West Susitna Access Reconnaissance Study
West Susitna Access to Resource Development

Transportation Analysis Report

6 EVALUATION OF PROPOSED ACCESS ROUTES

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Acronyms

AAC	Alaska Administrative Code
AASHTO	American Association of State Highway and Transportation Officials
ADF&G	Alaska Department of Fish and Game
ADL	Alaska Division of Land
AEA	Alaska Energy Authority
AIDEA	Alaska Industrial Development and Export Authority
AMHT	Alaska Mental Health Trust
ANCSA	Alaska Native Claims Settlement Act
ARDF	Alaska Resource Data File
ARTEC	Alaska Railbelt Transmission and Electric Company
AS	Alaska Statute
ASCMCRA	Alaska Surface Coal Mining Control and Reclamation Act
ATV	all-terrain vehicle
bbl	barrels
BIF	best interest finding
BLM	U.S. Bureau of Land Management
bpd	barrels per day
CEA	Chugach Electric Association
CBM	Coalbed Methane
CIE	Cook Inlet Energy, LLC
CIRI	Cook Inlet Region, Inc.
CWA	Clean Water Act
DEM	digital elevation model
DGGS	Division of Geologic and Geophysical Surveys
DNR	Alaska Department of Natural Resources
DOF	Division of Forestry
DOG	Division of Oil and Gas
DOT&PF	Alaska Department of Transportation and Public Facilities
DPOR	Department of Parks and Outdoor Recreation
EIS	environmental impact statement
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FMU	Forest Management Unit
GIS	Geographic Information System
GMU	Game Management Unit
KPB	Kenai Peninsula Borough

KPEDD	Kenai Peninsula Economic Development District
LNG	liquid natural gas
mcf	million cubic feet
MEA	Matanuska Electric Association
Mgal	million gallons
ML&P	Municipal Light and Power
MLW	Mining, Land and Water
MOA	Municipality of Anchorage
MSB	Matanuska-Susitna Borough
MW	megawatt
NHCC	National Highway Construction Cost Index
NPR-A	National Petroleum Reserve – Alaska
NWI	National Wetlands Inventory
OPMP	Office of Project Management and Permitting
PGDHS	A Policy on Geometric Design of Highways and Streets
PGE	platinum group elements
ROD	Record of Decision
RM	river mile
SRR	State Recreation River
SRS	State Recreational Site
syngas	synthetic gas
UCG	underground coal gasification
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

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6 EVALUATION OF PROPOSED ACCESS ROUTES

This section presents a comparison of the proposed routes developed for providing access to resources in the Susitna River basin. Because this is a reconnaissance-level study, the comparative analysis is based on existing available information. Numbers provided in this quantitative analysis present a broad picture of potential impacts and large swaths of resources to which access is provided.

One purpose of this report is to evaluate and compare the strengths (opportunities) and weaknesses (impacts) of the proposed access routes. This section explores some of the strengths and weaknesses of each route by utilizing a disaggregate method to describe opportunities and impacts for each route based in "natural" units. These measurements include physical units, monetary terms, or other quantifiable engineering and environmental terms. At this point, these access routes have been developed only to a reconnaissance level and could shift significantly in the future based on further study and refinement when more data become available, and therefore could result in different impacts.

6.1 Resource Accessibility

One of the key considerations of the proposed routes is opening up access to the identified resources. To determine how many acres of resources would be made accessible, a 5-mile-wide buffer on either side of the centerline (10 miles total) was applied to each of the proposed access routes. The assumption was that if an access route were provided into these areas, an interested party (claim/lease holder or land owner) would add their own infrastructure up to within 5 miles from the proposed route centerline. The study team recognizes the 5-mile-wide buffer on either side as a reasonable distance from which interested landowners could connect their own infrastructure. It is also true that access connections to the main spine road could also be made. This may be especially true in the northwest portion of the Study Area where there are numerous mineral deposits and mining claim clusters that extend outside of the 10 mile corridor. However, to quantify resources that are made accessible using the data available in GIS, a specific distance needed to be chosen and 5 miles (10 mile buffer) was deemed reasonable.

