WESTERN ALASKA ACCESS PLANNING STUDY

INVENTORY REPORT

March 2009

Prepared by:

DOWL HKM

TRANSPORTATION & PUBLIC FACILITIES
STATE OF ALASKA

WESTERN ALASKA ACCESS PLANNING STUDY

INVENTORY REPORT

DOT&PF Project No. 60800

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W.O. D60060

March 2009

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LIST OF ACRONYMS

AEA ..... Alaska Energy Authority
DOT&PF ..... State of Alaska Department of Transportation and Public Facilities
GIS ..... geographic information system
WAAPS ..... Western Alaska Access Planning Study

EXECUTIVE SUMMARY

The purpose of the Western Alaska Access Planning Study is to determine if a road connection between the contiguous national highway system and the isolated road system on the Seward Peninsula is technically and economically feasible. The length of the road is approximately 600 miles, depending on the route that is ultimately selected.

The study area contains a number of resources that could benefit from the proposed road connection. This report provides information on the quantity, value, and geographic location of the resources evaluated in this effort, although the quality of the information varies for each resource. The report also provides an indicator for the value of current economic activity that occurs in the communities within the study area. A future phase of this project will build on the information presented in this report to evaluate the technical and economic feasibility of the road.

At this stage in the planning process it is important to determine if the potential value of the resources is likely to be more than the cost of building a road to the Seward Peninsula. This report has focused on estimating the gross values of the identified resources, although in a benefit-cost analysis the net margin or profit of a project is used to estimate the benefits of a mine or other resource development project.

Table 1 illustrates estimated gross resource values for the study area, by resource or communities, as described in the following report sections and the resource papers presented in the appendices.

Table 1: Summary of Estimated Resource Values (Gross)

Resource	Gross Value ($ Billion)
Minerals	25
Oil, Gas	Unknown
Agriculture, Forestry	<0.4
Community Economic Activity	20.2
Fisheries (included in community data)	<0.02
Recreation, Tourism (included in community data)	<.01
Other	Unknown
Total	**45.6**

The resource values presented above are considered to be conservative since the minerals resources are only for known deposits. Community economic activity is based on current populations and current per capita income, and agriculture and forestry values assume sales to local markets only. Yet-to-be-discovered resources, population growth, and other factors are likely to increase these gross values.

If it is assumed that the net margins for the resources shown above are about 10 percent of gross revenue--a reasonable estimate for mining activity--then net benefits from these resources would be about 4.5 billion dollars. These net benefits would compare favorably to a potential cost of about $4 million per mile for a road connection over 600 miles, or $2.4 billion total. These preliminary results using “rules of thumb estimates” would suggest a benefit-cost ratio of about 1.9:1. The next phase of this project will complete a more rigorous evaluation of road corridor locations, costs, and benefits.

1.0 INTRODUCTION

In August 2008, the State of Alaska Department of Transportation and Public Facilities (DOT&PF) contracted with a team of consultants led by DOWL HKM to analyze the potential for constructing a road between the contiguous national highway system and the isolated road system on the Seward Peninsula. The purpose of the Western Alaska Access Planning Study (WAAPS) is to determine if this road connection is technically and economically feasible.

The purpose of this road is to facilitate resource and community development in the region. The length of the proposed highway is approximately 600 miles, depending on the selected route. Consultants involved in the study include DOWL HKM, McKinnon and Associates, Northern Economics, Inc., Hawley Resource Group, Petrotechnical Resources Alaska, and Allied GIS, Inc.

This report provides an overview of initial project work and contains, as appendices, the resource reports prepared for this effort. During this phase, the project team researched information about potential corridors and identified resource development potential including the quantity, quality, value, marketability, and geographic location of known resources.

In the next phase of the project, the team will further identify and evaluate potential corridors, including benefit cost analyses of the most likely corridors. In subsequent phases, the team will gather stakeholder feedback and make final recommendations.

Figure 1 is a map of the study area detailing land ownership, roads, and waterways. Exterior study area boundaries are shown in black. Larger maps that show more detail than those presented in the text are presented in Appendix A.

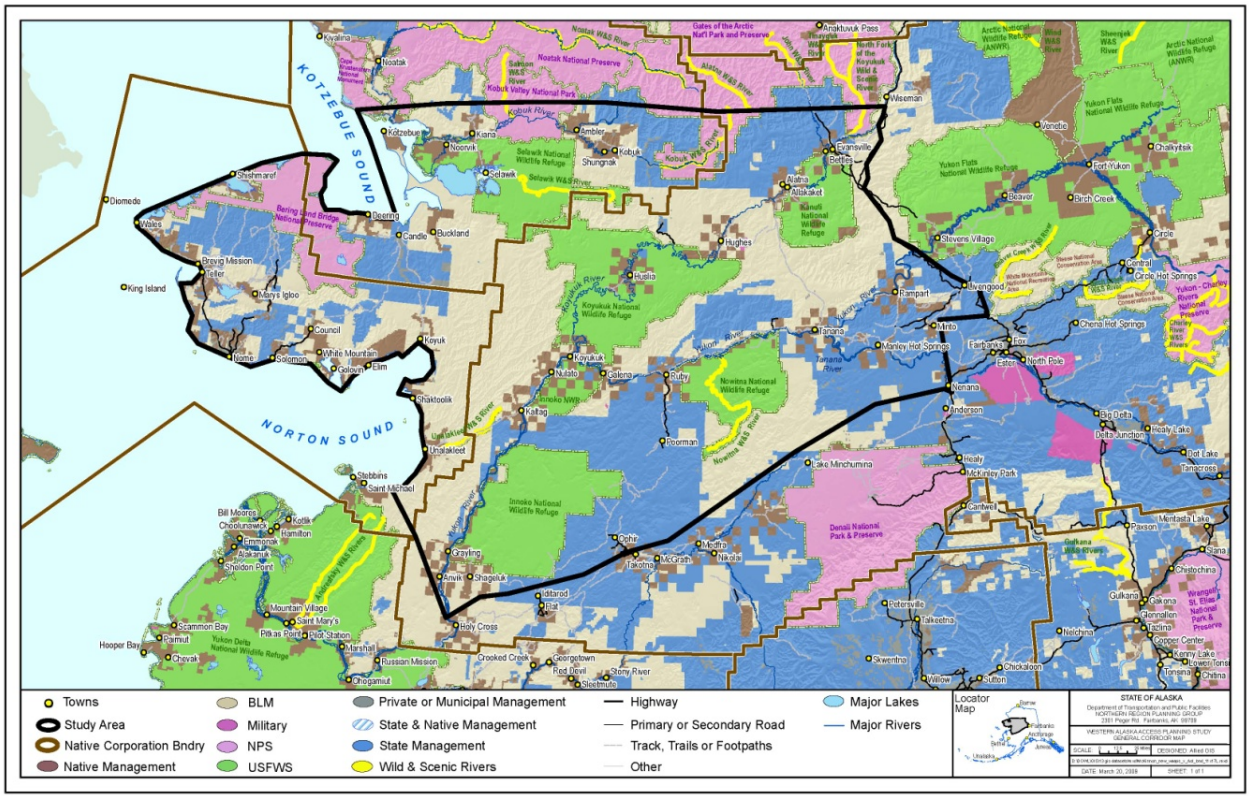


Figure 1: Study Area Map

2.0 RESOURCE DEVELOPMENT OPPORTUNITIES

There are three primary markets for resources located within the study area. Certain resources currently produced within or near the study area, such as zinc, lead, and certain seafood products, are sold into the global marketplace. Other resources such as fish, reindeer meat from the Seward Peninsula, and root vegetables are sold to in-state markets, and these same resources in addition to firewood are also sold in local markets within the study area.

In general, the global economy has a large influence on the development of Alaska's resources. The ability of Alaska's resource industries to influence prices for their products is very limited at the global level since these resource industries generally operate in Alaska's high production cost environments, typical of those found throughout the study area.

In many markets, Alaska is not only a higher-cost producer, but one of the last entrants into a market and the first to be displaced by competition from cheaper products and services from other supply regions. Demand and price for Alaska's export commodities is generally set by the global economy, and Alaska resource industries have a very limited ability to influence prices for

their products. Historically, low-value commodities have been viable only in local or regional markets since transportation costs have precluded global exports except in extreme market conditions.

In subsequent phases of this project, DOT&PF will evaluate the potential that a road connecting the Seward Peninsula with the national highway system will reduce transportation costs and enable development of some of the resources found in the study area.

The purpose of this report is to identify the known resources and attempt to place a gross value on those resources. The following subsections provide information on minerals, oil and gas, fisheries, agriculture, forestry, and tourism and recreation resources found in the study area. Additional information on each of these resources can be found in the appendices to this summary report.

2.1 Minerals

Alaska's mining industry includes exploration, mine development, and mineral production activities. With the recent run-up of mineral prices, mining exploration and development in Alaska has increased dramatically. Up until the end of 2008, the emergence of rapidly developing economies around the world and increased liquidity in financial markets resulted in increased demand for, and speculation in, base and precious metals. Mineral and metal prices have always been highly cyclical and in the last decade, the markets for metals have become more volatile. The recent drastic downturns in market prices for metals are further proof of this volatility.

As noted in the minerals report by Hawley Resources Group in Appendix C, the study area contains a significant part of Alaska's mineral endowment. The study area has produced millions of ounces of gold and silver and millions of pounds of tin, and has large areas that are prospective for minerals. The mineral terranes in the study area are defined in Figure 2 and shown in Figure 3. The most important presently defined resource of copper and base metals is in a nearly east-west belt along the south flank of the Brooks Range at the northern boundary of the study area. Copper, lead, zinc, substantial amounts of gold and silver, and rare metals such as cobalt and germanium are present. Two areas have large gold resources--Nome remains important, but on the basis of recent work, Livengood has a greater gold resource than Nome.

Other parts of the study area contain substantial resources. Tin and tin-affiliated substances including tungsten, beryllium, and fluorite are concentrated in the north half of the Seward Peninsula, but are quite widespread throughout the region.

