APPENDIX B TECHNICAL MEMORANDUM – MODELING APPROACH FOR RESOURCE REPORT NO. 5

ALASKA LNG

APPENDIX B: ECONOMIC MODELING APPROACH

USAI-PE-SRREG-00-000005-002

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

This document provides an overview of the methodology used to describe the socioeconomic impacts of the Alaska LNG Project (Project). The socioeconomic impact analysis evaluates the effects of each of the three Project facilities: 1) Liquefaction Facility (LNG Plant and Marine Terminal); 2) pipelines (Mainline, Point Thomson Transmission Line [PTTL], Prudhoe Bay Transmission Line [PBTL], and related aboveground facilities); and 3) Gas Treatment Plant (GTP). In addition, the analysis describes the effects of three non-jurisdictional facilities: 1) PTU Gas Expansion project; 2) PBU Major Gas Sales project; and 3) Kenai Spur Highway Relocation project.

This document is organized according to the following sections:

1. FERC minimum requirements for Resource Report No. 5;
2. Geographic scope;
3. Temporal scope;
4. Existing conditions and socioeconomic indicators;
5. Assessment of direct and indirect effects; and
6. Economic modeling approach
    A. Economic impact model
    B. Community distribution and radiation models (population)
    C. Fiscal impact models
    D. Integration of models
    E. Summary of information needs
    F. Impacts on transportation infrastructure
    G. Impacts due to loss of production in agricultural/pasture land and timberland.

1.1 FERC'S MINIMUM REQUIREMENTS FOR RESOURCE REPORT NO. 5

The economic analysis required for Resource Report No. 5 involves addressing the following FERC filing requirements:

1. For major aboveground facilities and major pipeline projects that require an environmental impact statement, describe existing socioeconomic conditions within the project area.
2. For major aboveground facilities, quantify impact on employment, housing, local government services, local tax revenues, transportation, and other relevant factors within the project area.

In addition, FERC notes that the following items are additional information often missing, resulting in data requests:

1. Evaluate the impact of any substantial immigration of people on governmental facilities and services and describe plans to reduce the impact on local infrastructure.
2. Describe on-site manpower requirements, including the number of construction personnel who currently reside within the impact area, would commute daily to the site from outside the impact area, or would relocate temporarily within the impact area.
3. Estimate total worker payroll and material purchases during construction and operation.
4. Estimate project-related ad valorem and local tax revenues.
5. Determine whether existing housing within the impact area is sufficient to meet the needs of the additional population.
6. Describe the number and types of residences and businesses that would be displaced by the project, procedures to be used to acquire these properties, and types and amounts of relocation assistance payments.
7. Describe impacts on local traffic due to construction- and operation-related traffic and worker commuting. Where applicable (e.g., LNG import/export facilities), address impacts on marine traffic
8. Evaluate the effects of the project on minority and low income populations in consideration of Executive Order 12898.
9. Conduct a fiscal impact analysis evaluating incremental local government expenditures in relation to incremental local government revenues that would result from construction of the project. Incremental expenditures include, but are not limited to, school operating costs, road maintenance and repair, public safety, and public utility costs.

1.2 GEOGRAPHIC SCOPE

Resource Report No. 5 uses the term “area of interest” (AOI) in describing the geographic scope (or Project area) for the socioeconomic impact analysis. For the purpose of this analysis, the AOI encompasses the boroughs and census areas where the Project facilities and major Project transportation routes are located. The impacts of the construction and operation of the Project are expected to affect a wide geographic area from the North Slope, where the GTP, PTTL, and PBTL would be built, through the Interior and Southcentral Alaska where the Mainline would traverse, to the Kenai Peninsula Borough, where the Liquefaction Facility would be built. Construction activities are also going to impact areas beyond where the Project facilities would be located as major ports, roads, railroads, and airports are expected to be utilized to move construction workers, supplies, and equipment.

The AOI covers 11 boroughs and census areas, including the North Slope Borough, Yukon-Koyukuk Census Area, Fairbanks North Star Borough, Denali Borough, Matanuska-Susitna Borough, Kenai Peninsula Borough, Municipality of Anchorage, Southeast Fairbanks Census Area, Valdez-Cordova Census Area, Municipality of Skagway, and Aleutians West Census Area. The first six boroughs and census areas have Project facilities within their boundaries. The latter four have transportation facilities that could be used by the Project. To the extent possible, given data limitations, the analysis of socioeconomic impacts is carried out at the community level. Generally, a quantitative analysis of community-level effects was limited to population changes and the fiscal impacts of those changes. The list of potentially impacted communities totals approximately 70. The AOI is presented and described in detail in Section 5.2 of Resource Report No. 5.

1.3 TEMPORAL SCOPE

The direct and indirect effects of the construction and operation phases of the Project would span a period of over 40 years. As noted in Resource Report 1, it is anticipated that construction and commissioning of facilities would take approximately nine years to complete. The first phase of construction activities, which includes construction related to the first LNG and GTP trains, marine facilities, Mainline, PBTL, and PTTL, is planned to start in 2019 and continue through 2025. After 2024, the installation of the remaining Project facilities needed for full production would take place. Project commissioning is planned to start in 2025 with full production expected to occur in 2027 with the start-up of the third LNG train. The first full year of production would be in 2028. The operation phase of the Project would last at least 30 years as currently authorized by the U.S. Department of Energy. The current economic model has the ability to project to 2060.

1.4 EXISTING CONDITIONS AND SOCIOECONOMIC INDICATORS

Resource Report No. 5 describes the existing socioeconomic conditions in the AOI in terms of various socioeconomic variables or indicators. Sources of demographic, economic, fiscal, and transportation data include a wide range of federal and State agencies, such as the U.S. Census Bureau, U.S. Army Corps of Engineers (USACE), U.S. Department of Transportation (USDOT), Federal Aviation Administration (FAA), U.S. Department of Commerce, Alaska Department of Labor and Workforce Development (ADOLWD), Alaska Department of Education and Early Development (ADEED), Alaska Department of Health and Social Services (ADHSS), Alaska Department of Commerce, Community, and Economic Development (ADCCED), Alaska Department of Public Safety (ADPS), Alaska Department of Administration (ADOA), Alaska Department of Revenue (ADOR), and Alaska Department of Transportation and Public Facilities (ADOT&PF). The data presented are the most recent available at the time of analysis, with most data being for 2009-2013, 2013, or 2014.

The following tables provide an overview of the tabular information presented in the description of existing socioeconomic conditions.

Table 1: List of Demographic Indicators

Indicator	Years	Units	Source
Population			
Population Size	2000; 2013	Number of persons	U.S. Census Bureau
Population Density	2000; 2010	persons per square mile	U.S. Census Bureau
Population Growth	2000 to 2010	Percent change	U.S. Census Bureau
Age Characteristics			
Under 16 Years; 16-64 Years; 65 Years and Over	2010	Percent of population	U.S. Census Bureau
Race and Ethnicity			
White; Black or African American; Alaska Native and American Indian; Native Hawaiian/Other Pacific Islander; Asian; Some Other Race; Total Minority[a]	Average 2009 to 2013	Percent of population	U.S. Census Bureau
Distribution of Minority Population[a]	Average 2009 to 2013	Percent of population	U.S. Census Bureau
Distribution of Alaska Native and American Indian Population	Average 2009 to 2013	Percent of population	U.S. Census Bureau
[a] 100 percent minus “White, non-Hispanic or Latino”			

Table 2: List of Economic Indicators

Indicator	Years	Units	Source
Employment and Income			
Average Annual Employment by Place of Work	2013	Number of persons	ADOLWD
Top Employment Industries	2013	Percent of total employment	ADOLWD
Distribution of Average Per Capita Income	Average 2009 to 2013	Dollars per person	U.S. Census Bureau
Average Per Capita Income	Average 2009 to 2013	Dollars per person	U.S. Census Bureau
Median Household Income	Average 2009 to 2013	Dollars per household	U.S. Census Bureau
Average Unemployment Rate	Average 2009 to 2013	Percent of labor force	U.S. Census Bureau
Seasonal Difference in Unemployment Rates	2013	Percent of labor force	ADOLWD
Percent not in Labor Force	Average 2009 to 2013	Percent of labor force	U.S. Census Bureau
Average Poverty Rate	Average 2009 to 2013	Percent of population	U.S. Census Bureau
Poverty Rate by Race/Ethnicity	Average 2009 to 2013	Percent of population	U.S. Census Bureau
Cost of Living	2014	OCONUS index	U.S. Department of Defense
Worker Residency (Local/State)	2013	Percent of total workers	ADOLWD
Alaska Residents Employed in Occupations Important to the Oil and Gas Industry	2013	Number and percent of total workers	ADOLWD
Supply of Qualified Alaska Residents by Occupation	2014	Number of workers	ADOLWD
Affected Industrial Sectors			
Oil and Gas; Support Activities for Mining; Construction; Transportation (Air, Water, Truck); Tourism[a]; Professional Scientific, and Technical Services; State and Local **Government**	2013	Employment, compensation, average annual wage rate, and output	REMI

[a] This industry consists of the scenic and sightseeing transportation sector; museums, historical sites, and similar institutions sector; amusement, gaming, and recreation sector; food services and drinking places sector; and accommodation sector.