Table 6-1 summarizes resources accessed within the 10-mile buffer by each access route. Figure 6-1 through Figure 6-3 depict this graphically for mining, oil and gas, forestry/timber, and agricultural resources. To quantify the amount of recreational resources made accessible, (State Recreation Rivers, State Recreation Areas and State Refuges within the Study Area were evaluated in GIS to calculate acreages accessed using the same buffer width.[156]

[156] The study team recognizes the limitations in using this methodology to assess the amount of recreational resources made accessible. This approach discounts the importance of lands other than State Recreation Rivers, State Recreation Areas, and State Refuges in providing areas of hunting, fishing, wildlife viewing, and other types of outdoor recreation such as camping or access to recreational cabins. The study team recognizes the southern portion of the Study Area is more readily accessible by existing means, whereas the lands made accessible by the access routes in the middle of the Study Area would create new access opportunities for moose and ptarmigan hunting, for example. While not the most ideal methodology, there is not a readily comparable way to measure recreational access quantitatively using GIS.

Table 6-1. Summary of Amount of Resources Made Accessible within a 10-mile Buffer of Proposed Routes ("Route Strengths")

Resources Accessed	North Petersville Road	North Skwentna	Middle Susitna-Skwentna River	Beluga	Deshka Variant
Hardrock minerals					
Claims/Leases (#)	404	676	688	8	68
Acres of claims/leases accessed	39,104	79,306	78,788	16,668	2,353
Placer gold mining					
Claims (#)	3	4	5	0	0
Coal					
Acres of leases accessed	119,655	103,438	264,258	288,278	81,624
Oil and gas					
Permits/Leases (#)	2	10	28	158	10
Acres of permits/leases accessed	7,245	70,599	87,760	109,919	183,392
Forestry/Timber Resources					
Acres Accessed	56,618	150,290	179,049	43,674	97,718
Agriculture					
Acres Accessed	0	0	7,262	0	21,132
Recreation [1]					
Acres Accessed	19,439	15,899	61,643	116,025	21,968

Analysis based on a 10-mile-wide corridor, 5 miles on either side of the proposed route centerline.

As further detailed in the footnote of Table ES-1, colored shading was used to comparatively indicate the more or less favorable metrics.

Green = Proposed access route(s) with the greatest number of claims, leases, or acres of resources accessed.

Red = Proposed access route(s) with the fewest number of claims, leases, or acres of resources accessed.

[1] Recreation resources accessed, as listed in the table, represents State-identified parks, refuges and recreation areas, as stated earlier. One could argue most of the land in the Study Area provides recreational opportunities.

Compared to other routes, the North Skwentna route provides access to the greatest number of acres of hardrock mineral resources. Due to the length of this route, the Middle Susitna-Skwentna River route provides access to the greatest number of claims and acreages of a number of resources, including hardrock minerals, placer gold mining claims, and the potential for forestry/timber resources. Compared to other routes, the Beluga Access route provides access to the greatest number of acres of coal resources and second greatest acreage of oil and gas resources.