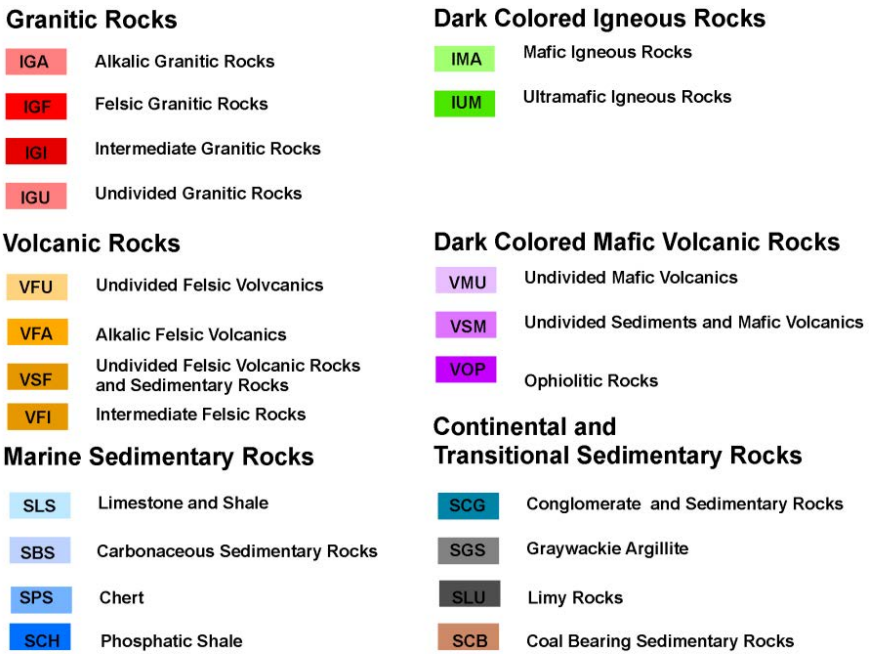


Figure 2: Explanation for Mineral Terrane Map

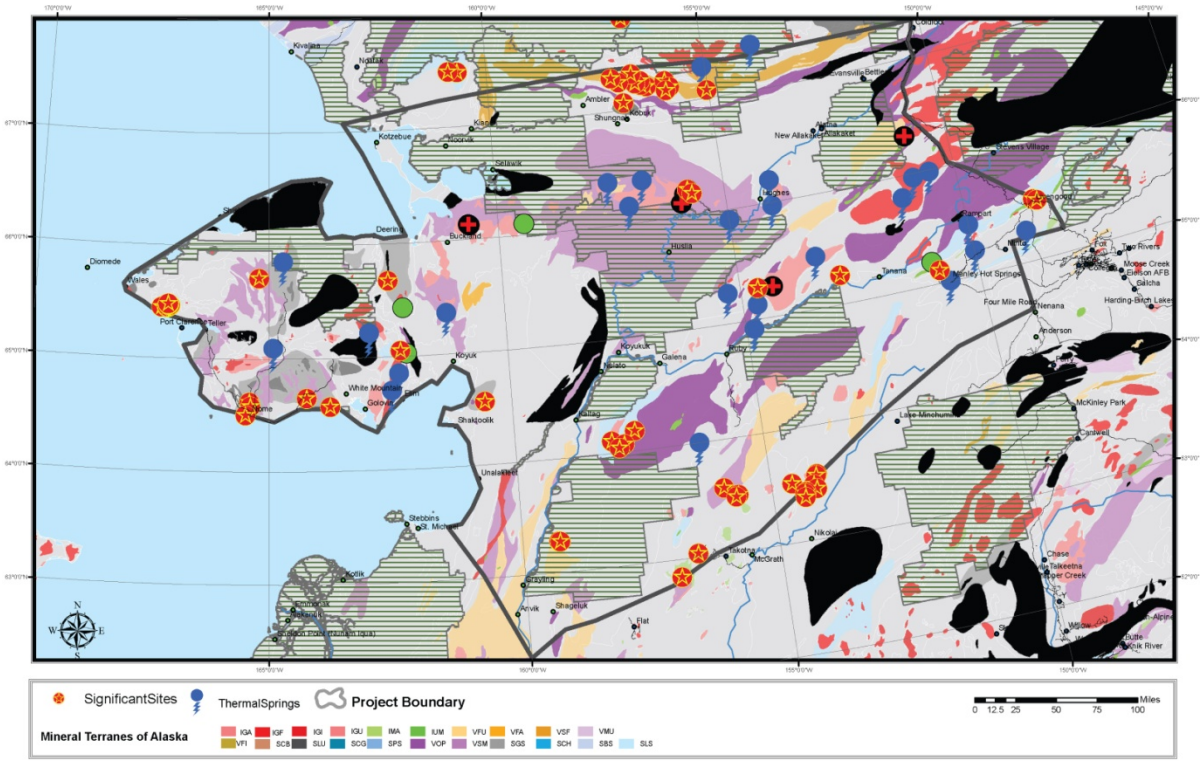


Figure 3: Significant Occurrences and Mineral Terranes

In addition to historically known districts, there are recent discoveries of entire mineral districts exemplified by the Reef Ridge oxide zinc district north of Medfra and the Illinois Creek district south of Galena. Many of the mineral deposits occur along linear trends that suggest naturally defined development corridors. Only the Pebble district in southwest Alaska exceeds western Alaska in copper resource.

The most valuable commodities in the study area are the copper and base metal resources of the South Flank of the Brooks Range. As presently modeled, the resource consists of 4.9 billion pounds of copper, 1.75 billion pounds of lead, and 8.36 billion pounds of zinc with an estimated value of $10.07 billion for copper, $1.03 billion for lead, and $7.36 billion for zinc--a total of $18.46 billion. Accompanying these metals as byproducts are more than 1.4 million ounces of gold and 185 million ounces of silver valued (medium summary) at more than $2.5 billion.

The copper and base metal occurrences in the study area are massive types of deposits that yield dense concentrates of intermediate value that would need bulk transport or smeltering at the mine site for economic development. Low-sulfide ores such as copper porphyries also would yield dense concentrates that need bulk transport.

Gold is the second most valuable commodity of the region. The major gold resources at Nome are estimated at 3.04 million ounces and Livengood at 4.02 million ounces--a total of 7.06 million ounces with a value of $4.89 billion dollars. Substantial gold resources also exist in the Hogatza area, the Innoko district, and the Seward Peninsula away from Nome. Because of its inherent high-unit value, gold is not as sensitive to transport costs as copper and the base metals.

The tin resource of the study area is generally located in the northern half of the Seward Peninsula and is at least five million pounds with a current market value of about $25 million. The geologic resource could be much greater. Uranium prices are fluctuating, and a reported resource of about one million pounds of uranium oxide at Boulder Creek has been downgraded. New uranium occurrences were, however, found nearby--but have not been sufficiently valued to compensate for the loss at Boulder Creek.

Tin and other metals such as uranium, tungsten, and molybdenum are less sensitive to transport than copper porphyries. Porphyry deposits classed as tungsten, gold, uranium, and unusual carbonatite deposits are also found in the study area.

Development of the mineral resources in the study area has been constrained by the scarcity of transportation infrastructure and the difficulty in obtaining access across conservation units in the region. Deposits on the south flank of the Brooks Range have the highest value. Large mines have large energy requirements for electricity and heating. The high cost of transporting diesel fuel to remote mine sites has been an issue for several projects, even those with river-barge access. A road could improve the economics of potential mines by reducing the need to move all of the fuel needed for 10 months of use within a short ice-free season, and reduce the cost of carrying this fuel inventory through the winter and spring. Trucks could deliver the fuel year-round, which might reduce costs. Alternatively, electric transmission lines or natural gas pipelines could be located within a road right-of-way and be routed to major mines for their use. A major load center, such as a mine, would be needed to cover the cost of building such energy infrastructure, but the benefits could extend to communities that are located near such infrastructure, and reduce their costs of electricity and heating.

2.2 Oil and Gas

Alaska's oil and natural gas industries stand apart from other resource industries with respect to the relationship between production and world prices. Alaska's oil and natural gas resources require substantial long-term infrastructure investment. Consequently, once a field comes on stream, the production from that field does not generally change in response to the world price unless the price drops far enough below the field's marginal cost of production to make it cheaper for the producer to close the well rather than continue producing.

Currently, local users of Alaska's natural gas resources are somewhat insulated from the vagaries of the global marketplace; however, as external market prices are factored into natural gas contracts for local utilities and construction of a natural gas pipeline to other North American markets is considered, external markets for natural gas could exert more influence on Alaska natural gas prices and production.

The oil and gas resource paper prepared by Petrotechnical Resources of Alaska and presented in Appendix D of this report notes that some oil and gas exploration has occurred in the study area including the drilling of test wells and aerial observations. Many of the basins with potential are considered under-explored. There has not been any significant production of oil or gas in the study area.

Table 2 shows a summary of the oil, gas, and coal bed methane resources of the study area. These onshore resource basins are labeled in Figure 4 and **Error! Reference source not found.**. Hydrocarbon resources within the study area are thought to be very low except for the Nenana Basin. Two wells drilled there have not encountered commercial quantities of oil or gas, so there is no quantity information and subsequently, there is no value estimate.

Table 2: Hydrocarbon Basins of the Study Area

Basin	Gas Potential	Oil Potential	Coal Bed Methane Potential	Wells Drilled?
Nenana or Middle Tanana Basin	Moderate	Low to Very Low	Yes	Yes
Selawik Basin	Low	Very Low to None	No	Yes
Minchumina and Holitna Basin	Low	Very Low	Yes	No
Nulato No. 1 Well	None	Very Low to None	Yes	Yes
Seward Peninsula	-	-	Yes	Yes
Koyukuk	-	-	Yes	Yes
Offshore Hope Basin	Moderate to Low	Low	No	No
Offshore Norton Basin	Moderate	Low	No	Yes

Figure 4 shows that most of the study area does not contain sedimentary rocks as defined by the sedimentary basins, which are colored green. The orange area in Figure 4 is considered to have very low to no oil and gas potential because appropriate sedimentary rocks to generate and reservoir hydrocarbons are absent. Certain areas outside of the sedimentary basins may have limited coal-bed methane potential if coal is present at depth.