Table 3: List of Housing Indicators

Indicator	Years	Units	Source
General Housing Characteristics			
Total Units	2010	Number of units	U.S. Census Bureau
Occupied Units	2010	Percent of total units	U.S. Census Bureau
Median Value of Owner Occupied Units	Average 2009 to 2013	Dollars per unit	U.S. Census Bureau
Median Gross Rent	Average 2009 to 2013	Dollars per unit	U.S. Census Bureau
Vacant Housing Characteristics			
Vacant Units	2010	Number of units	U.S. Census Bureau
Units for Sale; Units for Rent; Vacant for Seasonal, Recreational, or Occasional Use; Other Vacant	2010	Percent of vacant units	U.S. Census Bureau
Hotel/Motels	2014	Number of units	ADCCED
RV Parks/Campgrounds	2014	Number of units	ADCCED
Modular Camp Leasing Companies	2014	Number of camp facilities owned and average camp size	

Table 4: List of Public Infrastructure and Services Indicators

Indicator	Years	Units	Source
Education			
All Grades; Elementary; Secondary; High; Other	FY2015	Number of schools	ADEED; ADCCED
Enrollment	FY2015	Average daily membership	ADEED; ADCCED
School Capacity	FY2015	Percent of capacity used	ADEED; ADCCED
Student to Teacher Ratio	FY2015	Ratio of number of students to teachers	ADEED; ADCCED
Average Annual Cost per Student	FY2014	Revenue per average daily membership	ADEED
School Funding Sources	FY2014	Percent of total funding	ADEED
Medical Services			
Hospitals; Health Clinics and Centers	2014	List of facilities	ADHSS
Emergency Medical Services	2014	List of facilities, level of service, and access to service	ADHSS
Police and Fire Protection Services			
Police Department; Village Public Safety Officer; Alaska State Trooper Post	2014	Presence/absence	ADPS
Nearest Law Enforcement Facility	2014	List of facilities	ADPS
Local or Borough Fire Department	2014	Presence/absence	ADPS
Utilities			
Community Piped Water; Community Piped Sewage; Landfill Facility; Electric Utility; Natural Gas Utility	2014	Name of provider	ADCCED
Primary House Heating Fuel	average 2009 to 2013	Percent of total occupied units	U.S. Census Bureau
Average Residential Rate for # 1 Fuel Oil	2013	Dollars per gallon	Alaska Energy Data Gateway
Average Residential Rate for Natural Gas	2013	Dollars per thousand standard cubic feet	Alaska Energy Data Gateway
Estimated Per Unit Heating Cost	2013	Dollars per million British Thermal Units	Alaska Energy Data Gateway
PCE Program	2013	Presence/absence	Alaska Energy Data Gateway
Average Residential Electricity Rate With/Without PCE	2013–2014	Dollars per kilowatt hour	Alaska Energy Data Gateway

Table 5: List of Government Revenue and Expenditure Indicators

Indicator	Years	Units	Source
State Government Revenue	FY2012, 2013, 2014	Dollars	ADOA
State Government General Fund Expenditure Uses	FY2012, 2013, 2014	Dollars	ADOA
Local Government Revenue Sources	FY2013	Dollars	ADCCED
Local Government Operating Expenditure Categories	FY2013	Dollars	ADCCED

Table 6: List of Transportation Indicators

Indicator	Years	Units	Source
Highways			
Annual Average Daily Traffic	2004-2013	Number of vehicles	ADOT&PF
Location Variation in Average Annual Daily Traffic	2013	Number of vehicles range	ADOT&PF
Seasonal Variation in Average Monthly Daily Traffic	2013/2014	Number of vehicles range	ADOT&PF
Truck Traffic	2013/2014	Percent of total vehicles	ADOT&PF
Average Annual Daily Traffic in the Nikiski-Kenai-Soldotna Area	2013	Number of vehicles	ADOT&PF
Railroad			
Cargo volume	2014	Tons	Alaska Railroad Corporation
Distance of rail routes	2014	Railway miles	Alaska Railroad Corporation
Ports/Harbors and Navigation Channels			
Primary Freight	2013	Freight type	USACE
Freight Traffic	2013	Short tons	USACE
Vessel Traffic	2014	Number of vessel calls by vessel type	U.S. Dept. of Commerce
Vessel Traffic	2014	Monthly number of vessel calls	Nuka Research
Navigation Channel Characteristics	2014	Controlling depth (feet), primary vessel traffic (vessel type), and monthly number of vessels	U.S. Dept. of Commerce
Characteristics of Commercial Salmon Fisheries in Navigation Channels	2014	Number of permits fished, harvest quantity (pounds), harvest value (dollars)	Alaska Commercial Fisheries Entry Commission
Airports			
Characteristics of Airports	2014, 2015	Maximum runway length (feet), number of flights, and primary operation type (percent of total flights)	USDOT; FAA
Commercial Air Traffic	2013	Enplanements and pounds of cargo	USDOT; FAA

1.5 DIRECT AND INDIRECT EFFECTS

Direct effects are "caused by the action and occur at the same time and place" (40 CFR 1508.8). The table below summarizes the major potential direct impacts included in the socioeconomic impact analysis of the Project:

Table 7: List of Direct Socioeconomic Impacts by Category

Category	Direct Impact
Demographics	Number of workers temporarily/permanently relocating and duration of stay
	Number of workers commuting daily to site from outside Project area
Economy	Changes in unemployment rate
	Changes in employment and income levels
	Availability of labor and impacts on wage rates
	Dollar value of payroll and materials purchases affecting local economy
	Tax revenues to be paid to State and municipalities
	Economic effect of loss of production in agricultural/pasture/timber land
	Changes in cost of living/inflationary effects
Housing	Effect of worker immigration on availability of housing
	Potential for competing demand for housing
Infrastructure and Services	Effect of immigration on State and municipal infrastructure and services
	Effect of Project on State and municipal infrastructure and services
Transportation	Effect of movement of equipment/materials/workers on roads, railroad system, ports and harbors, airports
	Impacts caused by limitations in available dock space, storage areas, longshoremen, dock workers, and railroad cars.
	Effect of Project on other transportation users

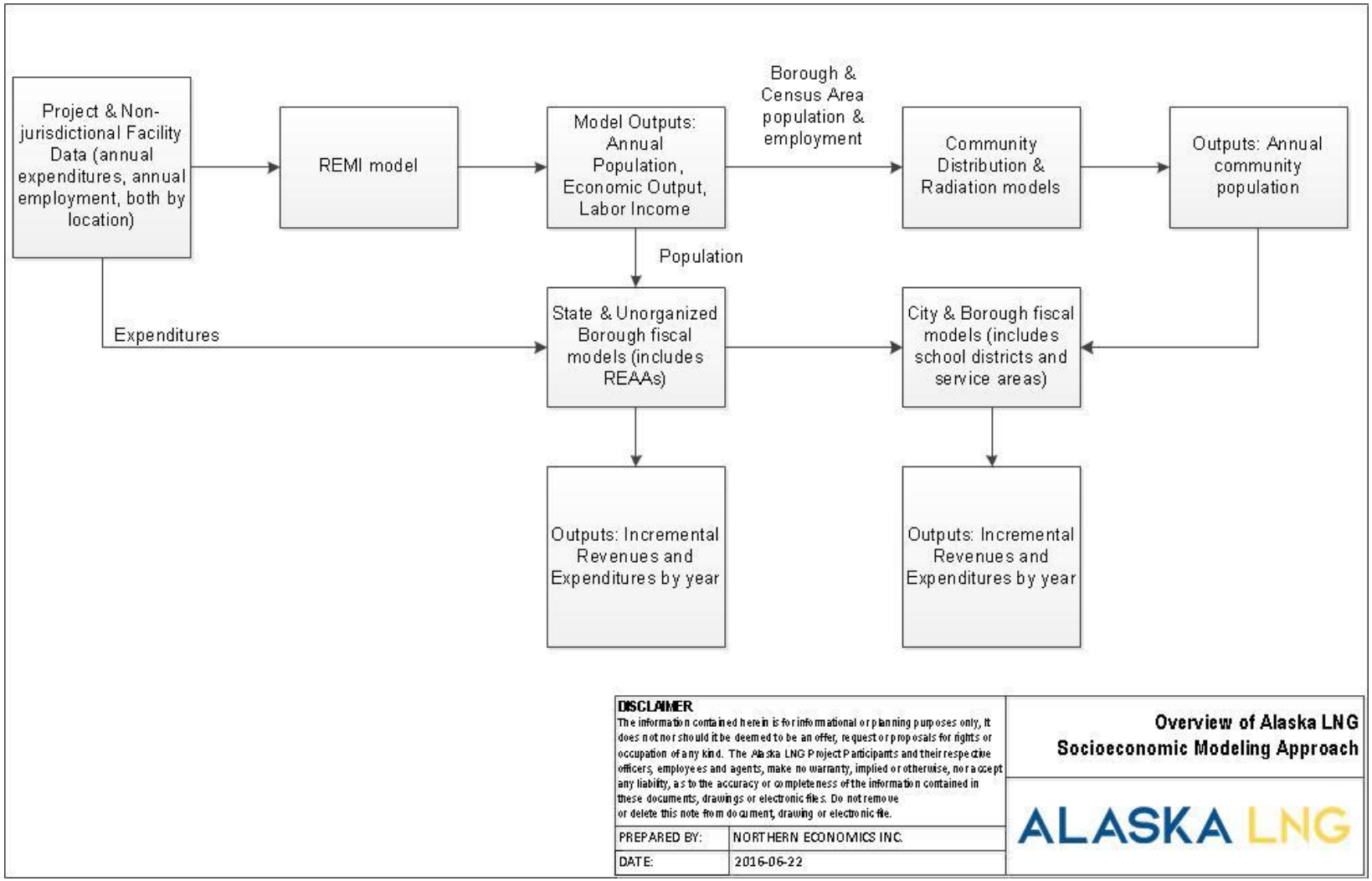
Indirect effects are "caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable." For the purpose of this socioeconomic impact analysis, the indirect effects include the multiplier effect on Alaska's economy of in-state spending during Project construction and operation. The multiplier effect of this spending would be of two types: indirect and induced. Indirect effects would occur when contractors, vendors, and manufacturers receiving payment for goods or services required by the Project are, in turn, able to pay others who support their businesses. Examples of these types of activities related to Project construction include the goods and services that would be purchased to support ice road construction, camp fabrication and installation, site development, and logistics activities. Induced effects would occur when persons employed by the Project or by linked businesses make purchases from retailers and service establishments in the normal course of household consumption. To the extent that additional revenues accrue to the State of Alaska and local governments as a result of the Project, these revenues would also be anticipated to create an induced multiplier effect.