Figure 6-1. Mining Resources within a 10-mile Buffer of Proposed Routes

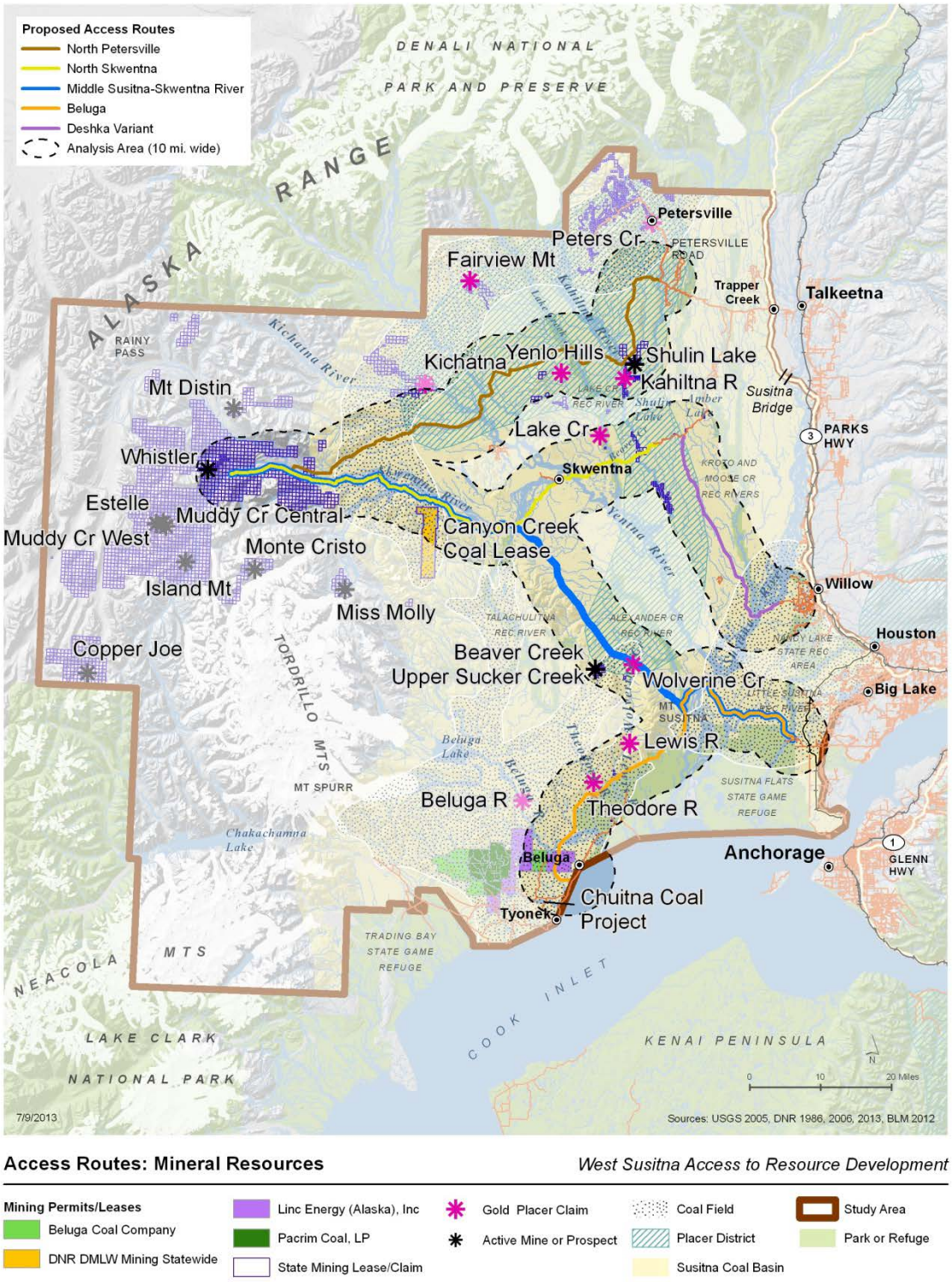
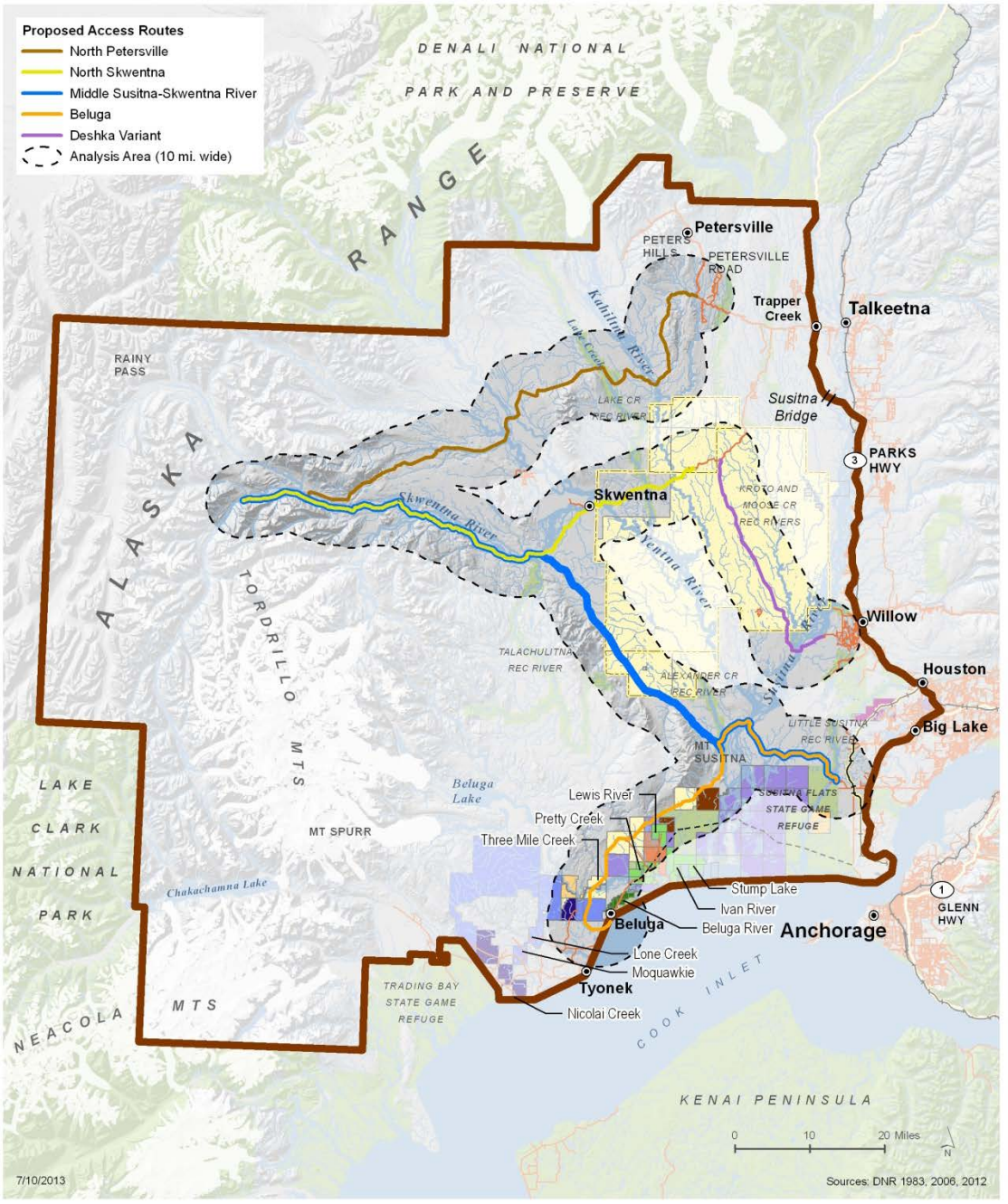