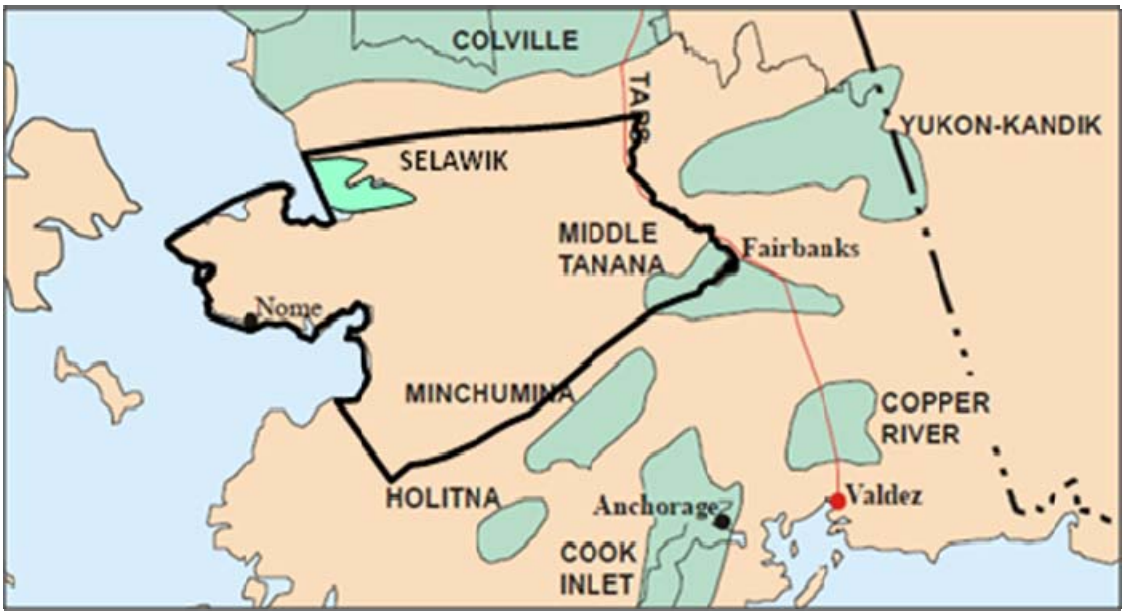
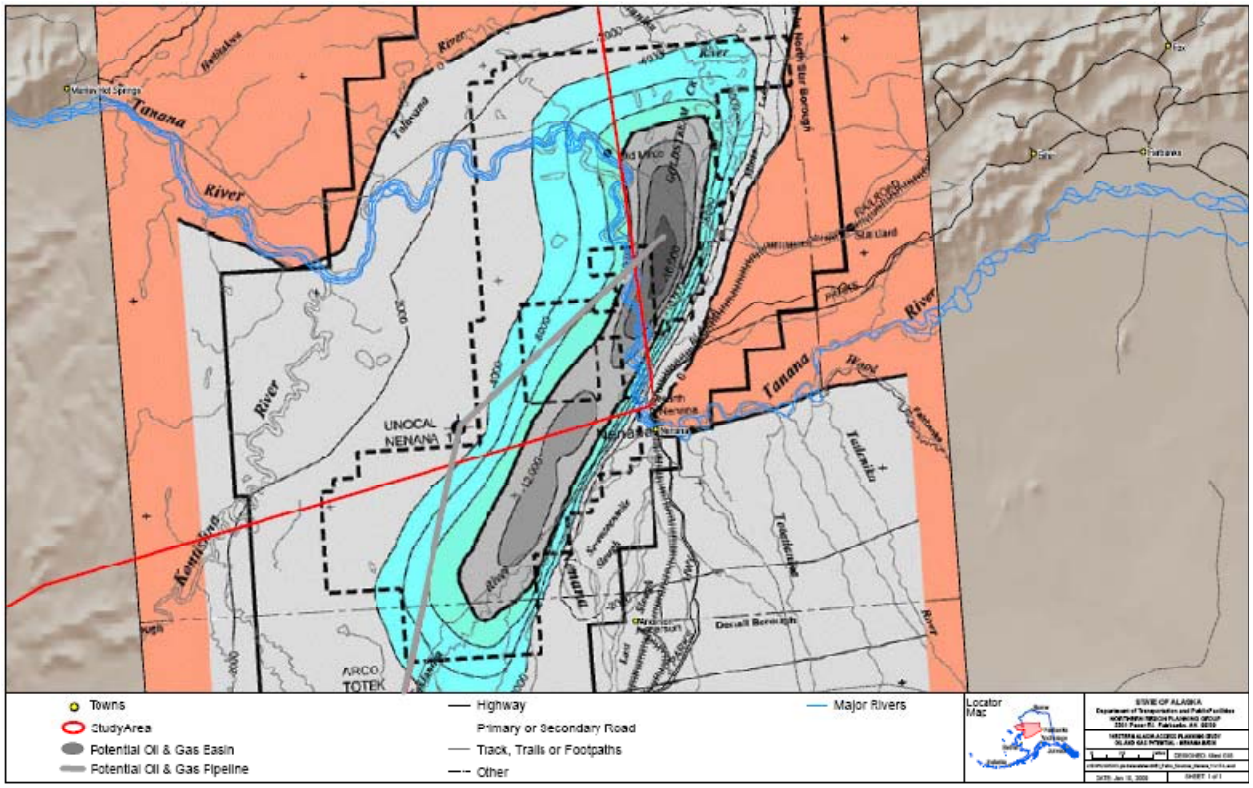


Figure 4: On Shore Basins of The Study Area

No confirmed oil shows are reported for wells in the onshore study area, which includes wells in the Nenana, Selawik, and Galena areas. Wells in the offshore Norton Sound basin south of Nome have absent to weak oil shows.

Unlike oil, gas has been found in various wells in the study area. Several wells near Kotzebue found shallow gas that is rich in methane and contained only traces of ethane and longer molecules. This gas is likely biogenic and originated from decaying organic matter at shallow depth. No well in the Kotzebue area measured significant amounts of gas during a flow test. Two wells in the Middle Tanana (Nenana) basin found minor amounts of methane gas associated with coal, but no evidence of oil. Another well located in the center of the study area near Galena had no indications of oil or gas. Several wells in the offshore Norton basin had gas shows during drilling, but these shows were not tested.

Interest in potential gas resources in the Nenana basin has increased in recent years as heating costs have risen substantially in Fairbanks and as the gas reserves in Cook Inlet have continued to decrease. An exploration well was underway in February 2009 to test the oil and gas potential in a deeper part of the Nenana basin. The basin is located on the eastern boundary of the study area (see Figure 5) and in close proximity to existing rail and highway infrastructure. If a commercial discovery is made, a public road in proximity to the reservoir would improve the economics of the discovery, but the absence of such a road is not likely to be a key element in a decision to proceed with development.

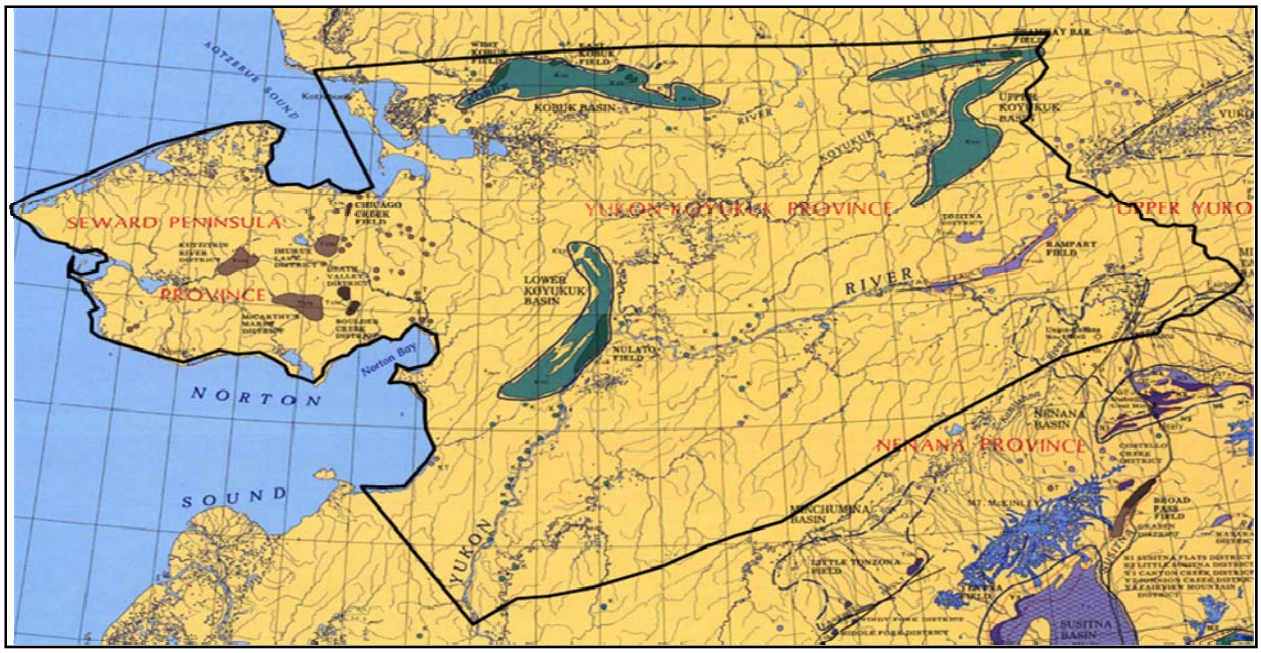


Note: The red line is the southern and eastern boundary for the study area.

Figure 5: Location of Nenana Basin and Study Area Boundary

The coal bed methane potential of much of central Alaska is unknown, but coals are common in several basins. Subsurface coals are particularly common in the Nenana (Middle Tanana) basin, which probably has the highest coal bed methane potential in the study area. Based on the Nenana basin well data, at least thin coals are present at several thousand feet depth, where they may be viable coal bed methane targets if they are sufficiently thick and gas saturated. Shallow coals are found on the Seward Peninsula as a series of isolated, structurally controlled fields of Tertiary age. It is uncertain if these coals are present over a significant area at several thousand feet, the depth typically needed for viable coal bed methane prospects.

Other coal fields in the central Alaska province may have coal bed potential (See Figure 6), but available information is usually limited to sparse data on outcrops or from near-surface mining.



Source: Merritt and Hawley, 1986

Figure 6: Coal Reserves of the Study Area

2.3 Fisheries

The importance of different fisheries species groups has changed over time in Alaska. Typically, Alaska fisheries are divided into five major species groups: groundfish (that includes pollock and Pacific cod), shellfish, salmon, Pacific herring, and Pacific halibut. While residents and organizations within the study area participate in the groundfish industry, most of this activity occurs far offshore in the Bering Sea and there is very little commercial harvest of groundfish near the study area.

During the late 1980s, salmon generated about half of the total ex-vessel value of Alaska fisheries, while shellfish typically contributed more than one-fifth of the overall value. Since the 1990s, groundfish has dominated the overall value and volume of Alaska's harvest due to the growing demand for "whitefish" in domestic and overseas markets. In 2007, the groundfish fishery accounted for 50 percent of the ex-vessel value of all commercial fisheries off Alaska, while the salmon fishery was second with 20 percent of the total Alaska ex-vessel value.