2.0 ECONOMIC MODELING APPROACH

This section describes the methodology and the models used in quantifying Project impacts—the economic impact model (REMI model), the community distribution and radiation models, and the fiscal impact models. Separate fiscal impact models have been created for the State of Alaska and for each borough and incorporated city in the AOI.

Figure 1 provides an overview of the linkages between the models and the major inputs and outputs for each model.

Figure 1: Alaska LNG Socioeconomic Modeling Approach



Note: REAA = Regional Educational Attendance Area

2.1 THE ECONOMIC IMPACT MODEL (REMI MODEL)

The analysis of the socioeconomic effects of the Project requires a dynamic modeling framework that provides impact information necessary to fulfill the requirements for Resource Report No. 5. A dynamic model is appropriate for the analysis because of the long timeframe required to analyze the impacts of the various phases of the Project and the structural changes in the economy anticipated to occur over that timeframe. A dynamic model allows the incorporation of changes in population due to economic migration; substitution effects among inputs to production due to changes in wages, fuel costs, and other input prices; and the subsequent effects on regional trade flows in the estimates of future economic effects, which would not be possible with the use of a static model. Using a static model would assume that the existing demographic conditions, economic activities, and linkages among industrial sectors would remain constant in the future and that is not the situation with a project of this magnitude.

The REMI PI+ version 1.7 (REMI model), a dynamic forecasting model developed by Regional Economic Models, Inc., was selected for the socioeconomic impact analysis of the Project because of the analytical requirements of quantifying the long-term macroeconomic effects of the Project. The baseline forecast without the Project is compared to the alternative forecast with the Project to quantify the change to the economy over the course of construction and during operation. The REMI model integrates input-output, computable general equilibrium, econometric, and economic geography methodologies to generate forecasts on an annual basis through the year 2060. A full discussion of the data sources and estimation procedures of the REMI PI+ model is available at Regional Economic Models, Inc. (2015).

The REMI model is custom-built to address the analytical requirements of a particular application. The model developed to estimate the socioeconomic impacts of the Project is a 17-region model with 70 industrial sectors. Additional information on the regions and sectors included in the customized model is provided below.

2.1.1 REMI Model Regions

The REMI model has 12 Alaska sub-regions and divides the rest of the United States into five regions known as U.S. Petroleum Administration Defense Districts (PADDs).[1] The Alaska boroughs and census areas that are modeled individually are areas in which significant levels of impact from the Project are expected (Figure 2). The 12 Alaska sub-regions include:

1. North Slope Borough;
2. Yukon-Koyukuk Census Area;
3. Fairbanks North Star Borough;
4. Southeast Fairbanks Census Area;
5. Denali Borough;
6. Valdez-Cordova Census Area;
7. Kenai Peninsula Borough;
8. Municipality of Anchorage;
9. Matanuska-Susitna Borough;
10. Southeast Alaska;
11. Northwest Alaska;
12. Southwest Alaska.

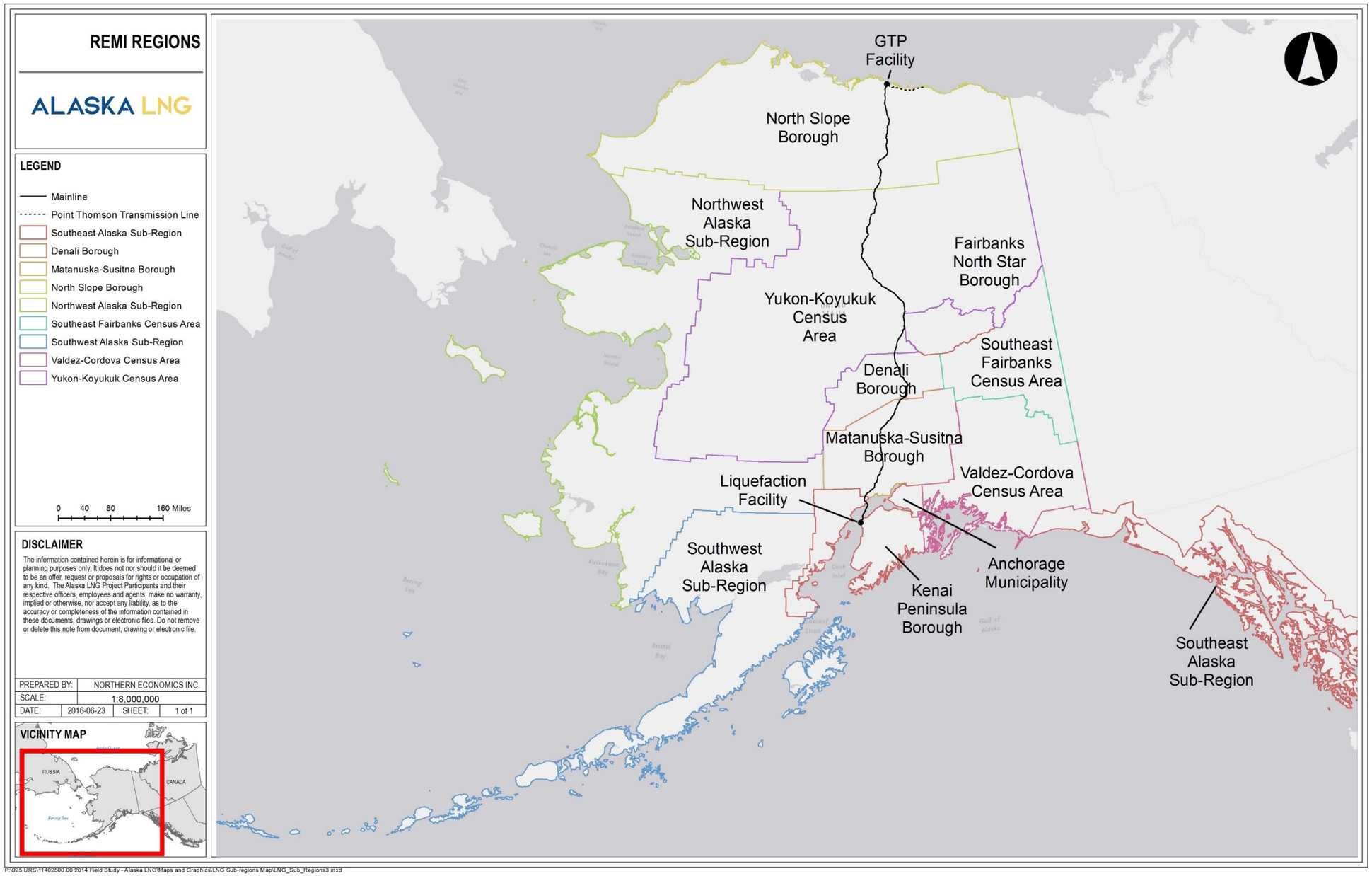
The Southeast Alaska sub-region includes: Haines Borough, City and Borough of Juneau, Municipality of Skagway, City and Borough of Sitka, City and Borough of Wrangell, City and Borough of Yakutat, Hoonah-Angoon Census Area, Ketchikan Gateway Borough, Petersburg Census Area, and the Prince of Wales-Hyder Census Area.

The Northwest Alaska sub-region includes: Bethel Census Area, Kusilvak Census Area (formerly known as Wade Hampton Census Area), Nome Census Area, and Northwest Arctic Borough.