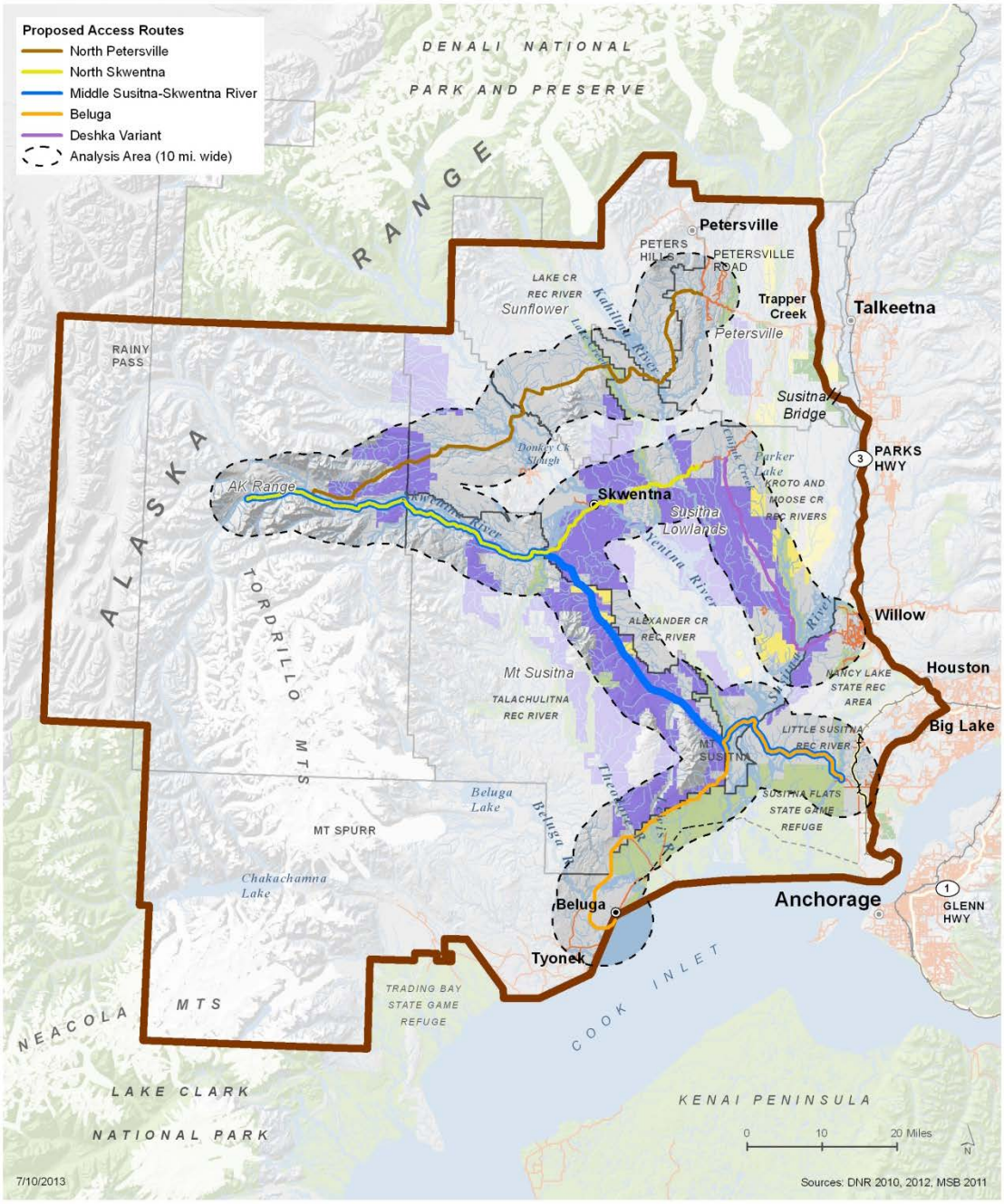
Figure 6-2. Oil and Gas Resources within a 10-mile Buffer of Proposed Routes