The fishery resource paper prepared by Northern Economics and contained in Appendix F divided the fishery activity of the study area into two groups: ocean fisheries in the west and

inland fisheries of the upper Yukon River. Table 3 shows the five-year average ex-vessel value of the designated fisheries in each area and the area total.

Table 3: Five-Year Average Ex-Vessel Value of Study Area Fisheries

Fishery	Value ($ Thousands)
Ocean Fisheries	
Norton Sound District Salmon	348
Kotzebue Sound District Salmon	137
Kotzebue Sound District Salmon	1,061
Norton Sound King Crab	197
Norton Sound Gillnet Herring Roe and Bait	137
Norton Sound Beach Seine Herring Roe	-
Ocean Total Average Value	**1,880**
Inland Fisheries	
Fish Wheel Salmon Fisheries	71
Gillnet Salmon Fisheries	11
Inland Total Average Value	**82**

Commercial ocean fisheries adjacent to the study area harvest primarily salmon, red king crab, Pacific halibut, and Pacific herring. The harvest of fish and shellfish species is also an important component of the subsistence economy in the study area, and during a commercial fishing season, many local residents participate in both commercial and subsistence harvest activities. Poor market conditions have been the primary reason for low harvest levels, ex-vessel revenue, and limited effort in the commercial herring fisheries in Norton Sound.

Inland fisheries of the upper Yukon River have accounted for only a small fraction of the commercial harvest of king salmon in the Yukon River, but much of the summer chum salmon harvest has occurred in the area. Low commercial harvests occurred between 1997 and 2002 because of low summer chum salmon runs but summer chum salmon runs have improved since 2001. In most of the upper Yukon River, summer chum salmon flesh is difficult to market due to the high cost of transportation and the degradation caused by freshwater and advancing sexual maturity.

Construction of a highway between the contiguous Alaska Highway system and the highway system on the Seward Peninsula has the potential to foster additional development of commercial fisheries in the study area.

For commercial fisheries a road connection would:

- Provide regional seafood processing facilities with a transportation option for bringing supplies (equipment, packaging, etc.) in and shipping product out.
- Improve access to markets by enabling product to move in refrigerated vans and be trucked to Fairbanks, Anchorage, or other markets and destinations.
- Improve backhaul cargo. Backhaul vans could be loaded with packing materials and other processing supplies, as well as building materials and other products that may be consumed in the area.
- Facilitate deliveries of fuel. Fishers have occasionally had to cease fishing operations due to a lack of fuel.

However, even if road transportation proves to be a less expensive alternative to air or marine service, it will likely continue to cost more to ship fish products to Lower 48 or foreign markets from the study area than it does from processing plants in Southeast or Southcentral Alaska; consequently, processing facilities in the study area will remain at a competitive disadvantage relative to plants in other parts of Alaska.

2.4 Recreation Resources

The state's tourism industry has been affected by recent global events. Following the terrorist attacks of 2001, Alaska appeared as a safe and affordable tourist destination, and the Alaska tourism industry enjoyed an extended period of increasing air visitor arrivals until 2008. During the same period, cruise ship passengers became an increasingly larger portion of Alaska's overall visitor market, with cruise passenger volume increasing by 49 percent between 2001 and 2007, and then dropping significantly with the 2008 recession. The number of cruise ship passengers peaked in 2007, and the number is projected to decline through 2009 and perhaps longer.

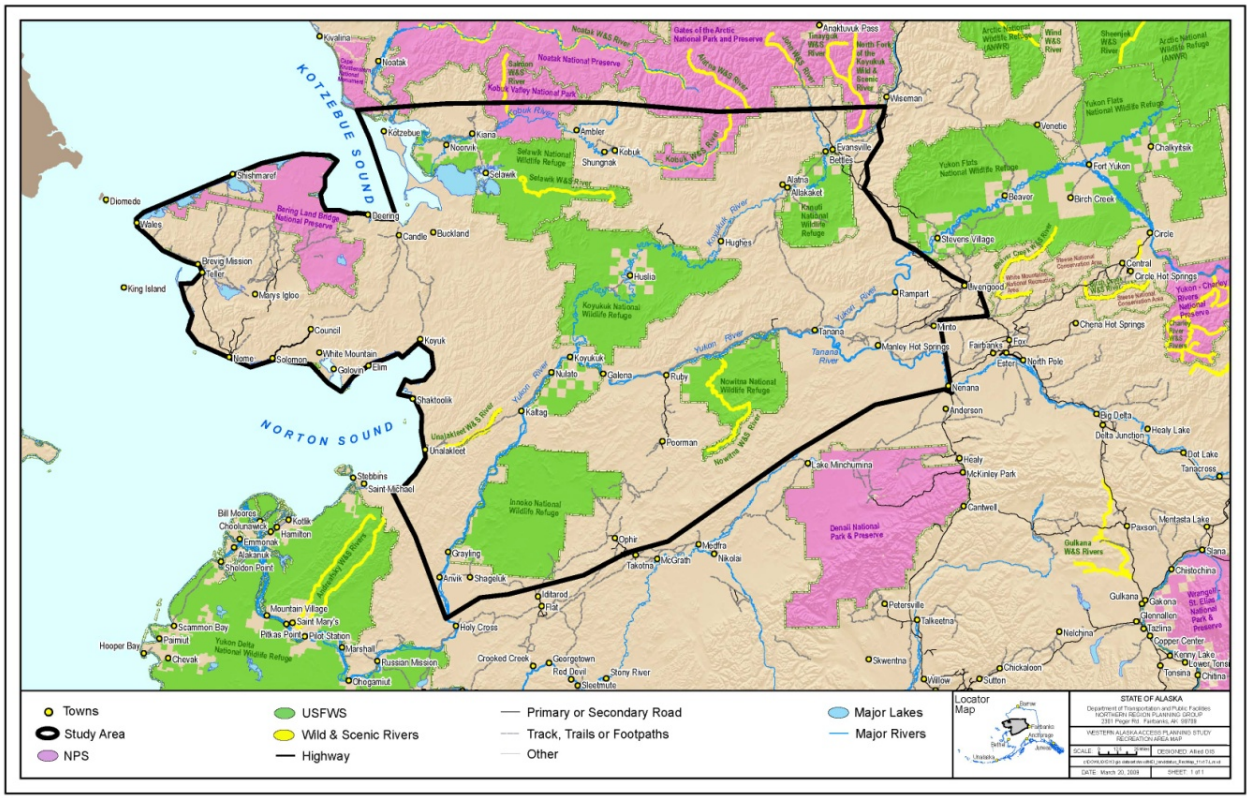
The change in the demographics of Alaska cruise passengers, together with the slowdown in the U.S. economy, may result in lower per capita spending in Alaska by cruise passengers. During the 2001-2007 period, the number of individuals crossing the U.S./Canada border has trended downward likely due to the rising price of fuel.

The only estimate found for the value of tourism in the study area was for Nome. However, the study area includes the remainder of the Nome Census Area, the Yukon-Koyukuk Census Area, and portions of the Northwest Arctic Borough. The 2004 Nome study estimated that tourism brought in $3.7 million per year. The multiplier effect of these dollars circulating in the region was estimated at $4.9 million.

The major tourist and recreational assets in the study area are National Parks and other conservation units, wildlife, Alaska Native culture, and the mining history of certain areas. Tourists coming into the western part of the study area typically reach Nome or Kotzebue by airplane or expedition-class cruise ships. From there, they take small planes to Alaska Native villages for cultural activities or to remote areas for hunting, fishing, backpacking, rafting, and similar activities. Access in the eastern part of the study area typically begins in Fairbanks with potential air travel to Galena, Bettles, or other subregional centers where smaller planes access smaller villages or remote areas. In the winter, Alaska residents and some out-of-state visitors may travel by snowmachine into the study area.

The thousands of square miles of public lands in the study area offer visitors abundant opportunities to pursue these activities. About one-quarter of the land within the study area is federally owned and protected as parks, monuments, preserves, and wildlife refuges. As shown in Figure 7, these federal lands include the following:

- Koyukuk National Wildlife Refuge
- Kanuti National Wildlife Refuge
- Gates of the Arctic National Park and Preserve
- Selawik National Wildlife Refuge
- Noatak National Preserve
- Cape Krusenstern National Monument
- Kobuk Valley National Park
- Bering Land Bridge National Preserve
- Innoko National Wildlife Refuge
- Nowitna National Wildlife Refuge



Source: Alaska Department of Natural Resources at http://www.asgdc.state.ak.us/ and http://www.dggs.dnr.state.ak.us/pubs/pubs?reqtype=digitaldata; National Park Service at http://www.nps.gov/gis/data_info/park_gisdata/ak.htm; DGGS =

Figure 7: National Parks, Monuments, Preserves, Wildlife Refuges, and Wild and Scenic Rivers in the Study Area

Note: A larger map with this information is presented in Appendix A.

Road access to recreational areas would increase visits by reducing travel costs, provide new dispersal sites for the staging of off-road vehicles such as rafts and snowmachines, and create demand for tourist related services, which would increase the area's appeal for some.

Constraints to increased tourism include the expense of travel, competition from other "remote" locations in Alaska, the short peak-visitor season in summer, a lack of tourist related infrastructure, and Native concerns regarding impacts on subsistence resources such as fish and wildlife.

2.5 Forest Products

Forest products such as lumber, rough-sawn timbers, and house logs move to villages in the study area primarily by waterborne barges; several products are supplied by local mills in the eastern portion of the study area.

Overall, wood products have high-volume and low-value characteristics. Lower haul costs enhance market development and could spur entrepreneurs to establish small mills or processing facilities in areas with adequate wood supply. Examples include the City of Tanana, Manley Hot Springs, and Rampart.

Markets for export forest products from Alaska's interior forest have declined as Asian markets have substituted Russian white wood for Alaska's white spruce. Peak markets during the 1980s are not likely to return as higher quality (and higher cost) interior lumber appear to be priced out of Japanese markets. These export harvests are typical of one-time "spot" markets and are not typical of local or regional markets within the study area.

Firewood is the primary forest product consumed from local forest resources within the study area. In many cases, trees are carried downstream by rivers such as the Yukon and are harvested by residents with boats and ropes. As spring floods recede, claimed logs dry out and are processed into firewood using chain saws, hand and machine splitters, and are then delivered by all terrain vehicles or snowmachines.