The Southwest Alaska sub-region includes: Aleutians East Borough, Aleutians West Census Area, Bristol Bay Borough, Dillingham Census Area, Kodiak Island Borough, and Lake and Peninsula Borough.

[1] The PADDs are geographic aggregations of the 50 states and the District of Columbia into five districts: PADD 1 is the East Coast, PADD 2 the Midwest, PADD 3 the Gulf Coast, PADD 4 the Rocky Mountain Region, and PADD 5 the West Coast. These aggregated regions are used by the Energy Information Administration in analyzing regional petroleum product supply and movements. These regions were originally created during World War II to help organize the allocation of gasoline and diesel fuel.

Figure 2: REMI Model Alaska Regions



2.1.2 REMI Model Industrial Sectors

The REMI model contains 70 industrial sectors that are based on the North American Industry Classification System (Table 8).

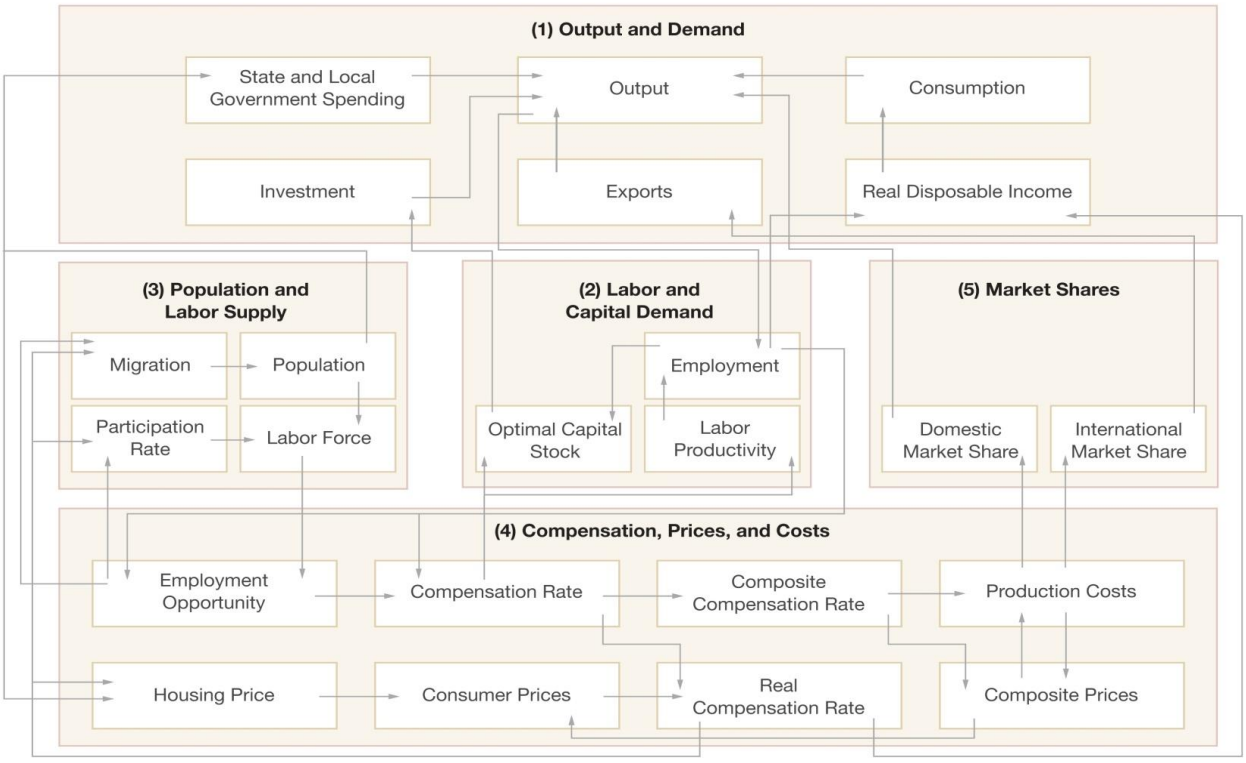
Table 8: List of Industrial Sectors in the REMI Model

Forestry and logging; fishing, hunting, & trapping	Paper manufacturing	Professional and technical services
Agriculture and forestry support activities; Other	Printing and related support activities	Management of companies and enterprises
Oil and gas extraction	Petroleum and coal product manufacturing	Administrative and support services
Mining (except oil and gas)	Chemical manufacturing	Waste management and remediation services
Support activities for mining	Plastics and rubber product manufacturing	Educational services
Utilities	Wholesale trade	Ambulatory health care services
Construction	Retail trade	Hospitals
Wood product manufacturing	Air transportation	Nursing and residential care facilities
Nonmetallic mineral product manufacturing	Rail transportation	Social assistance
Primary metal manufacturing	Water transportation	Performing arts and spectator sports
Fabricated metal product manufacturing	Truck transportation; Couriers and messengers	Museums, historical sites, zoos, and parks
Machinery manufacturing	Transit and ground passenger transportation	Amusement, gaming, and recreation
Computer and electronic product manufacturing	Pipeline transportation	Accommodation
Electrical equipment and appliance manufacturing	Scenic and sightseeing transportation; support activities	Food services and drinking places
Motor vehicles, bodies & trailers, and parts manufacturing	Warehousing and storage	Repair and maintenance
Other transportation equipment manufacturing	Publishing industries, except Internet	Personal and laundry services
Furniture and related product manufacturing	Motion picture, video, & sound recording industries	Membership associations and organizations
Miscellaneous manufacturing	Internet publishing and broadcasting; ISPs, search portals, and data processing; Other information services	Private households
Food manufacturing	Broadcasting, except Internet; Telecommunications	Local
Beverage and tobacco product manufacturing	Monetary authorities - central bank; Credit intermediation and related activities; Funds, trusts, & other financial vehicles	State
Textile mills	Securities, commodity contracts, investments	Federal, civilian
Textile product mills	Insurance carriers and related activities	Farm
Apparel manufacturing	Real estate	
Leather and allied product manufacturing	Rental and leasing services; Lessors of nonfinancial intangible assets	

2.1.3 REMI Model Structure and Policy Variables

Figure 3 illustrates the REMI model's structure and linkages. The model consists of thousands of simultaneous equations with a structure that is relatively straightforward. The exact number of equations used varies depending on the extent of industry, demographic, demand, and other detail in the specific model being used. The overall structure of the model can be summarized in five linked groups or blocks of economic variables: (1) Output and Demand, (2) Labor and Capital Demand, (3) Population and Labor Supply, (4) Compensation, Prices, and Costs, and (5) Market Shares. As noted above, the REMI model is dynamic and continually adjusts forecasts based on the interaction between the five blocks. The Output and Demand block shows a business that sells to all the sectors of final demand as well as to other industries. The Labor and Capital Demand block shows how labor and capital requirements depend both on output and their relative costs. Population and Labor Supply are shown as contributing to consumer spending (demand) and to wage determination in the product and labor market. The feedback from this market shows that economic migrants respond to labor market conditions. Demand and supply interact in the Compensation, Prices, and Costs block. Production costs determine Market Shares, which along with components of demand, determine output.

Figure 3: REMI Model Structure and Linkages



Source: Regional Economic Models, Inc. (2015)

Modeling the economic effects of the Project primarily involves (1) Output and Demand and (2) Labor and Capital Demand. The economic effects of the construction of the Liquefaction Facility, Mainline, GTP, and the other ancillary facilities, for example, are modeled using data on labor, materials, services, and equipment expenditures during the construction phase, while the economic effects during the operation phase of the Project are modeled using annual employment.

The REMI model contains nearly 200 policy variables that can be used to model various policy changes, economic events, or changes in demographic conditions. The following is a list of the major policy variables used to quantify the economic effects of the Project:

1. *Industry sales* (this policy variable is used to model Project expenditures during construction; expenditures are allocated to sectors such as the construction sector, manufacturing sector, professional and technical services, water transportation, air transportation, etc.);
2. *Exogenous final demand* (this policy variable is used to model the increase in demand for construction services);
3. *Industry employment* (this policy variable is used to model the operation phase of the Project; annual Project operation jobs are allocated to sectors such as the pipeline transportation sector, petroleum manufacturing sector, oil and gas extraction sector, and support activities for mining);
4. *Residence adjustment amount* (this is used to convert place-of-work income [wages and salaries] to a place-of-residence basis, a necessary step to reflect the fact that some of the construction workers work in remote construction camps and spend their incomes not in their place of work but in places where they reside);
5. *Nullify intermediate inputs induced by employment* (this policy variable is used to eliminate the endogenous effect of industry employment on intermediate inputs; to override the model's default intermediate input response so that specific information regarding payments to construction labor are specified for each region);
6. *State government spending* (this policy variable is used to model the effects of increased State revenues generated by the Project); and
7. *Local government spending* (this policy variable is used to model the effect of increased local government revenues generated by the Project).