Access Routes to Oil and Gas Permits/Leases *West Susitna Access to Resource Development*

Oil and Gas Permits/Leases
- Apache Alaska Corp.
- Aurora Exploration
- Aurora Gas
- Conocophillips AK, Inc
- Cook Inlet Energy
- Escopeta Oil & Gas Corp.
- Hilcorp Alaska
- Linc Energy AK, Inc.
- Pacific Energy AK Operation
- Storm Cat Energy Corp.
- Susitna Exploration License Area
- Study Area
- Park or Refuge

Figure 6-3. Forestry/Timber and Agricultural Resources within a 10-mile Buffer of Proposed Routes



6.2 Land Status

The status of general land ownership was presented in Section 4.4 and Table 4-2. To determine a preliminary quantity of land that would be impacted by land owner, a 200-foot-wide ROW buffer (100 feet on both sides of the centerline) was applied within GIS. Land ownership is generalized, based upon the DNR 2013 General Land Status database, which approximates land status at the section level. Data limitations exist and ownership types are aggregated for planning purposes only. The acreage of land by land owner type for each access route is shown in Table 6-2.

Compared to other routes, the North Petersville Road and North Skwentna route options utilize the most State land within 100 feet on either side of their centerlines. As previously presented, utilizing state lands is viewed as a strength or opportunity.

Table 6-2. Land Status within a 200-foot-wide ROW of Proposed Access Routes

Land Type (by acres)	North Petersville Road	North Skwentna	Middle Susitna-Skwentna River	Beluga	Deshka Variant
Federal	-	-	-	-	-
State	1,510	1,275	1,717	640	484
Borough	17	-	461	704	113
Native	-	-	-	31	-
Private	383	462	388	97	216

Analysis based on a 200-foot-wide buffer, 100 feet on either side of the proposed route centerlines.

As further detailed in the footnote of Table ES-1, colored shading was used to comparatively indicate the more or less favorable metrics.

Green = Proposed access route(s) utilizing greatest amount of land identified as an opportunity.

Red = Proposed access route(s) utilizing greatest amount of land identified as a constraint.

6.3 Wetlands

Information on wetlands in the Study Area and available wetlands data was presented in Section 4.4. A significant portion of the Study Area has no NWI wetlands mapping. Routes going through the Study Area that are located in areas that have no available wetlands mapping include North Petersville Road, North Skwentna, and Deshka. Acres of wetlands impacted for each access route, based on available data, is shown in Table 6-3.

