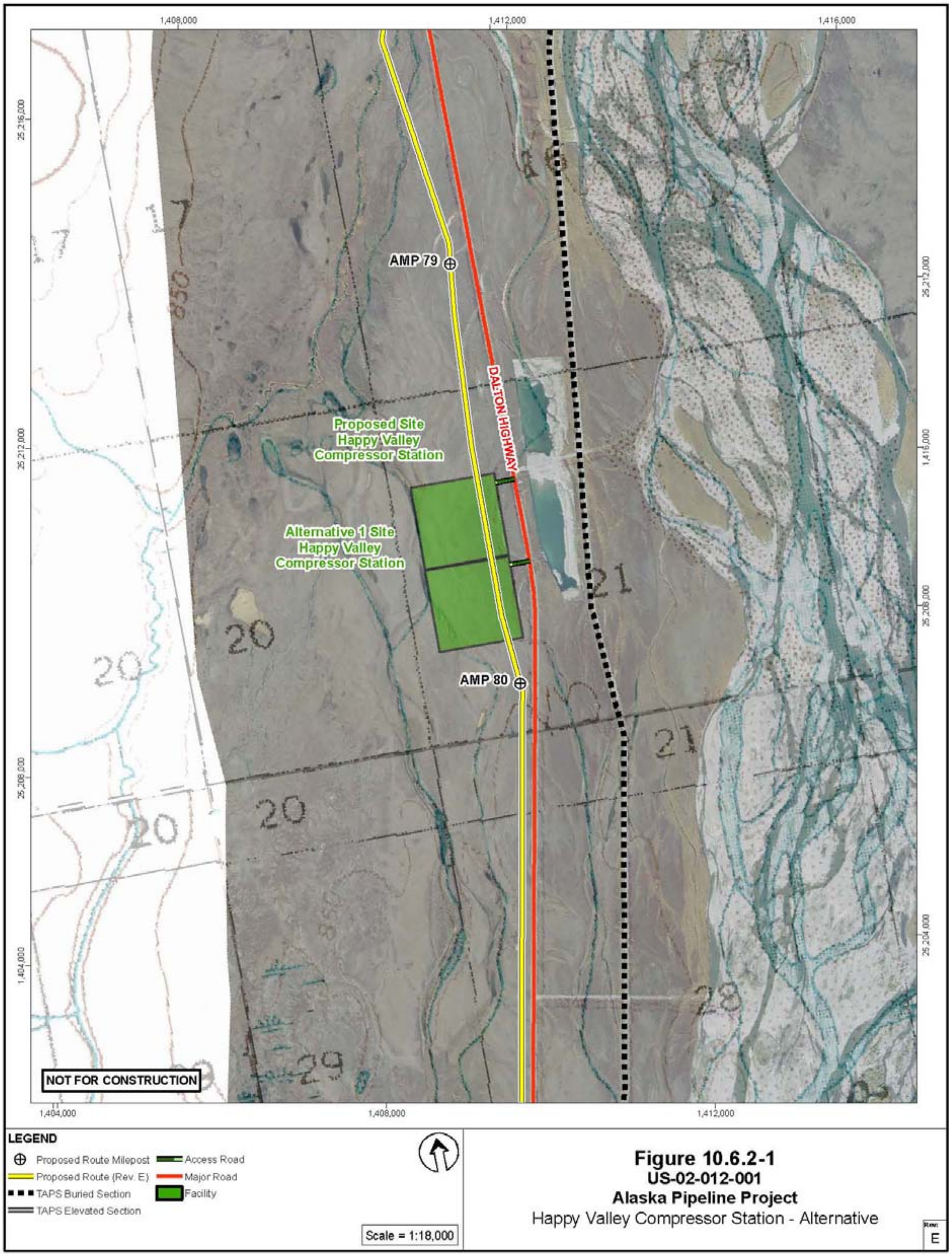

Figure 10.6.2-1
US-02-012-001
Alaska Pipeline Project
Happy Valley Compressor Station - Alternative