2.1.4 REMI Model Historical and Baseline Data

The historical data on employment, wages and salaries, population, commuter data, and housing prices for the 12 Alaska sub-regions in the model were obtained from State and federal agencies that track Alaska-specific regional data. For example, the Alaska Department of Labor and Workforce Development (ADOLWD) provided the data on the number of workers by place of work and by place of residence. ADOLWD relies on a unique set of databases, including the unemployment insurance wage records that contain worker occupation and place of work, Alaska Permanent Fund Dividend (PFD) database, and other data series, to accurately monitor the resident hire status of employers, industries, occupations, and regions in the State. This information was used to generate the commuter information and residency adjustment coefficients in the model. Historical population estimates for the Alaska regions were also obtained from ADOLWD. Population estimates at the place, borough, and census area use the U.S. Census Bureau's decennial census as the starting point for all Alaska population estimates. ADOLWD's estimation process relies upon administrative data, primarily the PFD applicant information to generate population estimates. The PFD application requires data on physical place of residence from applicants, which allows for more accurate geocoding of respondents to lower levels of geography.

The detailed structure of the REMI model requires an extensive amount of data. Most of the data for the REMI model come from the U.S. Bureau of Economic Analysis (BEA) and U.S. Census Bureau. In addition, the model uses several supplementary data sources. As a result of this combination of data sources, the REMI model data are more robust compared to data from a single source. A summary of primary data sources for the REMI model is provided in Table 9. The single most important source of data at the national, state, and borough levels is the BEA. The BEA data are available for the nation and states at an aggregated level that includes 94 industries, and for boroughs/census areas at a higher level of aggregation that includes 24 industries.

Table 9: Major Data Sources for the REMI Model

Indicator	Data Source	Years Available
Employment	U.S. Bureau of Economic Analysis U.S. Census Bureau	2001–2014 2013
Wages	U.S. Census Bureau	2013
Personal Income	U.S. Bureau of Economic Analysis	2001–2014
Compensation	U.S. Bureau of Economic Analysis	2001–2014

Source: Regional Economic Models, Inc. (2015)

Projections on employment, economic output, income, and other economic indicators are based on the historical trends specified in the data embedded in the model. The equations in the model used for forecasting economic changes and effects are based on economic theory and empirical studies.

2.1.5 REMI Model Inputs

The following are the major model inputs used in the socioeconomic impacts analysis of the Project:

1. Existing and projected employment by region and by industrial sector from ADOLWD

For the purpose of this analysis, the model's baseline data were calibrated to conform to the latest official ADOLWD employment projections. ADOLWD creates a 10-year industry and occupational forecast for Alaska every other year. The latest employment projection (industry forecast) from ADOLWD covers the years 2014 to 2024; data from 2025 to 2060 were extrapolated using the same annual growth rate assumed by ADOLWD for each of the industrial sectors. The projections for each industry are based on historical trends and expected economic changes, Alaska and U.S. population projections, and other industry-specific variables. ADOLWD also considers knowledge of specific projects and observations of the current economic climate in the forecast (Martz 2016).

Table 10 shows the latest ADOLWD employment projections for the major industrial sectors in Alaska. ADOLWD predicts that the management of companies and businesses (22.4 percent growth) and ambulatory health care services (22.2 percent growth) sectors are likely to grow at a faster rate than the economy overall; while the heavy and civil engineering construction (-15.7 percent decline) and oil and gas extraction (10.0 percent decline) sectors are expected to experience the greatest job losses relative to overall employment. The State government sector is projected to lose jobs in this forecast.

Table 10: Alaska Employment Forecast by Selected Industrial Sector, 2014-2024

Industry Description	2014 Estimated Employment	2024 Projected Employment	Change from 2014 to 2024	Total Percentage Change
Total Employment, All Jobs	336,659	356,311	19,652	5.8%
Mining	18,098	17,032	-1,067	-5.9%
Oil and Gas Extraction	4,203	3,785	-419	-10.0%
Mining (except Oil and Gas)	2,766	2,918	152	5.5%
Support Activities for Mining	11,128	10,329	-800	-7.2%
Construction	16,904	17,189	285	1.7%
Construction of Buildings	4,603	5,065	462	10.0%
Heavy and Civil Engineering Construction	3,909	3,294	-615	-15.7%
Specialty Trade Contractors	8,392	8,830	438	5.2%
Manufacturing	14,567	14,278	-288	-2.0%
Wholesale Trade	6,454	6,775	321	5.0%
Retail Trade	36,168	38,912	2,744	7.6%
Air Transportation	5,918	6,439	522	8.8%
Water Transportation	1377	1573	196	14.2%
Truck Transportation	2,831	3,099	268	9.5%
Utilities	2,189	2,152	-37	-1.7%
Real Estate and Rental and Leasing	5,898	5,775	-123	-2.1%
Professional, Scientific, and Technical Services	14,863	15,458	595	4.0%
Health Care and Social Assistance, Public & Private	45,387	52,563	7,176	15.8%
Accommodation and Food Services	29,812	33,017	3,205	10.8%
Accommodation	8,208	8,985	777	9.5%
Food Services and Drinking Places	21,604	24,032	2,428	11.2%
Total Federal Government	13,048	13,861	813	6.2%
Total State Government	18,071	17,451	-620	-3.4%
Total Local Government	16,829	17,592	763	4.5%

Source: Martz (2016)

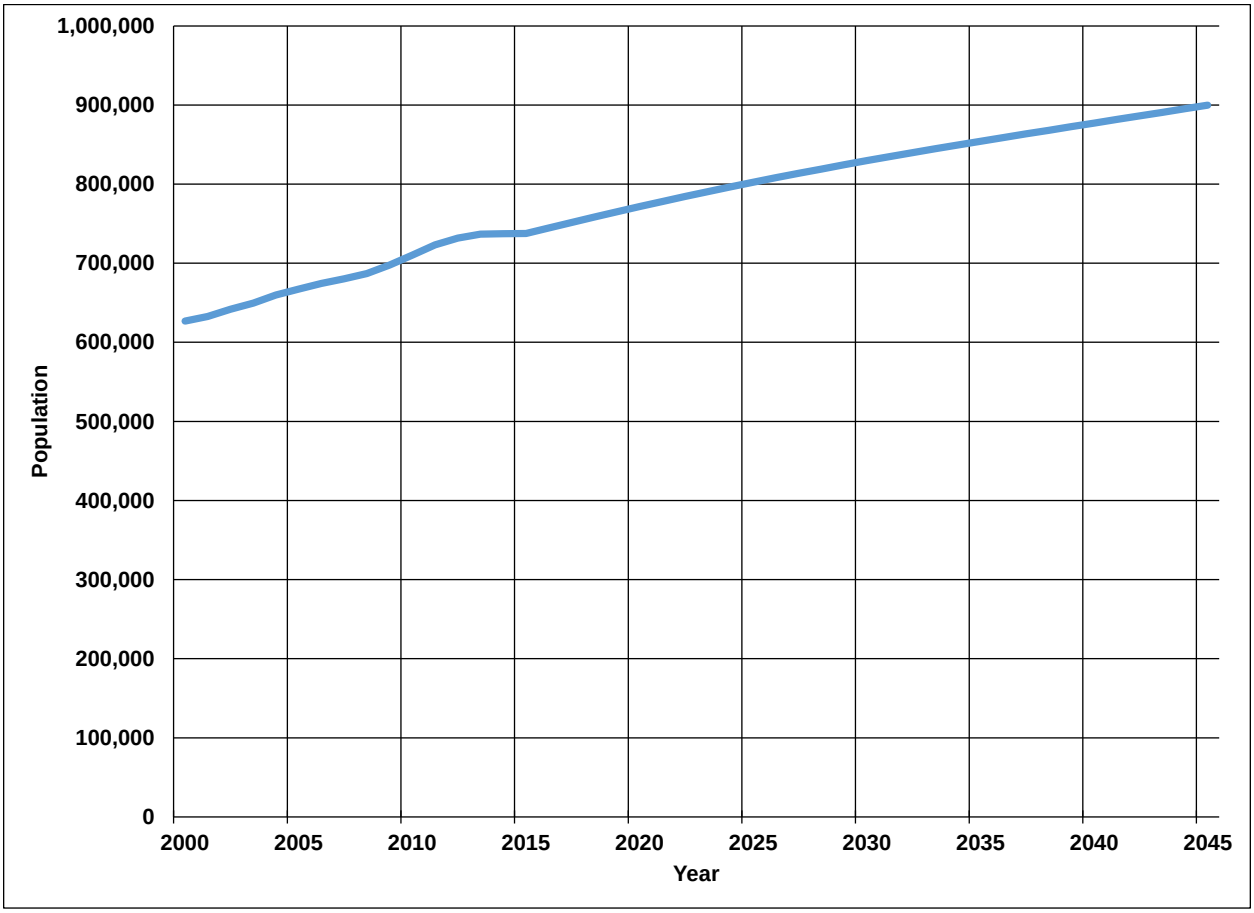
2. Existing and projected population by region from ADOLWD

The REMI model's baseline data were also calibrated to conform to ADOLWD's latest regional population projection. The latest ADOLWD population projection covers the period 2015 to 2045 (Alaska Department of Labor and Workforce Development 2016a); the data from 2046 to 2060 were extrapolated using the preceding years' annual growth rate. ADOLWD's population forecast is based on population age structure and historical trends in each of the components of population change: birth rates, death rates, and migration. The Alaska statewide forecast includes three migration scenarios, high, low, and baseline. The "baseline" scenario, considered most likely, uses a net migration rate of zero; this means the number of persons moving into and out of Alaska each year are equal. The high and low scenarios assume net migration rates of 1 percent and -0.5

percent, respectively. The population projections do not account for any large economic projects or events that would change population trends. This analysis uses the baseline scenario for the statewide population forecast.