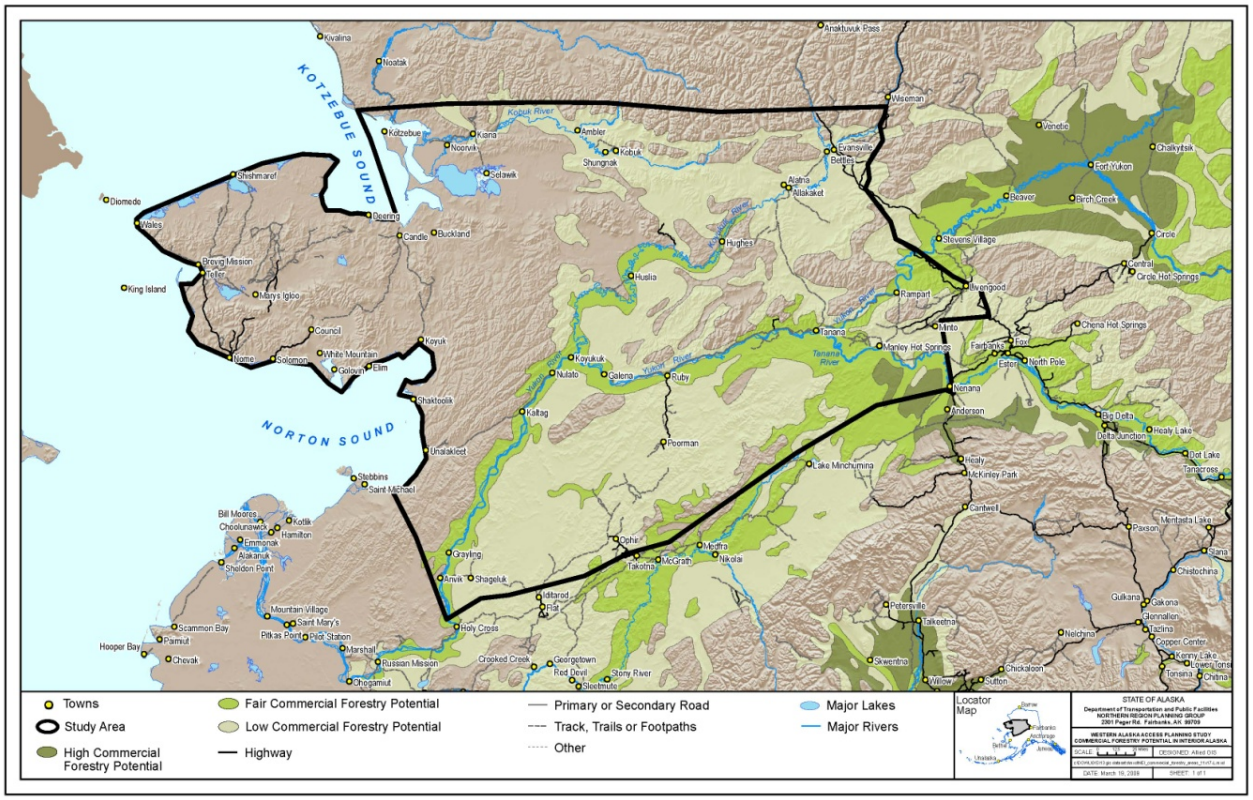
Gross forest valuations are shown in Table 4, with projected harvest levels and firewood values based on current market information in Tanana, the Kotzebue area, and areas on the eastern boundary of the study area. Volumes per acre are based on field inventories conducted in Manley, five villages near Kotzebue, and along the Yukon River system.

Table 4: Forest Lands, Gross Valuation

Forest Land	Total Acres	Estimated Harvest	Cords/ acre	Cords/ Year	Value/ Cord	Value/ Acre	Total Value
High potential	369,600	370	30	11,088	$250	$7,500	$2,772,000
Fair potential	8,405,000	841	22	18,491	$250	$5,500	$4,622,750
Low potential	27,010,500	270	12	3,241	$150	$1,800	$486,189
Total	**35,785,100**	**1,481**		**32,820**			**$7,880,939**

Source: Northern Economics.

Figure 8 illustrates commercial forestry potential based on soils information, prior field visits, and field-based inventories (or timber cruises). As shown, higher potential areas predominate on the eastern study area boundary, along thawed river banks, and on flatter ground south and east of Manley. Soil temperature is a main factor in tree growth, with warmer ground growing taller trees.



Source: Reid, Collins, 1981.

Figure 8: Commercial Forestry Potential

The highest-value woody forest products are firewood and, where feasible, sawn lumber and timbers. Non-woody forest products are also valuable, including wildlife habitat, watersheds, and scenic vistas; however, these products are not traded in conventional markets.

High potential forest development will occur where productive forests and local markets generate market-based "product pull." This is what happened in the 1980s as export markets attracted white spruce logs from private lands near Nenana. Current markets consist of firewood (to reduce fuel oil consumption) and very limited sawn products. Regional and within-study area potential includes lumber manufacture, mechanical firewood processing, and shipping of woody materials on barges.

Slower-growing forests, such as the vast acreages of black spruce found in parts of the study area, also provide firewood and outbuilding materials. Typical products, besides smaller-sized firewood, include poles for fish wheels and drying racks, small diameter logs for road and trail sub-grades across muskegs, and fences around local gardens.

Development constraints are generally market-related; limited demand reduces the ability to pay for higher capital cost equipment, such as mechanical feller-bunchers, log skidders, firewood processors, and sawmills. Hand logging is slow, dangerous, and expensive on a per unit basis and is best used in very small markets.

2.6 Agriculture Products

Alaska's agricultural resources have traditionally served local markets. Market experience has generally indicated agricultural production in the state is limited in size and products are priced too high to compete outside of Alaska.

Regional and local markets are similar to those for forest products. Generally, locally grown food is small in volume (with higher unit costs), has low to medium market values, and may have a shelf life that further limits sales areas. Most products are grown and harvested within a village or an area that is quickly accessible and generally needs fencing to protect crops against marauders such as moose.

Within the study area, Table 5 illustrates two levels of crop land, along with reindeer grazing acreage. Gross values per farm (and then per acre) are derived from USDA published values.

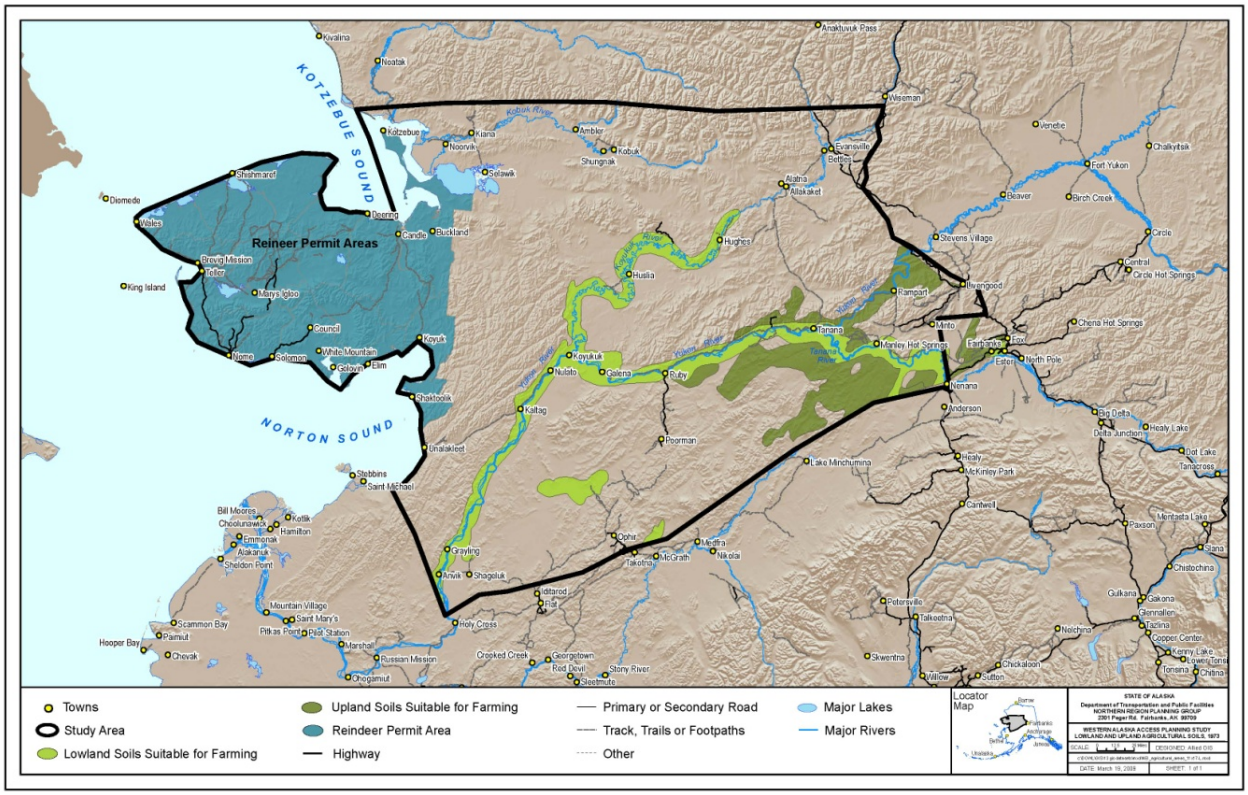
Table 5: Agricultural Lands, Three Gross Production Value Estimates

Agricultural Land Class	Gross Acres	Acres Utilized	$ per Acre	Total Value
Upland	3,721,400	1,088	$45.00	$48,960
Lowland	5,340,600	861	$10.00	$8,610
Reindeer	14,124,200	12,700,780	$0.02	$254,016
Total	**23,186,200**	**12,702,729**		**$311,586**

Source: Northern Economics, NASS data, 2007.

Figure 9 shows the location of upland and lowland agricultural soils within the study area. There are notable exceptions, as local gardeners have grown extensive crops in areas such as St. Michael, near the mouth of the Yukon.

In an effort to test growing conditions, agricultural experiment stations were established in the late 1800s at Rampart and Fairbanks, among other areas. Crops, especially root crops such as turnips and rutabagas, proved successful and have been grown in small gardens since that time.



Source: Selkregg, 1974.

Figure 9: Upland and Lowland Agricultural Soils

Another successful crop is hay, grown for horses and cattle. Russians grew hay in several agricultural areas to feed horses and livestock over winter; generally, these attempts were successful, with the ability to dry and safely store hay being a key factor.

Agricultural development is limited by market demand and the ability to efficiently mechanize crop sowing, tending, and harvest. With the exception of reindeer herding, most agricultural products are grown for one or more residences, not commercial production. Agricultural areas attract animals, such as moose, and need fencing to exclude these large creatures. Fertilizer, pesticides and herbicides, and even irrigation can be very expensive in rural Alaska and further limit large-scale production.