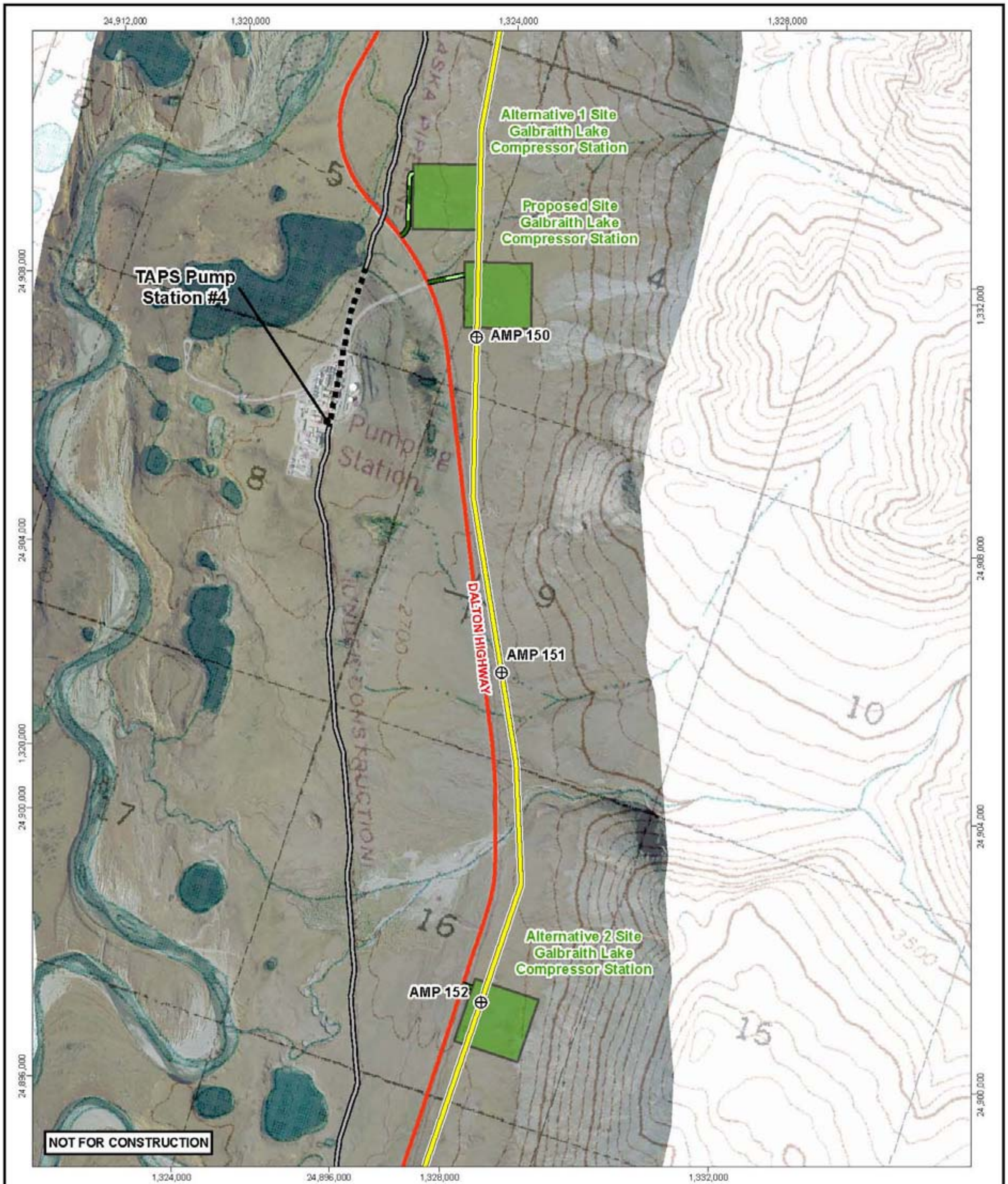

Figure 10.6.2-2
US-02-012-002
Alaska Pipeline Project
Galbraith Lake Compressor Station - Alternative

The proposed and Alternative 1 sites are located on the west side of the Dalton Highway in a location directly across from the existing TAPS Pump Station (PS) 4, which limit potential visual impacts to a single area. The Alternative 2 site is further to the south, also along the Dalton Highway, but not near an existing facility, so it would create a new area of disturbance along the Dalton Highway. All of the sites are located in the BLM Galbraith Lake Area of Critical Environmental Concern and would have to be moved approximately 4.0 miles south of the proposed site to be located outside of the Area of Critical Environmental Concern. Moving further south, however, is not desirable because it would decrease the hydraulic efficiency of the pipeline system. The principal advantage of the Alternative 1 site is that it has less of a slope than the proposed site, which would reduce the amount of work needed to level the site for development. The Alternative Site 1 location would require an adjustment of the mainline alignment to match the compressor station layout. The Alternative 2 site has a steep slope across it and was therefore eliminated from further consideration.

10.6.2.3 Chapman Creek Compressor Station

APP identified two alternatives to the proposed Chapman Creek Compressor Station site, which are depicted on Figure 10.6.2-3. The Alternative 1 site is located at AMP 258.6 and is approximately 2.6 miles south of the proposed site. The Alternative 2 site is located at AMP 257.1 and is approximately 0.8 miles south of the proposed site. All of the sites generally meet the siting criteria identified in Section 10.6.2, including avoidance of NSAs, and all are located on the west side of the Dalton Highway. Table 10.6.2-2 provides a comparison of key environmental and constructability considerations for the proposed site and the two alternative sites.

TABLE 10.6.2-2

Alaska Pipeline Project
Chapman Creek Compressor Station Site Alternatives Comparison

Key Comparative Factors	Proposed Site (AMP 256.0)	Alternative 1 Site (AMP 258.6)	Alternative 2 Site (AMP 257.1)
NSAs	No.	No.	No.
Distance to existing road	Less than 0.1 mile.	0.2 mile.	Less than 0.1 mile.
Land use	Undeveloped.	Disturbed – on a granular material site with existing access to the highway.	Undeveloped.
Drainage	Poor – low area with standing water.	Good – high and dry area.	Good – high and dry area.
Topography	30 feet sloping from east to west.	20 feet sloping from east to west.	15 feet sloping from east to west.