The annual growth rates are modest in the baseline forecast starting at an annual growth rate of 0.9 percent in the next few years and declining to an annual growth rate of 0.5 percent in the years 2035 to 204 (Figure 4).

Figure 4: Historical and Projected Statewide Population, Baseline Scenario



Source: Alaska Department of Labor and Workforce Development (2016a).

3. Workforce requirements (employment) and payroll data associated with the Project
4. Capital expenditures (CAPEX) and operating expenditures (OPEX) data associated with the Project
5. Economic data associated with the non-jurisdictional facilities
6. Local hire estimates

The estimated workforce requirements, payroll, CAPEX, and OPEX data are provided by the Alaska LNG Project. Economic data for the non-jurisdictional facilities are provided by the respective project managers for each of the facilities.

Assumptions regarding local hire are developed outside of the model and are used as inputs into the model. Local hire percentages and numbers were developed from the Project's demand for

specific skills and occupations, and the potential supply of Alaska workers with experience in those occupations that were working in other occupations in 2014 supplied by ADOLWD (2016b). The potential supply estimates do not include persons with experience in those occupations that were unemployed in 2014, and thus may underestimate the number of Alaska residents that could find employment on the Project. The methodology for estimating resident hire was developed in collaboration with ADOLWD.

Developing REMI model inputs involves translation and disaggregation of the engineering-based CAPEX cost categories into the 70 industry sectors available in the REMI model. Examples of CAPEX cost categories may include engineering, materials and equipment, modules, logistics, camps, construction, owners' costs, etc. These categories are then assigned to various industrial sectors such as the ones listed in Table 11.

Table 11: List of Typical REMI Model Industrial Sectors Used to Assign CAPEX Cost Categories

Mining	Motor Vehicles/Trailer Manufacturing	Rental & Leasing services
Other Mining Services	Petroleum & Coal Products	Professional & Technical Services
Construction	Wholesale Trade	Repair & Maintenance Services
Construction – Payments to Labor	Rail Transportation	Management of Firms
Wood Products	Water Transportation	Administrative Support Services
Fabricated Metal Products	Truck Transportation & Couriers	Royalties, Duties, Overhead/Profit & Adjustments
Machinery Manufacturing	Insurance Related Services	
Primary Metal Manufacturing	Banking and Related Services	

Note that CAPEX paid to suppliers from outside Alaska are not assigned to a sector. As noted above, economic impacts to the rest of the U.S. are not included in the analysis for Resource Report No. 5. The construction, professional and technical services, management of companies and enterprises, water transportation, rail transportation, truck transportation, wholesale trade, and mining support services are typically the top industrial sectors affected by construction activities in Alaska.

Direct jobs during the construction phase correspond to the workforce requirements estimated by the Applicant for each of the Project facilities (Liquefaction Facility, pipelines, and GTP) and construction-related logistics. Other entities provided information for the non-jurisdictional facilities. As noted above, for the purpose of this socioeconomic impact analysis, the indirect effects include the multiplier effects (both indirect and induced) on Alaska's economy of in-state spending during Project construction.The industry defined as "mining support services" is an important industry in Alaska, and in particular to the oil and gas industry. Almost all of the service companies that support the oil and gas industry are included in this sector. For example, Peak Oilfield Services, ASRC Energy Services, and Schlumberger are all considered part of the mining support services sector. These companies are heavily involved in developing the infrastructure for ANS oil and gas fields and are likely to compete for many of the contracts or subcontracts during construction of the Project.

The "management of firms" sector is also an important sector with respect to CAPEX. This industrial sector is comprised of firms or establishments that hold the securities of (or other equity interests in) companies and enterprises for the purpose of owning a controlling interest or influencing management decisions. Establishments in this sector perform essential activities that are often undertaken, in-house, by establishments in many sectors of the economy, such as strategic or organizational planning and decision-making within the company. The assignment of CAPEX to

this sector is not because large holding companies are assumed to be contracted to perform most of the Project construction work, but rather as a means to assign CAPEX to company management and administration within the REMI model.

"Royalties, Duties, Overhead/Profit & Adjustments" are usually CAPEX values that leak out of the State's economy and are therefore not incorporated into the Alaska model. However, some local gravel royalties are included through the State fiscal impact model.

After the assignment of CAPEX to individual REMI sectors, the next step is to allocate expenditures to specific geographic regions within Alaska. Geographic allocations are generally based on the physical location of the firms that supply the types of goods and services indicated by the sector. In Alaska for example, most of the professional and technical service firms are based in Anchorage, so most of the Alaska expenditures flowing to that sector are allocated to Anchorage-based firms. Similarly, many of the large construction firms in Alaska that are able to compete for work on Project are based in Southcentral Alaska and Fairbanks. For some cost items, regional assignments are based on the place of work. For example, gravel production and sales, which is the primary component of the CAPEX going to the mining sector, is assumed to be produced within the same region as it is used. Even though the construction firms are mostly based in Anchorage, workers employed by these firms could come from all regions of the State.

The REMI model uses current residency and commuting patterns in Alaska for workers on the Mainline and the GTP/PTTL/PBTL since those Project facilities would have rotations or seasonal jobs, and use hub airports that are similar to the existing activity pattern on the North Slope. Residency and commuting patterns data are from the U.S. Census Bureau (2016). The REMI model and a radiation model are used to determine the residency and commuting patterns for the Liquefaction Facility.

Modeling the economic activities associated with the Project's operation phase is done using the employment policy variable. For example, operation and maintenance jobs for the pipeline are modeled by adding jobs in the pipeline transportation sector in the region where the pipeline operating entity is assumed to be located. Operations and maintenance activities associated with the GTP and Liquefaction Facility are modeled by adding jobs in the oil and gas sector and mining support services sector in the North Slope Borough and the Kenai Peninsula Borough; additional jobs are added in the Municipality of Anchorage, where headquarters are likely to be located.

2.1.6 REMI Model Outputs

The model generates projections of various indicators of economic and demographic effects. Some of the major model outputs used in the socioeconomic analysis include--

1. *Economic output:* The amount of production, including all intermediate goods purchased as well as value added (compensation and profit); also referred to as total industry sales;
2. *Employment:* Estimates of the number of jobs, full-time plus part-time, by place of work. Full-time and part-time jobs are counted as equal weight. Employees, sole proprietors, and active partners are included, but unpaid family workers and volunteers are not included;
3. *Compensation:* The sum of wages and salaries and supplements to wages and salaries;
4. *Wages and salaries:* The monetary remuneration of employees, including the compensation of corporate officers; commissions, tips, and bonuses; voluntary employee contributions to certain deferred compensation plans, such as 401(k) plans; and receipts in kind that represent income;
5. *Average annual wage rate:* Calculated by dividing wages by employment for each sector;
6. *Net economic migration:* Migrants under age 65 (who were part of the civilian population the preceding year) who respond to economic and amenity factors; if value is negative, then more people are moving out of a region than moving in, and vice versa; and
7. *Population by age cohorts*.

The Project impacts are summarized and aggregated into the following major economic drivers identified in the existing conditions section:

1. Oil and gas;
2. Construction;
3. Transportation;
4. Tourism;
5. Professional, Scientific, and Technical Services; and
6. State and local government.

Note that the REMI model does not have a tourism sector per se; the effects of the Project on tourism are analyzed by looking at tourism-related sectors, such as accommodation, food services and drinking places, scenic and sightseeing transportation, amusement gaming, and recreation.

The REMI model provides estimates of various economic indicators for each borough and census area.

2.2 COMMUNITY DISTRIBUTION AND RADIATION MODELS

To estimate potential changes in population at the community level during Project construction and operation, two modeling approaches have been developed: 1) A community distribution model for allocating population associated with the Project facilities outside of the KPB, and a 2) radiation model for allocating population associated with the Liquefaction Facility within the KPB.

The combination of the KPB radiation model and community distribution model allows population changes to be estimated at the community level.

2.2.1 Community Distribution Model

The community distribution model is used to assign population changes during Project construction and operation to individual communities in boroughs and census areas, excluding the KPB. The REMI annual population change for the borough or census area is distributed to each community according to the population trends for that community in relationship to all other communities in the borough or census area. The sum of the annual population change in all communities equals the REMI annual population change for the borough or census area.

Annual population estimates at the community level from 2000 to 2014 published by ADOLWD are used as the baseline for the community population forecasts. Using a logarithmic regression model and borough-level population projections, published in five year increments through 2045 by ADOLWD, populations at the community level were projected through 2060 (Alaska Department of Labor and Workforce Development 2015; Alaska Department of Labor and Workforce Development 2016a).

Because the population of each community is forecasted separately, the relative proportion of a borough's or census area's population living within a particular community may change from year to year. In each borough or census area there could be communities with stable, increasing, or decreasing populations. If there is an increase in a borough's or census area's population, the forecasted population of a given community within that borough or census area may or may not increase at the same percentage, depending on the community's historical population trend.