One possibility is greenhouse agriculture such as that used to grow hot-house tomatoes, in areas such as Manley Hot Springs, with geothermal resources that could be a low-cost source of heat. Manley also has a road to Fairbanks and, if greenhouse agriculture were to prove successful, fresh vegetables command a premium price during winter.

Like forest products development, agriculture is somewhat limited to local and regional markets. Crops are generally grown and consumed locally, within a single residence or perhaps as a school garden. Import substitution for food items helps reduce high rural Alaska costs, though food processing and storage is also limited to canning, freezing, and drying at a small scale.

The single most important development constraint is cost. Just delivering needed supplies to a suitable location can be very expensive, especially with air cargo. In many cases, it is cheaper to deliver final-form food items, such as pre-packaged meats, dairy products, or grains, than to grow and process them on-site. Small agricultural production sites are generally higher cost, even when compared to other areas in Alaska, such as the Tanana Valley or the Matanuska-Susitna Valley.

2.7 Renewable Energy

DOT&PF asked the consultant team to identify and map sources of renewable energy found in the study area; resource papers for each renewable energy source were not required. Research by the consultant team led analysts to maps in the Renewable Energy Atlas published by the Alaska Energy Authority (AEA). Maps for wind, hydro, and geothermal power resource potential are presented on the following pages and in a larger format at the end of this report. Biomass resources are similar to those presented for forestry earlier in this report.

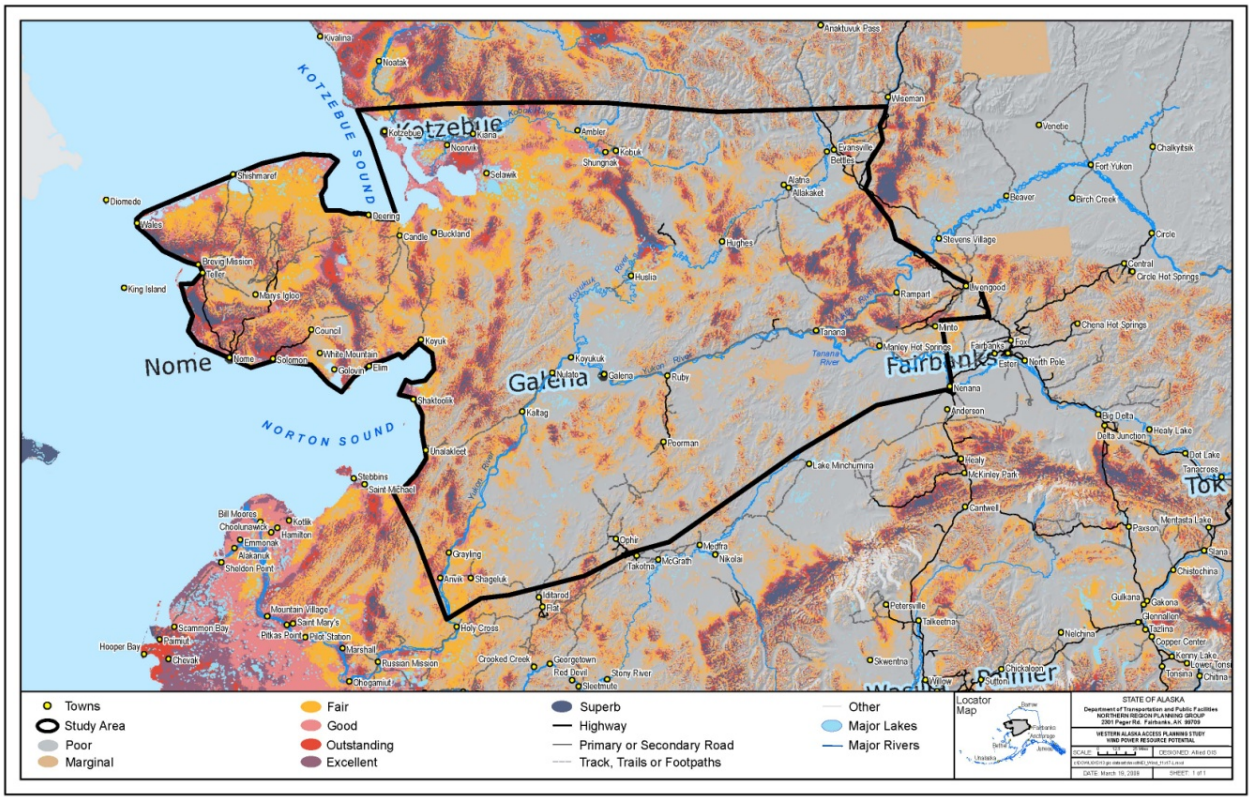


Figure 10: Wind Power Resource Potential

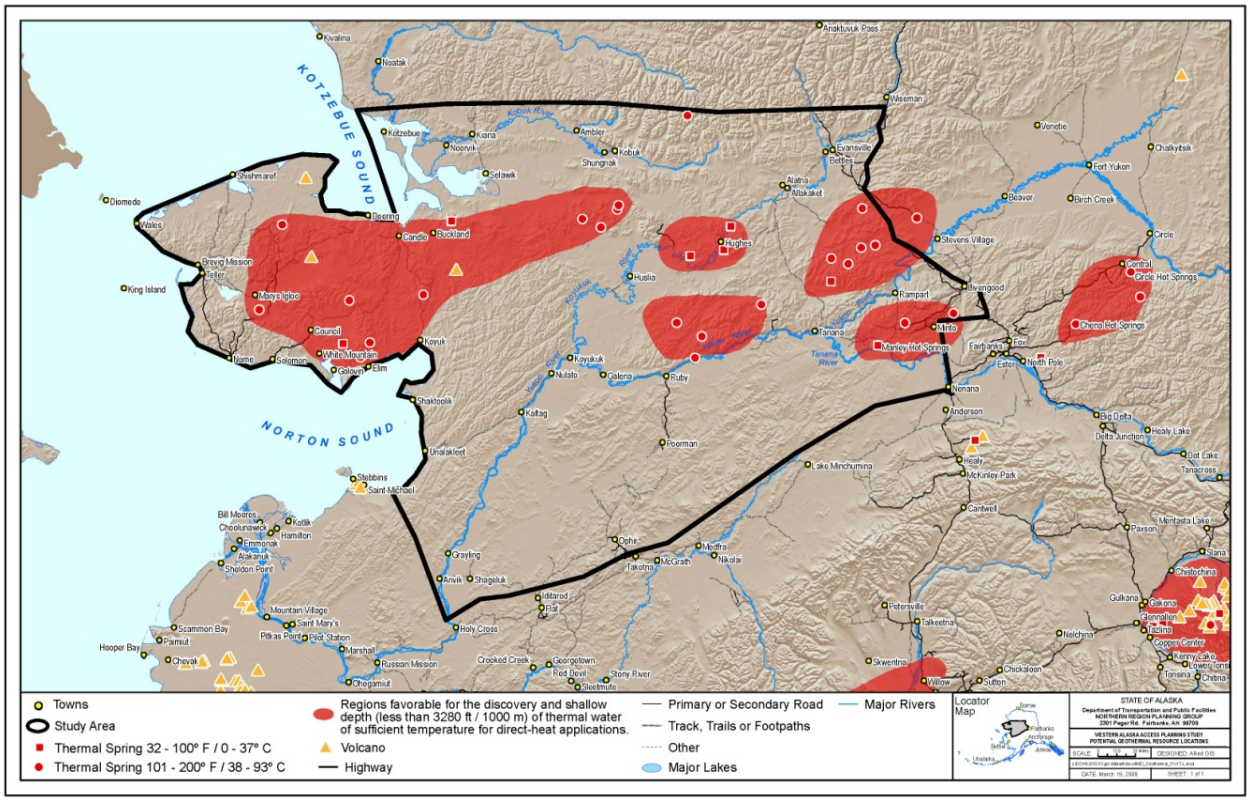


Figure 11: Geothermal Energy Potential

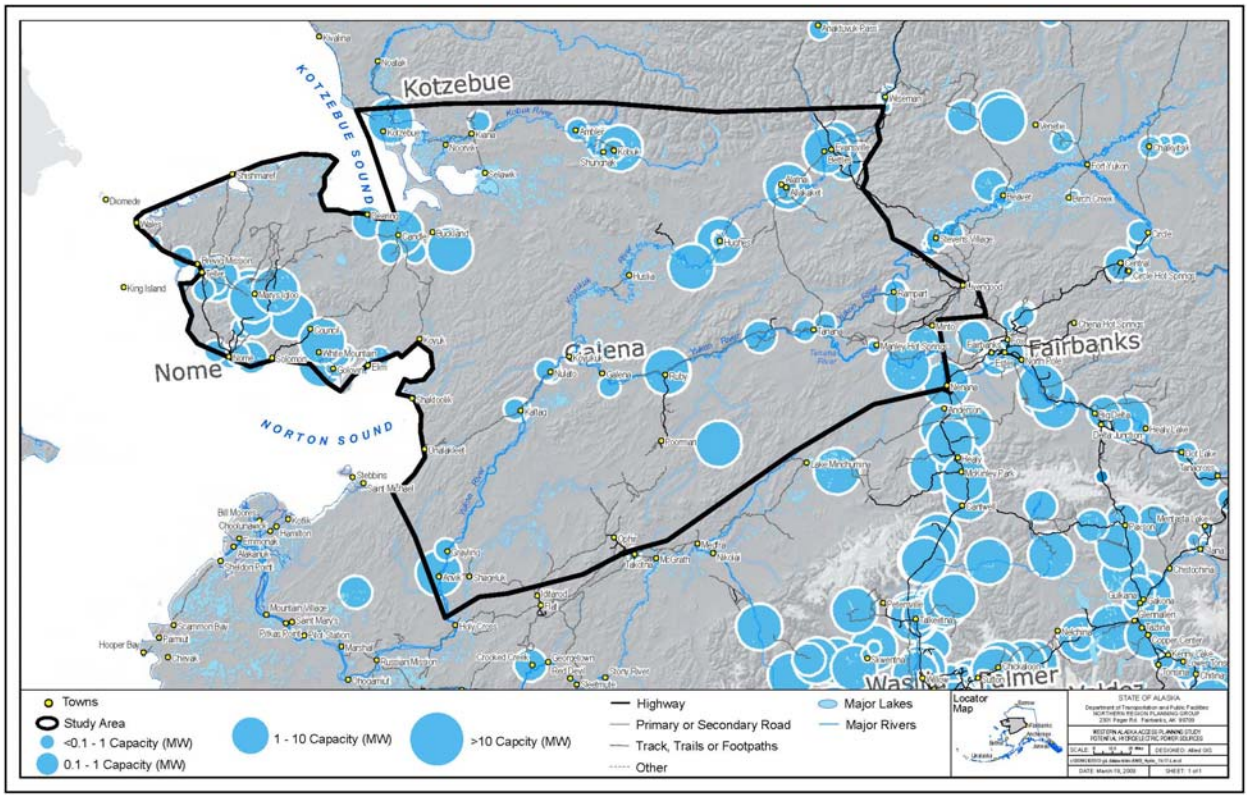


Figure 12: Hydropower Resource Potential

3.0 OTHER STUDY PRODUCTS

The previous sections of this report identified the resources of the study area. This section describes the other work products that were developed for this phase of the Western Alaska Access Planning Study including the economic activity generated in communities within the study area, the influence of the global economy on demand and prices for Alaska's resource producers, and scenarios that describe possible study area development patterns over the study period. This phase of the study also refined the area that will be evaluated for a road corridor in the next phase, developed a geographic information system (GIS) data base, compiled a bibliography on the study area and previous transportation studies in the region, and identified potential data gaps that will need to be addressed in the next phase.