The principal advantage of the alternative sites over the proposed site is that field observations determined they are located in good, relatively dry locations, whereas the proposed site is located in a low area with standing water. The Alternative 1 site is located in a disturbed area consisting of granular material, whereas the proposed and Alternative 2 sites are on undeveloped land. The Alternative 1 site is also currently accessible by an existing gravel road from the Dalton Highway that is approximately 0.2-mile-long, which is double the length of access that would be needed for the proposed or Alternative 2 site. In addition, the Alternative 1 site location would require an adjustment of the mainline pipeline alignment to match the compressor station layout. [Note: These proposed alternatives are still under evaluation and will be updated in the final report.]

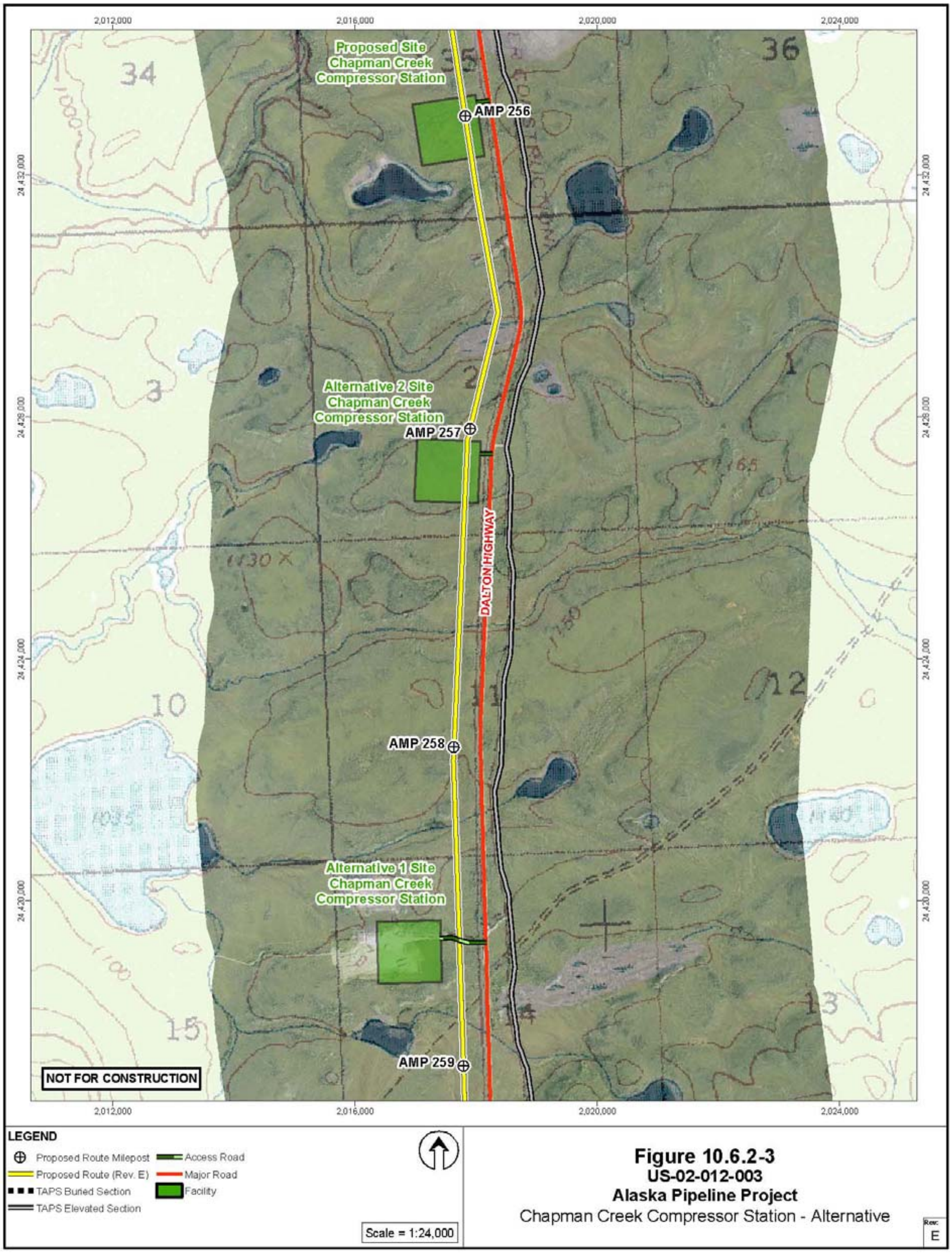

Figure 10.6.2-3
US-02-012-003
Alaska Pipeline Project
Chapman Creek Compressor Station - Alternative

10.6.2.4 Fort Hamlin Hills Compressor Station

APP identified two alternatives to the proposed Fort Hamlin Hills Compressor Station site, which are depicted on Figure 10.6.2-4. The Alternative 1 site is located at AMP 337.7 and is approximately 0.3 mile north of the proposed site. The Alternative 2 site is located at AMP 340.1 and is approximately 2.0 miles south of the proposed site. All of the sites generally meet the siting criteria identified in Section 10.6.2, including avoidance of NSAs, and all are located on the west side of the Dalton Highway. Table 10.6.2-3 provides a comparison of key environmental and constructability considerations for the proposed site and the two alternative sites.