Table 6-3. Wetlands Potentially Impacted within a 200-foot-wide ROW of Proposed Access Routes

	North Petersville Road	North Skwentna	Middle Susitna-Skwentna River	Beluga	Deshka Variant
Wetlands impacted [1] (acres)	42.1	215	217.5	123.7	137.2

Analysis based on a 200-foot-wide buffer, 100 feet on either side of the proposed route centerline.

Wetland impacts determined through GIS intersection analysis of NWI database and a 200-foot-wide corridor.

[1] Acreages are greatly underreported for the North Petersville access route, and to a lesser extent for the eastern portion of the North Skwentna access route and Deshka variant, due to a large area of no wetlands data within the NWI database.

6.4 Terrain Types and Road Grades

The terrain in the Study Area is characterized by relatively flat and rolling terrain to the east, which gains relief as it becomes more rolling and mountainous terrain farther west towards the foothills of the Alaska Range. Terrain and ground profiles along the access routes were classified as level, rolling, or mountainous, according to the values listed in Table 6-4 and shown in Figure 6-4. Profiles of the existing ground line were created along the centerline of the access route using GIS. A 200-foot buffer (100 feet on either side of the centerline) was created to give a representation of the terrain in proximity to the routes. Length and percent of the route for each terrain type classification is summarized in Table 6-5. Terrain type is considered for cost estimating and constructability purposes.

Table 6-4. Terrain Types

Terrain Type	Ground Profile Along the Access Route (% grade)
Level	< 10
Rolling	10-25
Mountainous	> 25

The North Skwentna access route runs through the greatest percentage of mountainous terrain compared to the other access routes. The Beluga access route and Deshka variant are mostly located in level terrain (67 percent and 84 percent of their routes, respectively) with only 5 percent and 3 percent, respectively, of their alignments going through mountainous terrain. The amount of mountainous terrain will likely affect the roadway construction cost and its operational efficiency. Should these routes be furthered for evaluation, the alignments should be refined to make better use of the level/flat terrain.

Table 6-5. Terrain Type by Proposed Access Route

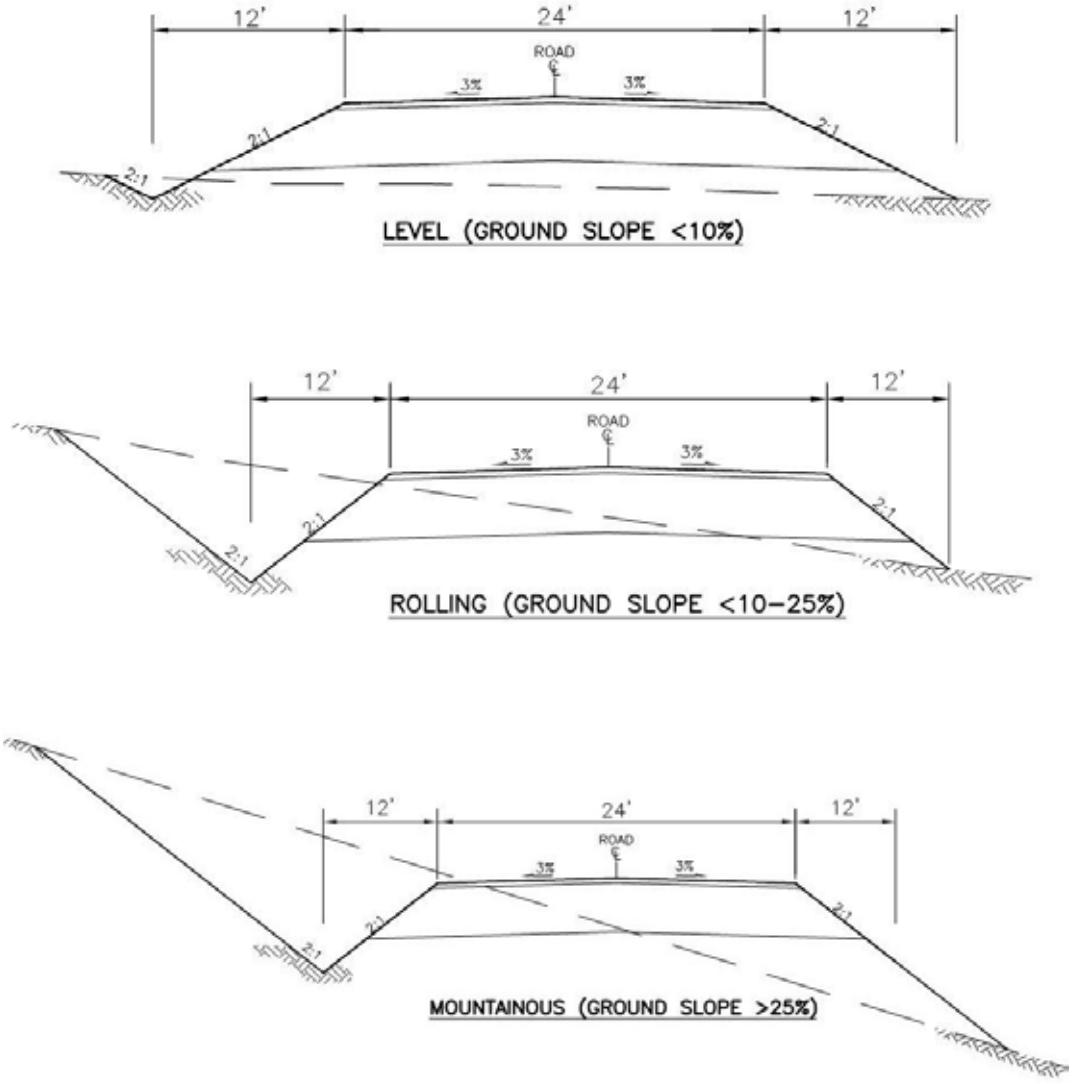
		North Petersville Road	North Skwentna	Middle Susitna-Skwentna River	Beluga	Deshka Variant
Length (miles)		78.8	71.6	107.9	63.8	33.5
Terrain type						
Level	Miles	31.3	31.4	48.1	42.9	28.2
	% of route	*40*	*44*	*45*	*67*	*84*
Rolling	Miles	25.7	16.3	29.14	18.33	4.63
	% of route	*33*	*23*	*27*	*29*	*14*
Mountainous	Miles	21.92	24.1	31.15	2.91	0.85
	% of route	*28*	*34*	*29*	*5*	*3*