3.1 Community Economic Activity

In conducting research for the fisheries resources and tourism and recreation resources, it became apparent that activities such as fishing, hunting, trapping, hiking, backpacking, and similar activities are widely dispersed throughout the study area, and that geographic information on

specific locations for these activities is limited. However, many of the transactions for these activities take place within study area communities.

For example, while commercial fishers may cast their nets in many locations along the Yukon River, sales to local processing plants or buying stations more often occur in the cities and villages along the river. Another example, as noted earlier, occurs when visitors to the region fly into Nome or Kotzebue and then take a small plane to a Native village or remote areas for other activities such as river rafting. In many instances, the air carrier or guide service that provides the flight is located in a study area community, and the financial transaction between the visitor and the company supports the local economy.

While the focus of this report is on resources in the study area and potential access to those resources, it became evident that the study also needed to show the level of economic activity associated with study area communities since some of them may obtain road access if the Western Alaska Access project moves forward. Potential benefits from this access would enhance economics of the road project.

Figure 13 shows an estimate of the value of economic activity occurring in the study area communities over the study period. A measurement of economic output is not available at the community level so this estimate uses total personal income in 2007 for the community as a proxy and, to be conservative, assumes no population growth or decline in the region. Since resource development will continue over the 50-year study period, total personal income in each community is summed for that same time period.

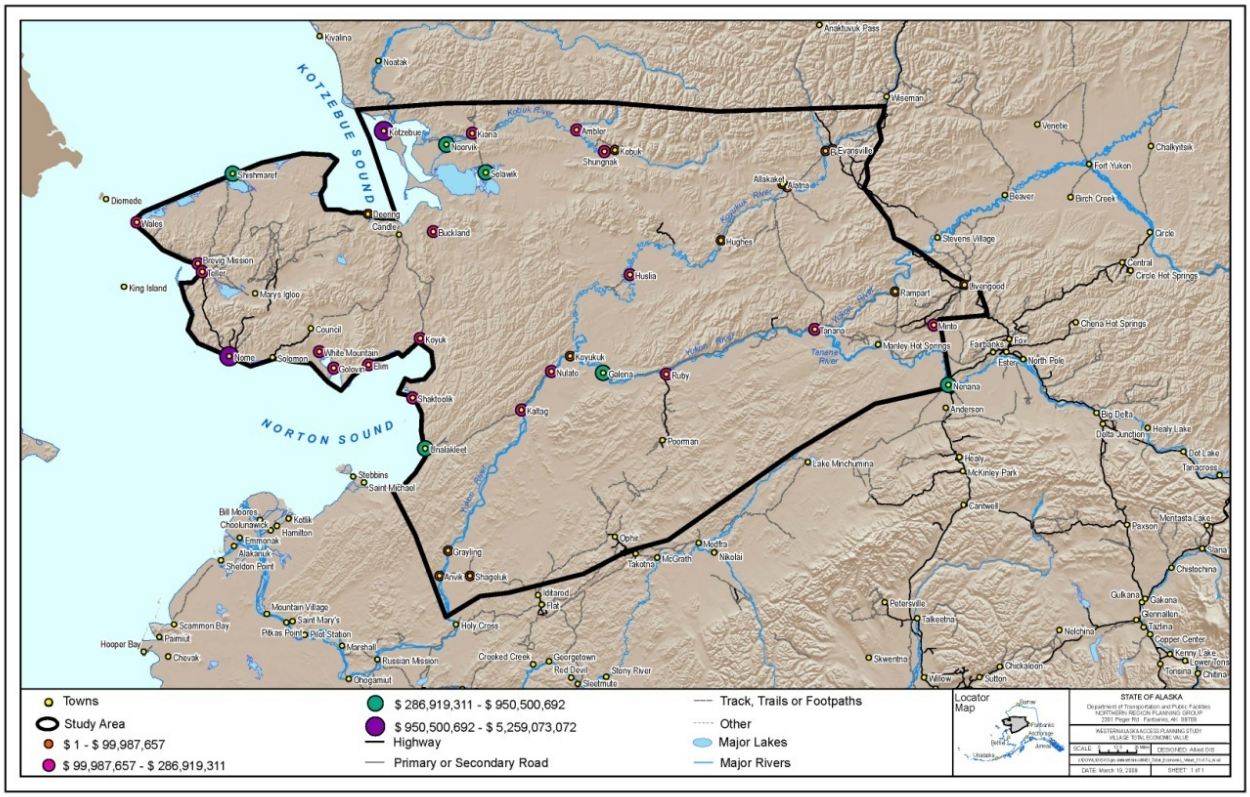


Figure 13: Value of Community Economic Activity

As noted in Figure 13, Nome and Kotzebue would be the communities with the largest total personal income over the study period, followed by the subregional centers of Galena and Unalakleet. The high level of personal income in Shishmaref, Noorvik, and Selawik is likely due to employment at the Red Dog Mine, which is the largest private sector employer in the region. This finding suggests that mineral development elsewhere in the study area could also increase personal income in study area communities.

3.2 Global Influences and Development Scenarios

As noted in Section 2.0, the demand and prices for Alaska's resources are primarily set by global markets and Alaska producers have limited ability to influence either demand or price for their products. The high cost of transportation to distant markets and from major supply centers has resulted in Alaska being a high cost producer compared to its global competitors so that Alaska's products are often the last to enter a market with rising market prices and the first to exit when prices decline. Low value products generally cannot compete in global markets and are limited to use within the study area.

It is not possible to forecast the global economy over the 50-year study period so development scenarios have been created to provide a range of possible futures that might occur. These development scenarios start with an assumption about the state of the global economy: weak growth (low development scenario), strong growth (high development scenario), or cyclical growth as has occurred in recent history (mid development scenario).

The low development scenario assumes that over the period from 2010 through 2060, a weak global economy results in low demand for Alaska's resources with the result that prices for oil, gas, minerals, and other commodities are low compared to historical averages as measured on a real 2008 dollar basis. These low prices in turn result in a state budget that is smaller than would be expected, with a minimal capital budget. Under this situation, the capital budget would be limited to matching funds for federal programs, with few other state-funded capital projects.

Low commodity prices and reduced state budgets result in low levels of economic activity in the study area. Expansion of eco-tourism and recreation-related businesses is the only significant source of growth in the regional economy. The study area population remains near current levels with study area residents migrating from the smaller villages to the regional and subregional centers. With limited economic activity in the region and without population growth, only a few links of the potential road to the Seward Peninsula are built during the study period. These links will be identified in the benefit-cost analysis as those links with the highest net benefits independent of the entire road system.

The high development scenario envisions a strong global economy generally throughout the study period resulting in high commodity prices for the state's resource-extraction industries. In turn, these high oil and mineral prices provide the basis for a growing state budget, and in particular, a large capital budget. The availability of capital construction funds for design, permitting, and construction enables the state to complete the road by 2020.

The high commodity prices also result in high levels of exploration and development activity within the study area, with several major mines coming on line at about the same time as the road is completed. The mines require an extensive amount of energy and induce an energy transmission system, either a natural gas pipeline extending from the proposed natural gas pipeline that would parallel the Dalton Highway, or an electrical transmission line connected to

the electrical grid in the Railbelt with new electrical generation sources such as a Susitna Hydroelectric project or a geothermal project at Mount Spurr. The energy transmission system is completed shortly after the road is completed and prior to the mines opening.

The construction of the road and the transportation cost savings that result from it create conditions for high levels of economic activity in the study area for a number of years. Other mineral development occurs, and other resources are transported within the study area for local consumption. Population growth is slow, but increases are seen at the village level as well as the regional and subregional hubs. Local employment also increases with mines hiring local residents for jobs. However, many jobs are filled by residents of Railbelt communities who are flown in on a rotational basis. The presence of a road and other development changes the nature of the tourism and recreational activity in the area with fewer eco-tourists and high-end fishers and hunters. Larger numbers of independent travelers in recreational vehicles and vehicles traveling on the road for business create demand for service facilities along the road network. Road access also results in greater pressure on fish and game resources in proximity to the road, and competition for subsistence resources.

The mid development scenario anticipates that over the 50-year study period there will be times of strong global economic growth and periods when the global economy will contract, similar to the global business cycles experienced over the past 50 years. During periods of strong growth, demand for oil and other commodities will be high with resultant high prices, and during periods when the global economy slows or contracts, demand will fall and prices will decrease.

This cyclical situation results in periods of increasing state revenues and periods of decreasing state revenues, which affect the state's capital budget. This mid development scenario assumes that construction on the Western Alaska Access Project occurs during periods of budget surpluses and construction is put on hold when budget deficits exist. Completion of the road takes longer due to the on-again/off-again pattern of construction activity with the final road links completed in 2030 as compared to 2020 under the high development scenario.

Delay in completion of the road could hinder development of the mineral resources in the region and result in lower economic activity in the region as compared to the high development scenario. The level of economic activity would be higher than the low scenario as more road

construction activity occurs in the mid scenario, and the presence of additional road links within the study area would generate additional economic activity. This additional economic activity could increase local consumption of certain resources or additional tourism and recreation activity as portions of the study area are connected to the national highway system over time. Employment and population increases are very modest during the 20 years while road construction is ongoing, with higher growth rates occurring after the road is completed, the energy transmission system is in place, and major mines open in the study area. The effects of the mid scenario on fish and game resources and subsistence begin to resemble the high scenario after 2035 when the infrastructure development is complete and visitor numbers begin to increase. The increase in visitors and business travel in the area creates demand for service facilities along the road and in communities that are connected by spur roads to the Western Alaska Access Project.