TABLE 10.6.2-3

Alaska Pipeline Project
Fort Hamlin Hills Compressor Station Site Alternatives Comparison

Key Comparative Factors	Proposed Site (AMP 338.0)	Alternative 1 Site (AMP 337.7)	Alternative 2 Site (AMP 340.1)
NSAs	No.	No.	No.
Distance to existing road	Less than 0.1 mile.	Less than 0.1 mile.	Less than 0.1 mile.
Land use	Undeveloped.	Undeveloped.	Undeveloped.
Drainage	Poor – wet area.	Fair – higher area and slightly dryer.	Fair – higher area and slightly dryer.
Topography	10 feet sloping from south to north.	10 feet sloping from north to south.	20 feet sloping from center to edge of site.

The principal advantage of the alternative sites over the proposed site is that field observations determined they are located in fairly flat and drier locations whereas the proposed site is located in a wet area. Access to each site would be similar in terms of length from the Dalton Highway; however the soil conditions may be better for constructing access to the alternative sites. [Note: These proposed alternatives are still under evaluation and will be updated in the final report.]

10.6.2.5 Tatalina River Compressor Station

APP identified two alternatives to the proposed Tatalina River Compressor Station site, which are depicted on Figure 10.6.2-5. The Alternative 1 site is located at AMP 416.0 and is approximately 3.1 miles northwest of the proposed site. The Alternative 2 site is located at AMP 418.7 and is approximately 0.4 mile northwest of the proposed site. All of the sites generally meet the siting criteria identified in Section 10.6.2, and all are located on the west side of the Elliott Highway. Table 10.6.2-4 provides a comparison of key environmental and constructability considerations for the proposed site and the two alternative sites.