As further detailed in the footnote of Table ES-1, colored shading was used to comparatively indicate the more or less favorable metrics.

Green = Proposed access route(s) through the most amount of level terrain.

Red = Proposed access route(s) through the most amount of mountainous terrain.

Figure 6-4. Typical Road Cross Section by Terrain Type



6.5 Seismicity

The Study Area is located in one of the most seismically active areas in the country. In particular, the Beluga access route appears to follow a significant portion of the Castle Mountain fault in the southern end of the Susitna lowlands. Seismicity should be a consideration for any access route moved forward. A neotectonic study may be warranted to map active surface traces of faults and to evaluate the local ground motions that may be generated by significant events. Such a study would also cover liquefaction, tectonic folding or warping of the ground surface, as well as secondary tectonic ground deformation (i.e., slope stability, lateral spread, and rock fall).

6.6 Hydrologic Considerations

All the proposed access routes cross major rivers and numerous drainages, requiring multiple bridge structures and culverts, as highlighted in Table 6-6.

Table 6-6. Hydrologic Considerations by Proposed Access Route

	North Petersville Road	North Skwentna	Middle Susitna-Skwentna River	Beluga	Deshka Variant
Length (miles)	78.8	71.6	107.9	63.8	33.5
Bridges (#)					
Conventional [1]	9	12	20	11	1
Long span [2]	4	6	4	2	2
Total	13	18	24	13	3
Bridges (>1,000 feet)	1,150 (Yentna)	1,200 (Yentna) 1,200 (Hayes)	1,200 (Hayes) 1,640 (Susitna)	1,640 (Susitna)	1,200 (Susitna)
Culverts (#)					
Large [3]	12	12	14	6	2
Small [4]	37	26	40	12	11
Minor drainage [5]	316	292	440	260	136

As further detailed in the footnote of Table ES-1, colored shading was used to comparatively indicate the more or less favorable metrics.
Green = Proposed access route(s) with the least number of bridges and culverts required.
Red = Proposed access route(s) with the greatest number of bridges and culverts required.
Assumptions:
[1] Conventional bridges are considered less than 300 feet in length.
[2] Long span bridges are 300 feet or longer.
[3] Culverts are approximately 96 feet or longer.
[4] Small culverts and minor drainage culverts have an assumed length of approximately 50 feet.
[5] An additional four culverts per mile to accommodate minor drainage patterns.