3.3 Refined Study Area

The WAAPS study area includes a substantial area south of the Yukon River. During the initial research on corridors accessing the Seward Peninsula, the following critical corridor features became compelling for moving the focus of the work to the north side of the Yukon River:

- The major mineral districts and community clusters associated with the east-west corridor lie on the north side of the Yukon River. These clusters represent the most likely justification from a cost/benefit standpoint to construct the access. A southern route could be located too far from the more promising resource opportunities.
- The major mineral districts on the south side of the Yukon River lie in the Ruby to Crooked Creek area. Providing road access to that district and then crossing the Yukon River to access the Seward Peninsula would require crossing the river in a region of exceptionally wide sections. A river crossing in this region of the middle Yukon River area was determined to be costly and impractical given the existing crossing and narrower sections upriver in the vicinity of Tanana.
- Road construction conditions between Ruby and Flat are very good, but road construction west of Flat toward the Yukon River and south of the Innoko Refuge will be a significant challenge, as reported in the DOT&PF Reconnaissance Engineering investigation of a road from Donlin Creek Mine to the river. In that

instance, DOT&PF was looking for a route across this region to connect to a potential port site on the Yukon for freight and fuel deliveries to the mine.

- Permittability is anticipated to be more difficult in the area south of the Yukon River.

As a result, the project will examine the traditional generalized eastern entry points including:

- Nenana to Tanana
- The zone around the western terminus of the Elliott Highway
- Dalton Highway north of the Yukon River Bridge
- Dalton Highway in the vicinity of Bettles/Evansville along the south flank of the Brooks Range

With these entry points and the finding that the corridor should be located north of the Yukon River, the consultant team is recommending that the next phase of work focus efforts on a smaller area of the original study area. This smaller area is shown in Figure 14 as the area within the red lines and defined in the legend as the interest area.

The analysis recognizes the value of accessing the Ruby to Crooked Creek mineralized zone and will likely identify that need as requiring separate attention. It is recognized that a barge hub at Ruby could serve the Ruby to Flat mining district if a service road was built to continue the existing Ruby-Poorman road south to Flat.

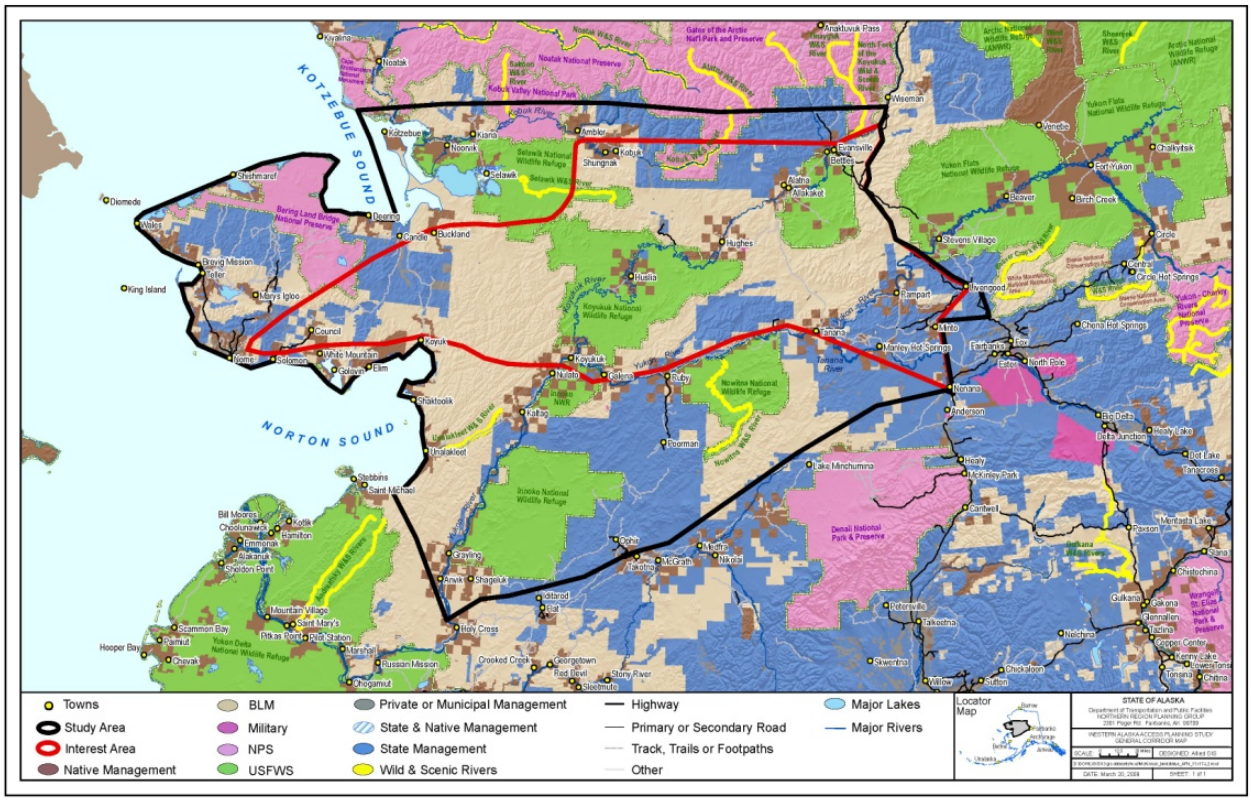


Figure 14: Refined Study Area Map

3.4 Bibliography

The project team identified and summarized previous relevant publications, feasibility studies, and other studies relating to transportation and resources in the WAAPS study area. Nearly 200 documents, dating as far back as 1959, were reviewed and included in the bibliography (found in Appendix B). The document collection includes approximately 80 historic transportation or engineering studies, as well as literature concerning minerals, oil and gas, fisheries, tourism and recreation, agriculture, forestry, land ownership/management, communities, and environmental studies in the project area. Additional resource-specific references can also be found in each of the Resource Papers included as appendices to this report.

The transportation and engineering documents included in the bibliography provide a fairly comprehensive background on transportation and corridor studies in the WAAPS area. Studies completed by both the public and private sector comprise a substantial information database on routing (including maps), multi-modal considerations, economic feasibility of corridor development, the interrelations of resource development and transportation, power/energy source

needs, engineering design and maintenance considerations, and environmental considerations. Some critical documents included in the bibliography are:

- 1968 *Report and Recommendations for Engineering Service Requirements - Transportation Corridor Nenana-Dunbar Area to Kobuk River Valley* by De Leuw, Cather, & Associates and Tryck, Nyman & Hayes.
- 1972 *Alaska Transportation Corridor Study* by Tudor-Kelly-Shannon.
- 1973 *Optimum Transportation Systems to Serve the Mineral Industry North of the Yukon Basin in Alaska* by the Mineral Industry Research Laboratory.
- 1973 *Western Access Road Project Reconnaissance Study* by Alaska Department of Highways Western District.
- 1978 *Transportation and Development of Alaska Natural Resources* for the Federal-State Land Use Planning Commission for Alaska.
- 1981 multi-volume *Western and Arctic Alaska Transportation Study* by Louis Berger and Associates, Inc.
- 1993 *State Land Selection Access Corridor Study and Major Corridor Descriptions* by Jerry Brossia and R.L. Odsather.
- 2001 *Resource Transportation Analysis* by CH2M HILL.
- Recent (2005) and historic transportation analyses from the Ambler Mining District.

For route alternatives identified, considered, and refined in future phases of the project, a significant amount of data is already available in the existing literature. The documents listed above, as well as many other useful documents contained in the bibliography, will serve as key models for routing, design elements, cost estimates, and maintenance and operations considerations and will provide supporting information on soils, geology, geologic hazards, resources, environmental considerations, land use and management issues, and potential material sources.

3.5 Geographic Information System Data Base

A substantial database of GIS information for the WAAPS study area was gathered as part of this initial phase of the project. The data collection efforts were targeted at the gathering of information with the potential to impose constraints and opportunities that influence route alternatives.

A total of 7.7 gigabytes of GIS data and 8.4 gigabytes of imagery were collected, primarily from state and federal agencies. Types of data collected include:

- Geological/Geophysical
- Geothermal
- Soils
- Minerals
- Environmental
- Cultural
- Biological
- Land Status/Land Ownership
- Boundaries
- Hydrographic
- Physical Features
- Digital Terrain Modeling (DTM)
- Digital Elevation Modeling (DEM)
- Economic

GIS mapping supported the resource analyses conducted during this first phase of the project, and GIS mapping will support corridor identification and analysis in the next phase.

3.6 Data Gaps

As discussed above in section 3.4, the bibliography contains a large amount of information and data that can be used in future phases of this study. No major data gaps were identified that would prevent the completion of the next phase of the study other than those included in the scope of work for the next phase of the project. This includes additional data collection from mining companies about mining economics, cost and other information from energy and power providers, information about land management constraints from landowners in the study area, DOT&PF information about maintenance and operations costs, and other similar data to supplement the information and data already collected. If the project moves ahead to more detailed environmental and engineering phases, some primary data collection in the field of on-site environmental and engineering data will be needed, but this primary data collection is not needed for this planning-level study.

4.0 NEXT STEPS

It is clear from research to date that a road can provide needed infrastructure for:

- Resource exploration and development,
- Transmission of natural gas and/or electrical power to mineral resource zones and communities, and
- Community development.

The next phase of WAAPS will determine if the road is economically and technically feasible. The next phase will identify road corridor alternatives, identify the economic benefits and costs of the alternatives, and make recommendations on a preferred corridor. Some of the tasks to be completed in the next phase include:

Corridor Analysis

- Mapping of corridors from prior studies
- Identifying environmental, engineering, and land ownership constraints
- Defining road design standards
- Discussing other infrastructure that would be needed to support a road
- Evaluating road corridor options, first at a screening level of a wide range of options and then at a higher level of detail for several final options
- Identifying links between the corridor and resource development nodes and communities
- Identifying construction and maintenance and operations costs
- Recommending a preferred corridor

Economic Analysis

- Economic analysis of benefits and costs of the corridor using high, medium, and low development scenarios over a 50-year period
- Community benefits
- Resource development benefits
- An overview of potential economic and social impacts of a road to the region

Following the completion of this phase of the study, DOT&PF intends to share study findings with the public and solicit comments. In the meantime, project updates will continue to be provided on the project web site at www.westernakaccess.com.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