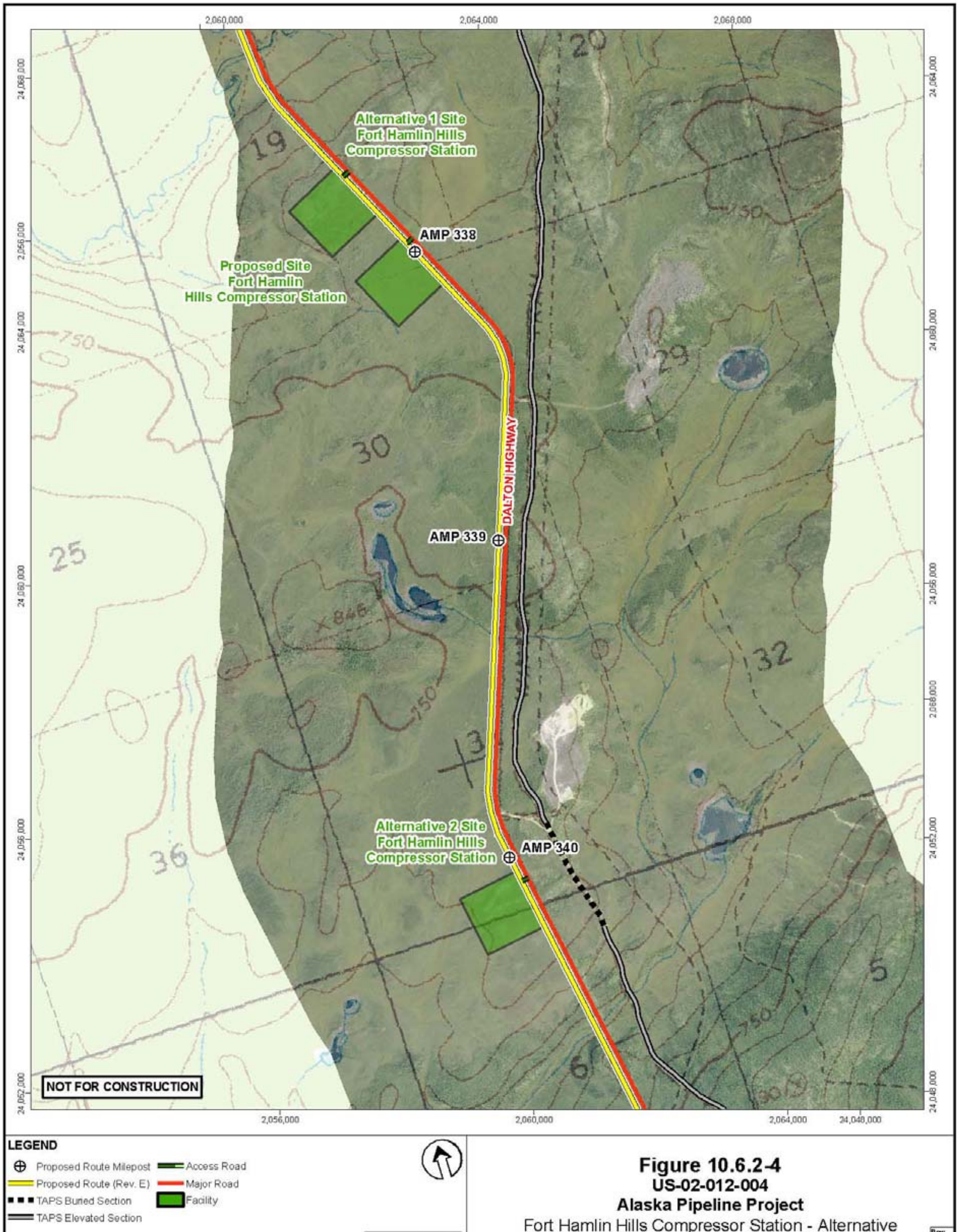

Figure 10.6.2-4
US-02-012-004
Alaska Pipeline Project
Fort Hamlin Hills Compressor Station - Alternative
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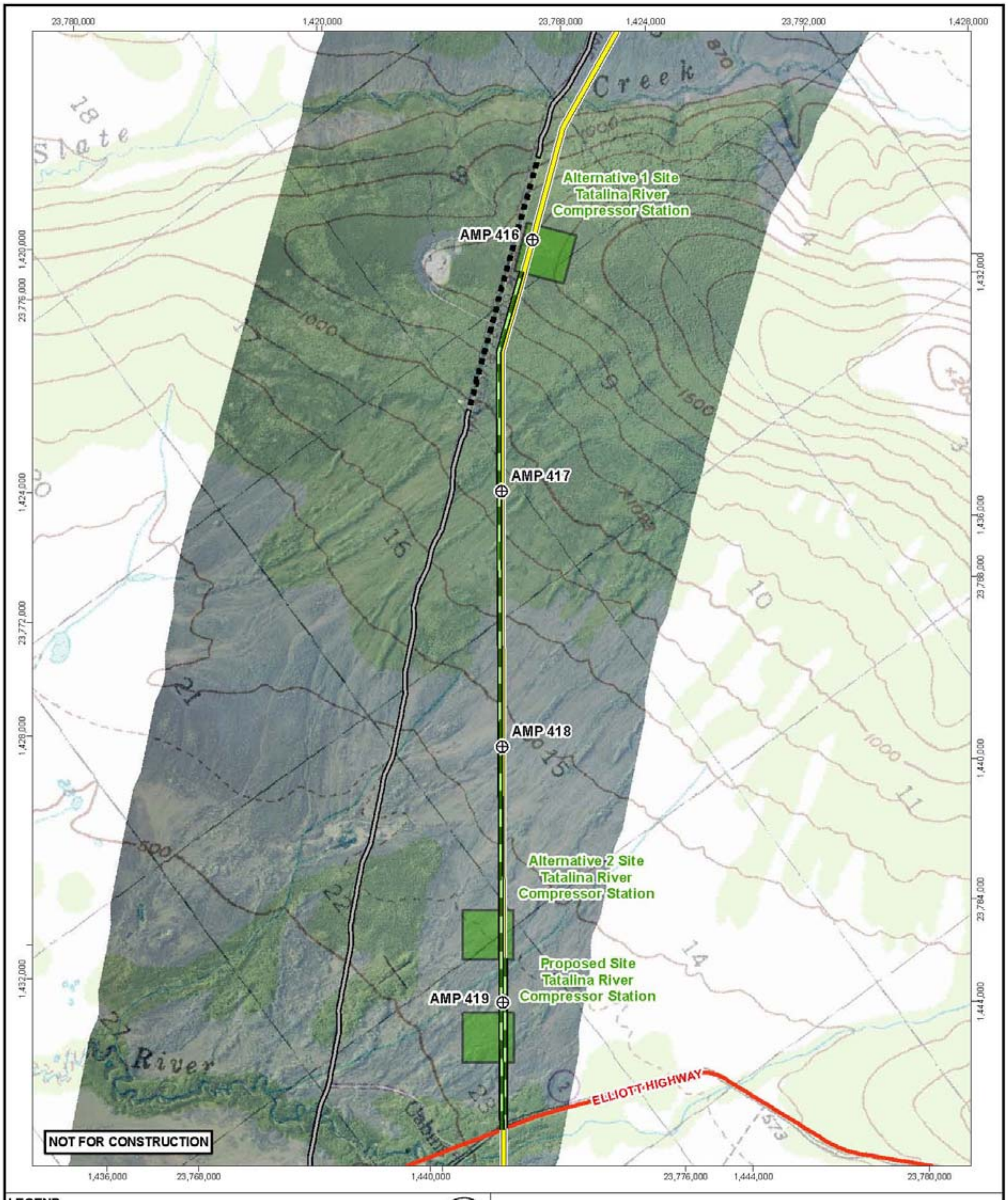

Figure 10.6.2-5
US-02-012-005
Alaska Pipeline Project
Tatalina River Compressor Station - Alternative

Rev: E

TABLE 10.6.2-4

Alaska Pipeline Project
Tatalina River Compressor Station Site Alternatives Comparison

Key Comparative Factors	Proposed Site (AMP 419.1)	Alternative 1 Site (AMP 416.0)	Alternative 2 Site (AMP 418.7)
NSAs	Yes, 3 residences located about one mile from site.	Yes, 3 residences located approximately 4.0 miles from site.	Yes, 3 residences located approximately 1.3 miles from site.
Distance to existing road	0.2 mile.	3.0 mile.	0.8 mile.
Land use	Undeveloped.	Undeveloped.	Undeveloped.
Drainage	Poor – in a low wet area with standing water.	Good – on a high area.	Poor – in a low wet area with standing water.
Topography	20 feet sloping from north to south.	100 feet sloping from west to east.	45 feet sloping from north to south.