2.2.2 KPB Radiation Model

Using existing population and place of work employment trends in the KPB is not appropriate for the construction phase of the Liquefaction Facility because facility construction is expected to be substantially larger than current economic activities in the region. The large construction workforce required for the Liquefaction Facility, together with the associated economic activity that the facility would generate, would be located near Nikiski and significantly expand this economic center for the KPB. Moreover, the percent population change in the KPB is anticipated to be much larger in comparison to the percent population change in other boroughs and census areas within the AOI. Hence, a radiation model was developed to allocate the KPB population change estimated by the REMI model to specific communities within the KPB. The allocation is based on factors such as average employment, distance and travel costs between locations, and the geographic distribution of communities. The radiation model is also used to estimate community-level population change in the KPB during Project operation.

The radiation model is a method of measuring population and workforce mobility that is analogous to the physics model measuring the light radiation and absorption process. The radiation model is an improvement on the gravity model, which uses distance between two locations and the mass of each location based on population or workforce. The radiation model considers population and employment opportunities distributed across space, rather than simply distance, to measure changes in mobility. Empirical testing demonstrates that the radiation model generally provides estimates that are better than those of the gravity model.

The radiation model equation is as follows:

$$T_{ij} = T_{\mathrm{i_i}} \frac{\mathrm{m_i n_j}}{(\mathrm{m_i} + \mathrm{s_{ij}})(\mathrm{m_i} + \mathrm{n_j} + \mathrm{s_{ij}})}$$

where i is the origin location, j is the destination location, m is the employment in i, n is the employment in j, and $\mathrm{s_{ij}}$ is the total employment in a circle centered on i and touching on j, excluding m and n. $T_{\mathrm{i_i}}$ is the total number of people who commute from i (to anywhere), and T_{ij} is an estimate of how many of those individuals commute from i to j. The circle shown in Figure 5 provides an example of the communities and their populations that would be included in the s term if Soldotna is the source and Nikiski is the potential destination.

The basic formula of the radiation model is robust and can be adapted to accommodate regionally specific issues. For example, since Alaskan communities differ markedly with respect to local road conditions and geographical features (e.g., proximity to inlets and mountains), travel time can be substituted for Euclidean distance (Figure 5). In addition, the use of travel time accounts for various community-imposed speed limits. As a result, the radiation model can account for the fact that the cost of travel between communities is not necessarily dependant on physical proximity. The shaded area shown in Figure 5 represents roughly equal travel times between Soldotna and communities in the KPB connected to Soldotna by major road networks. For example, in the same time that a Soldotna commuter reaches Nikiski, s/he could reach Clam Gulch.

To allocate REMI model population estimates to communities, the radiation model results are used to calculate a community's pro-rata share of the KPB's total commuter population. In this way, the model is able to allocate REMI population estimates among communities based on estimated commuting habits. For example, if at year x in the Project the radiation model forecasts 100 Project-related commuters from Soldotna to Nikiski, and the total number of Project-related commuters to Nikiski from any point within the KPB is estimated to be 1,000, Soldotna is expected to contain 10 percent of the Project-related commuting population, and, therefore, 10 percent of the REMI model population estimate.

Figure 5: Employment Opportunity Set for Soldotna Resident Considering Employment in Nikiski

The following bullets describe the data used for the radiation model. A summary of the data sources is provided in Table 12.

- Employment by place of work estimates are based on ADOLWD Quarterly Census of Employment and Wages data modified by BEA employment data that provide additional information on the self-employed. These estimates are used for the m and n terms in the radiation model equation described above, and are also a component of the s terms.
- The distance term, which determines which communities are to be included in the s terms in the radiation model equation, is based on estimated travel time data derived from Google Maps.
- T terms, or number of commuters, are based on 2000 travel time to work data provided by the U.S. Census Bureau. First, conservative travel times necessary to access each census designated place are estimated using Google Maps. Second, the people who report traveling far enough to work to leave their place of residence are identified as commuters on a place by place basis. Lastly, commuter estimates are normalized by 2010 decennial census population data.

Table 12: Radiation Model Data Sources by Variable

Variable	Data Source
$\mathrm{m_i}$	2014 Employment by Place of Work data from the ADOLWD and BEA
$\mathrm{n_j}$	2014 Employment by Place of Work data from the ADOLWD and BEA
$\mathrm{s_{ij}}$	2014 Employment by Place of Work data from the ADOLWD and BEA using travel times from Google Maps.
T_i	2000 Travel Time to Work data and 2010 Population data from the U.S. Census Bureau.
T_{ij}	Radiation model output

Source: U.S. Census Bureau (2015); Robinson (2015)

As described above, the radiation model operates by observing total employment opportunity along a network, set by the distance between community i and j. Because i and j represent the same location when considering a commute from Nikiski to Nikiski, T_{ij} cannot be realistically estimated using the radiation model framework.

To overcome model limitations regarding Nikiski commuter estimates, commuter estimates for Kenai are used as a proxy. This assumes that workers are indifferent between commuting from Kenai, a community that shares the same distance to the Liquefaction Facility construction site as some Nikiski residential clusters, and living somewhere within Nikiski itself. For some workers, Nikiski could provide housing closer to the construction site, but, with a larger population, Kenai may offer better amenities and a larger, more accessible housing stock.

2.3 MODEL ASSUMPTIONS ON DIRECT EMPLOYMENT AND COMMUTING PATTERNS

As previously noted, the Applicant provides the total number of direct jobs associated with Project construction and operation. The number of Alaska residents that could be employed by the Project is estimated based on additional information provided by ADOLWD and assumptions on the percent of the State's labor supply in specific occupations that may seek employment on the Project. The REMI model estimates economic migration into the State and within the State associated with the Alaska hires by borough and census area. The community distribution and radiation models determine the communities where direct and indirect workers and their families would reside. Out-of-state Project construction workers on rotation are not expected to move to the State.

The commuting patterns of Project construction workers on two-or-more-week long rotations are different from traditional daily commuting patterns because the cost of commuting to Project worksites is typically covered by the employer. The community distribution models anticipate that Alaska residents would need to travel to either Anchorage or Fairbanks to access subsequent travel to worksites. For the Liquefaction Facility at Nikiski, however, construction workers may be able to commute to the site if they are residents of the KPB. Hence, a percentage of the Liquefaction Facility construction workforce is assumed to follow the more traditional commuting pattern of driving to work each day. The balance of the construction workforce would reside in a construction camp and would be de-mobilized when their work activity is completed. The commuting patterns for the nonlocal construction workforce are anticipated to be similar to current patterns for workers who reside outside of the KPB but work in the KPB since nonlocal workers would need to access either Anchorage or Fairbanks to be transported to the Nikiski worksite.

All of the direct Project construction jobs are modeled as occurring at the airport hubs, thus requiring workers to commute to the airports at Anchorage or Fairbanks, except for residents of the KPB, who may be allowed to commute to work at the Liquefaction Facility. The REMI model develops estimates of employment, population, and other socioeconomic indicators based on this assignment of the "place of work" at the hub airports, which is similar to the current pattern of operations on the North Slope. The analysis uses residency information to determine economic impacts of wage spending. The rationale for this approach is that construction workers would not spend their money at Project worksites but rather in places where they reside, which is important for correctly modeling the spending of the workforce.

During Project operation, all Liquefaction Facility personnel are assumed to drive to work each day. The GTP operation workforce would commute to the plant on a rotational basis.

2.4 FISCAL IMPACT MODELS

The fiscal impact models are spreadsheet models developed for Resource Report No. 5 to address the following FERC requirements and guidance:

- Conduct a fiscal impact analysis evaluating incremental local government expenditures in relation to incremental local government revenues that would result from the construction of the Project. Incremental expenditures include, but are not limited to, school operating costs, road maintenance and repair, public safety, and public utility costs.
- Evaluate the impact of any substantial immigration of people on government facilities and services and describe plans to reduce the impact on local infrastructure.
- Estimate project-related ad valorem and local taxes.

A fiscal impact model for the State of Alaska and separate models for each municipality in the AOI were developed for this analysis. While the emphasis of the FERC guidelines is on the fiscal effects at the local government level, it is important to also include an analysis of fiscal impacts of Project construction and operation at the State government level to the extent State spending impacts local communities. The State of Alaska provides most of the public infrastructure and services in areas of the State that are not incorporated. The Yukon-Koyukuk Census Area, which is part of the unorganized borough, is an example of an unincorporated region in the AOI. Unincorporated communities along the Mainline corridor include Livengood and Wiseman among others. The State provides full funding for schools located in the unorganized borough. In addition, the State government contributes revenues to local governments throughout Alaska through various inter-governmental revenue sharing programs.

Fiscal impacts in the unorganized borough are captured in the State fiscal impact model, and impacts to unincorporated communities are included in either the State fiscal impact model or municipal fiscal impact models, depending on the powers authorized in a particular borough.

Additional details on the elements of the fiscal impact models are provided in the sections below.