6.7 Geological and Geotechnical Considerations

Numerous glaciers are found in the Alaska Range and extend down valleys to near the edges of the lowlands. Glacially carved bedrock, moraines, drumlins, and kettle lakes are some of the landforms in the Study Area that are constantly being reshaped by continuous erosional processes. A reconnaissance-level geotechnical evaluation of the proposed access routes was performed for this study, as included in Appendix C and summarized briefly in this section.

A limited amount of quantifiable data is available to evaluate the geologic and geotechnical conditions, and therefore was evaluated on a qualitative basis. Table 6-7 represents the suitability for a road corridor based on a number of geologic and geotechnical considerations.

It is possible geotechnical challenges may arise for the following access routes:

- North Petersville Road access route: potential constraints due to Pass Creek fault
- Middle Susitna-Skwentna River access route: potential constraints due to Castle Mountain fault
- Beluga access route: Potential constraints due to Castle Mountain fault

Table 6-7. Geologic and Geotechnical Considerations by Proposed Access Route

	North Petersville Road	North Skwentna	Middle Susitna-Skwentna River	Beluga	Deshka Variant
Rock borrow availability	Medium	Eastern half poor Western half good	Eastern half poor Western half good	Poor	Poor
Rock borrow quality	Poor	Eastern half poor Western half good	Good	Good	Poor
Soil borrow availability	Good	Good	Eastern half medium Western half good	Eastern half medium Western half good	Good
Soil borrow quality	Medium	Good	Eastern half medium Western half good	Eastern half medium Western half good	Good
Foundation support	Medium	Eastern half poor Medium	Medium	Medium	Poor
Permafrost conditions	Medium	Good	Eastern half good Western half medium	Good	Good
Subgrade support	Medium	Eastern half poor Western half good	Eastern half poor Western half good	Eastern half poor Western half good	Poor
Drainage	Good	Eastern half poor Western half good	Eastern half poor Western half good	Eastern half poor Western half good	Poor

As further detailed in the footnote of Table ES-1, colored shading was used to comparatively indicate the more or less favorable metrics.

Green = Proposed access route(s) with the greatest (optimum) availability/quality of rock borrow and soil borrow, in addition to most suitable drainage, subgrade support, foundation support, and permafrost conditions.

Red = Proposed access route(s) with the least (poorest) availability/quality of rock borrow and soil borrow, in addition to most suitable drainage, subgrade support, foundation support, and permafrost conditions.

See the Table on page 9 in the Geotechnical Reconnaissance Report in Appendix C for greater detail for how the geotechnical considerations were ranked and evaluated.

Rock Borrow Availability

In general, rock borrow sources are readily available along the access routes as they go further westward. Routes toward the eastern portion of the Study Area have no significant sources of rock borrow material. The North Petersville Road route has readily available rock materials scattered relatively widely along the alignment, with more available in the west. The Beluga route and Deshka Variant have no significant sources of rock borrow material.

Rock Borrow Quality

There is a potential for relatively high quality soil materials to be available, especially in glacial outwash and frequent alluvial/terrace formations, as found in the eastern portion of the North Skwentna route. For the Beluga route, the only rock source available appears to be intrusive igneous rocks (granodiorite) on the northeast end at the foot of Mount Susitna, which should yield relatively durable, high quality materials.

Soil Borrow Availability

In general, soil borrow materials area readily available along all the proposed routes.

Soil Borrow Quality

As with the relative availability of soil borrow materials, the quality of soil borrow materials along the proposed routes seems potentially high.

Foundation Support

Overall, foundation support conditions are anticipated to be relatively favorable, though pile foundations will likely be needed to varying depths.

Permafrost Conditions

The potential for permafrost along the North Petersville route is likely the greatest in comparison to the other routes in this study. Permafrost soils can be expected in higher elevations and on the north side of topographic high areas. Some of the low, poorly drained, boggy areas may also be underlain by permafrost soils.

Subgrade Support

In general, subgrade support is anticipated to be highly variable along the routes, and drainage in the boggy areas may be a challenge in design and construction. Routes in the western portion of the Study Area are likely to encounter more optimum subgrade support conditions than the eastern portion of the Study Area.

Drainage

All proposed routes will require frequent crossings of wetland/boggy areas.

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