The Alternative 1 site is located about 800 feet higher on the landscape than the proposed site in a drier, forested area, and is approximately 3.4 miles from the Elliott Highway. This compares to the proposed site which is lower on the landscape within a tussock muskeg that was observed to have up to 6 inches of water in some areas, but which is closer (0.4 mile) to the Elliott Highway. The principal advantage of the Alternative 1 site is that it is located directly across from an existing, cleared area and is located farther from NSAs which have been identified south of and within 1 mile of the proposed site. The principal disadvantage of the Alternative 1 site is its distance from the Elliott Highway and its steep site topography, which would increase the amount of work needed to access and level the site for development. The Alternative 2 site is also further from the NSAs than the proposed site, however, it is also located in a tussock muskeg with standing water. The Alternative 2 site is slightly farther from the Elliott Highway than the propose site, but is much closer than the Alternative 1 site, and it is on a steeper site than the proposed site, but not as steep as the Alternative 1 site. [Note: These proposed alternatives are still under evaluation and will be updated in the final report.]

10.6.2.6 Johnson Road Compressor Station

APP identified two alternatives to the proposed Johnson Road Compressor Station site, which are depicted on Figure 10.6.2-6. The Alternative 1 site is located at AMP 495.5 approximately 1.5 miles south of the proposed site. The Alternative 2 site is located at AMP 495.1 and is approximately 1.1 miles south of the proposed site. All of the sites generally meet the siting criteria identified in Section 10.6.2, except for maintaining at least 1 mile of distance from NSAs. Table 10.6.2-5 provides a comparison of key environmental and constructability considerations of the proposed site and the two alternative sites.

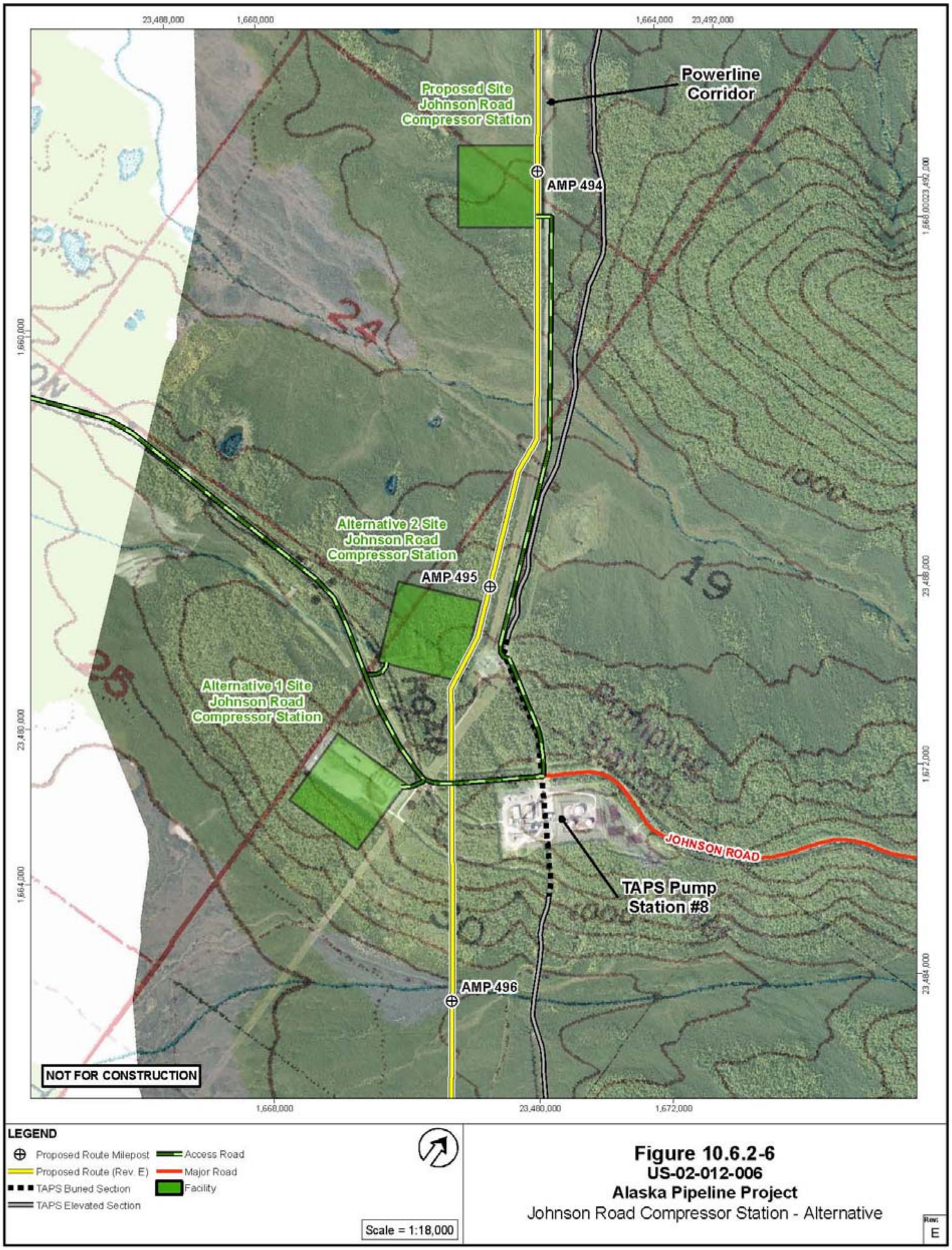

Figure 10.6.2-6
US-02-012-006
Alaska Pipeline Project
Johnson Road Compressor Station - Alternative

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TABLE 10.6.2-5

Alaska Pipeline Project
Johnson Road Compressor Station Site Alternatives Comparison

Key Comparative Factors	Proposed Site (AMP 494.0)	Alternative 1 Site (AMP 495.5)	Alternative 2 Site (AMP 495.1)
NSAs	Yes, 2 residences located approximately 1.0 and 1.1 miles from site, respectively.	Yes, 2 residences located approximately 0.3 and 0.9 mile from site, respectively.	Yes, 2 residences located approximately 0.2 and 0.8 mile from site, respectively.
Distance to existing road	1.3 miles.	0 mile (existing access).	Less than 0.1 mile.
Land use	Undeveloped.	Disturbed (storage site).	Undeveloped.
Drainage	Fair – low and wet area.	Good – high and dry area.	Good – high and dry area.
Topography	25 feet sloping from east to west.	20 feet sloping from northeast to northwest.	50 feet sloping from east to west.

As indicated in Table 10.6.2-5, all three sites are located within 1 mile of NSAs. The principal advantages of the alternative sites compared to the proposed site is that they are both near the existing TAPS PS 8 and much closer to Johnson Road than the proposed site. The Alternative 1 site is approximately 0.2 mile south of Johnson Road within a previously disturbed TAPS material and storage yard site, and on the western edge of an existing powerline corridor approximately 0.3 mile west of the TAPS PS 8. The Alternative 2 site is approximately 0.1 mile north of Johnson Road on undeveloped (forested) land, and is also just west of the powerline corridor approximately 0.4 mile from TAPS PS 8. This compares to the proposed site, which is approximately 1.3 miles north of Johnson Road and TAPS PS 8, also on undeveloped (forested) land, and also on the western edge of the powerline corridor. The Alternative 1 site location would require an adjustment of the mainline alignment to match the compressor station layout, whereas the Alternative 2 site and proposed site would not require a mainline adjustment. [Note: These proposed alternatives are still under evaluation and will be updated in the final report.]

10.6.2.7 George Lake Compressor Station

APP identified two alternatives to the proposed George Lake Compressor Station site, which are depicted on Figure 10.6.2-7. The Alternative 1 site is located at AMP 579.9 approximately 0.8 mile southeast of the proposed site. The Alternative 2 site is also located at AMP 579.9 and is approximately 1.1 miles east of the proposed site. All of the sites generally meet the siting criteria identified in Section 10.6.2, except for maintaining at least 1 mile of distance from NSAs. Table 10.6.2-6 provides a comparison of key environmental and constructability considerations of the proposed site and the two alternative sites.

Figure 10.6.2-7
US-02-012-007
Alaska Pipeline Project
George Lake Compressor Station - Alternative

TABLE 10.6.2-6

Alaska Pipeline Project
George Lake Compressor Station Site Alternatives Comparison

Key Comparative Factors	Proposed Site (AMP 579.1)	Alternative 1 Site (AMP 579.9)	Alternative 2 Site (AMP 579.9)
NSAs	Yes, 3 residences located approximately 0.3, 0.5, and 0.5 mile from site, respectively.	Yes, 3 residences located approximately 1.1, 1.3, and 1.3 miles from site, respectively.	Yes, 3 residences located approximately 1.1, 1.3, and 1.3 miles from site, respectively.
Distance to existing road	Less than 0.1 mile.	Less than 0.1 mile.	Less than 0.1 mile.
Land use	Undeveloped.	Partially disturbed (granular materials site).	Partially disturbed (granular materials site) and partially on agricultural land.
Drainage	Good.	Good.	Good.
Topography	10 feet sloped from south to north.	20 feet sloped from west to east.	20 feet sloped from west to east.

All sites are located equally less than 0.1 mile from the Alaska Highway on forested land, except the Alternative 1 site is on the south side, and the proposed site and Alternative 2 site are on the north side of the highway. The principal advantage of the alternative sites is that they are located more than 1 mile from potential NSAs, whereas the proposed site is within 1 mile of the NSAs. In addition, the Alternative 1 site is located directly adjacent to an existing disturbed granular material site and the Alternative 2 site is located partially over an existing disturbed granular material site, whereas the proposed site is not adjacent to a disturbed site. The Alternative 2 site partially overlaps actively cultivated land, but both the proposed site and the Alternative 1 site avoid agricultural land, however, the Alternative 1 site location would require an adjustment of the mainline pipeline alignment to match the compressor station layout. [Note: These proposed alternatives are still under evaluation and will be updated in the final report.]

10.6.2.8 Tetlin Junction Compressor Station

APP identified two alternatives to the proposed Tetlin Junction Compressor Station site, which are depicted on Figure 10.6.2-8. The Alternative 1 site is located at AMP 669.1 approximately 1.1 miles northwest of the proposed site. The Alternative 2 site is located at AMP 669.6 approximately 0.6 miles northwest of the proposed site. All of the sites generally meet the siting criteria identified in Section 10.6.2, including avoidance of NSAs, and all are located north of the Alaska Highway. Table 10.6.2-7 provides a comparison of key environmental and constructability considerations for the proposed site and the two alternative sites.

TABLE 10.6.2-7

Alaska Pipeline Project
Tetlin Junction Compressor Station Site Alternatives Comparison

Key Comparative Factors	Proposed Site (AMP 670.2)	Alternative 1 Site (AMP 669.1)	Alternative 2 Site (AMP 669.6)
NSAs	No.	No.	No.
Distance to existing road	0.1 mile.	1.0 mile.	0.8 mile.
Land use	Undeveloped.	Undeveloped.	Undeveloped.
Drainage	Good.	Good.	Good.
Topography	75 feet sloping from north to south.	25 feet sloping from east to west.	125 feet sloping from northeast to southwest.

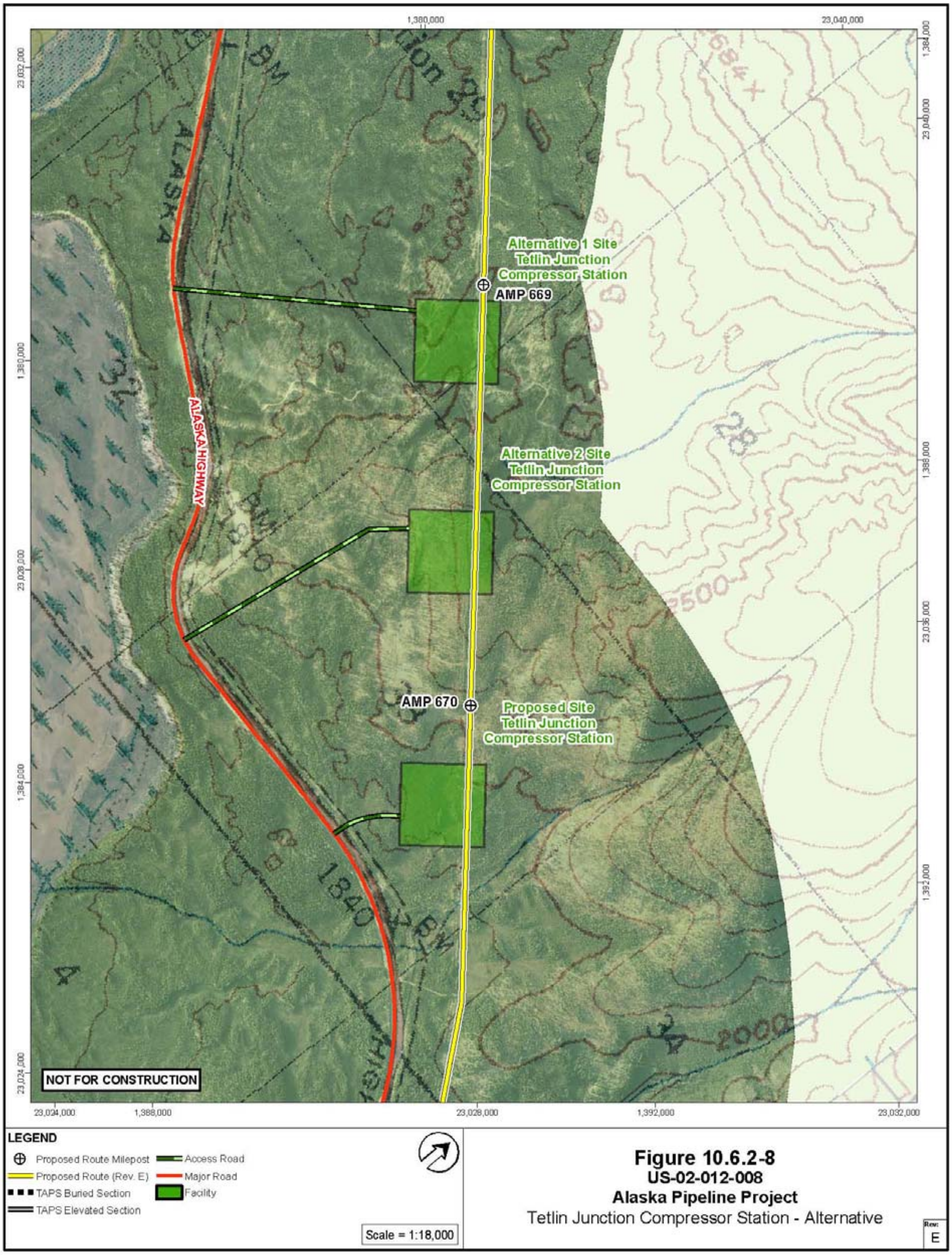

Figure 10.6.2-8
US-02-012-008
Alaska Pipeline Project
Tetlin Junction Compressor Station - Alternative

The principal advantage of the alternative sites is that based on field observations they are in a higher and drier area than the proposed site, and they may have better soil conditions, whereas the proposed site appears to have poor soil conditions. The principal disadvantages of the alternative sites are that they are farther from the Alaska Highway, whereas the proposed site is closer by 0.9- and 0.7-mile, respectively. [Note: These proposed alternatives are still under evaluation and will be updated in the final report.]

10.7 REFERENCES

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