2.4.1 Municipal Fiscal Impact Models

The following sections describe each of the revenue and expenditure categories included in the municipal fiscal impact model. The data collection effort for this component involves compiling annual financial data for each municipality, and then categorizing revenue and operating expenditures by type. Municipal financial records are available from the online Financial Documents Delivery System administered by ADCCED. Additional data were obtained from the online Alaska Taxable database administered by ADCCED.

2.4.1.1 Revenue Sources

2.4.1.1.1 Oil and Gas Property Tax

A municipality may levy and collect taxes on oil and gas production and pipeline property taxed by the State. However, payments in lieu of oil and gas property taxes have been proposed to offset costs borne by State and local governments during Project construction and operation. These payments are tentative and subject to required changes under existing property tax laws.

2.4.1.1.2 Property Tax (Non-Oil and Gas Property)

Municipalities in Alaska may levy a tax on all real and personal property unless it is exempted from property taxation. In the AOI, six boroughs and 13 cities levy property taxes. Assessors provide an annual report to the State Assessor which contains, among other items, a summary of all assessed values of all real and personal property within their jurisdictional boundaries. If a municipality does not provide an estimated value of exempt property, the State Assessor will estimate the value by using valuation models built for the various categories of property. No municipality may levy taxes exceeding 3 percent (30 mills) of the assessed value of property within the municipality during a year.

2.4.1.1.3 Sales Tax

State of Alaska statutes authorize municipal governments to levy a local sales tax on goods and services. Within the AOI, a number of boroughs and cities levy a sales tax. Taxation rates range from 2 to 5.5 percent. A borough may exempt any source from the borough sales tax if it is taxed by a city within the borough. Other exemptions may be granted by a local ordinance.

2.4.1.1.4 Special Taxes

Alaska municipalities are granted broad authority to levy special assessments beyond the ordinary sale of goods and services. A brief synopsis of special taxes levied in the AOI that would be potentially affected by Project-related changes in population or economic activity is presented below.

Alcohol Tax. Taxes are levied on the retail sale of alcoholic products in several municipalities within the AOI: City of Barrow (3 percent), City of Fairbanks (5 percent), and Fairbanks North Star Borough (5 percent).

Tobacco Tax. Five municipalities in the AOI levy taxes on the purchase of cigarettes, chewing tobacco, and other tobacco products. Taxation rates range from 5.29 to 12 percent, although some municipalities levy a fixed dollar amount per unit. For example, Barrow levies a tax of $1.00 per pack of cigarettes.

Bed Tax. Several boroughs and communities within the AOI levy a tax on hotel room rental transactions, ranging between 4 and 12 percent of the rent paid to the hotel operator.

Car Rental Tax. The Municipality of Anchorage allows the levy of an 8 percent tax on the rental of motor vehicles at the point of transaction. Taxes are generally limited to $120 for passenger cars and $240 for trucks, vans, and motorhomes per rental transaction.

Utility Tax. The City of Anderson levies a utility tax of 8 percent that encompasses fuel, electricity, propane, and cable services delivered to and consumed in the city..

Severance Tax. The Denali Borough levies a severance tax on the extraction of some non-petroleum natural resources, including gravel, coal, and limestone. The tax rate is $0.05 per ton of coal and limestone and $0.05 per cubic yard of gravel.

Other Tax. Other taxes included in the municipal fiscal model include passenger transit tax, motor vehicle tax, and seafood sales tax.

2.4.1.1.5 Charges for Services and Other Fees

Revenues received by municipalities include charges and fees received from providing goods or services to customers in the course of the ongoing activity of various government funds, including: service charges, licenses and permits, and fines and forfeitures.

2.4.1.1.6 Other Non-Tax Revenue

Other non-tax revenue received by municipalities include federal and State intergovernmental transfers, investment income/earnings, restricted contributions/grants, and other non-tax revenues.

2.4.1.1.7 Business-Type Activities/Enterprise Fund Revenue

Proprietary funds report the activities within each municipality that operate like a business, where the cost of providing goods or services is primarily financed by fees charged to the users of their services. Proprietary funds include enterprise and internal service funds. Enterprise funds report activities that provide supplies or services to the general public, including: water and wastewater utilities, electric utilities, public transit, solid waste, ports, harbors, airports, and various other activities. Internal service funds report activities that provide supplies and services for the municipalities programs and activities.

2.4.1.1.8 Special Revenue Fund Revenue

Special revenue funds are used to account for specific revenues that are legally and externally restricted to expenditure for a particular propose. Special revenue funds are used to account for emergency service districts, road service districts, environmental services, flood services, and recreation services.

2.4.1.2 Expenditure Categories

2.4.1.2.1 Transportation and Public Works

This category contains expenditures for infrastructure serving local populations, including roads and water distribution systems.

2.4.1.2.2 Education

The education category includes expenditures on overall education, training, and workforce needs. The municipal fiscal impact models consider education expenditures in cases where they are included in general financial statements for incorporated entities. Education expenditures for Regional Education Attendance Areas in the unorganized borough are addressed separately.

2.4.1.2.3 Public Welfare

Public welfare includes community service expenditures focused on helping the poor, elderly, and others in need.

2.4.1.2.4 Health and Human Services

This category includes local government expenditures for health clinics and other health needs and for sewer systems and refuse service.

2.4.1.2.5 Public Safety

Public safety expenditures cover the provision of police, fire, and emergency medical services. Financial support of volunteer efforts is also included in this category.

2.4.1.2.6 Environment and Housing

Environment and housing expenditures are focused on the quality of life and well-being of residents. Typical expenditures include the provision of parks, libraries, recreational programs, and arts and cultural events.

2.4.1.2.7 Government Administration

This category generally comprises the functions of financial administration, judicial and legal, and general public buildings. Included are activities related to personnel administration, recording, planning, zoning, and the like. The government administration category may also cover government spending that is not represented in any of the other categories.

2.4.1.2.8 Miscellaneous Expenditures

Other expenditure categories included in the municipal fiscal impact model include expenditures on parks and recreation, maintenance, community development, solid waste, emergency services, and public utilities.

2.4.1.2.9 Business-Type Activities/Enterprise Fund Expenditures

Business-type activities and enterprise funds function similarly to private organizations, but they are fully owned and operated by the local government. These activities and funds typically charge user fees (either public or government) to cover costs. Examples of enterprise funds include water and wastewater utilities, electric utilities, public transit, solid waste, ports, harbors, airports, and various other activities. Internal service funds report activities that provide supplies and services for the municipalities programs and activities.It should be noted that some jurisdictions may choose to account for certain activity using an enterprise fund, while another jurisdiction might report the same activity under the general fund.

2.4.1.2.10 Special Revenue Fund Revenue

Special revenue funds are used to account for specific revenues that are legally and externally restricted to expenditure for a particular propose. Special revenue funds are used to account for emergency service districts, road service districts, environmental services, flood services, and recreations services. Like enterprise funds, it is possible that special revenue fund expenditure categories could overlap those mentioned above.

2.4.2 State Fiscal Impact Model

The following sections describe each of the revenue and expenditure categories included in the state fiscal impact model. Categories are based on the current State fiscal structure. The data collection effort for this component involves compiling financial data for the State, and then categorizing revenue and operating expenditures by type. The primary data sources are the State of Alaska Comprehensive Annual Financial Report published by the Alaska Department of Administration and the Revenue Sources Book published by the Alaska Department of Revenue.

2.4.1.3 Revenue Sources

2.4.1.3.1 Oil and Gas Property Tax

Payments in lieu of oil and gas property taxes have been proposed to offset costs borne by State and local governments during Project construction and operation. These payments are tentative and subject to required changes in existing property tax laws.

2.4.1.3.2 Royalties

Alaska establishes a royalty rate for individual oil and gas leases according to the terms of the lease agreement. As an example, royalties for the PBU leases are 12.5 percent. Some leases receive royalty rate reductions from the original lease rate for new discoveries or economic considerations. Royalty can be taken in value or in kind, at the State's option subject to the terms of the lease. Royalty in value is paid in lieu of royalty being provided in kind and is based on the value of the oil or gas that would have been taken in kind. Certain leases and other agreements with certain lessees address what field expenses are paid by the State for royalty taken in kind or deducted from the sales value to calculate royalty in value and certain agreements with certain lessees address how to determine royalty value and what expenses can be deducted from the sales value to calculate royalty due.

2.4.1.3.3 Production Tax

Alaska imposes a tax on oil and gas production in the State. The net production tax is currently 35 percent and is based on the net value of oil and gas, which is the value at the point of production, less all qualified lease expenditures. Qualified lease expenditures include certain qualified capital and operating expenditures. After 2021, gas will be taxed at 13 percent of its gross value at the point of production under Alaska Statute 43.55.011(e), not gross value minus lease expenditures. Further, qualified gas producers may elect under Alaska Statute 43.55.014 to pay production tax in gas instead of the production tax levied for the gas by Alaska Statute 43.55.011(e).

2.4.1.3.4 Corporate Income Tax

Alaska levies a corporate income tax on the portion of a company's total taxable income that is attributable to its activities and presence in Alaska. The tax has graduated rates ranging from 1 percent to 9.4 percent. Corporations engaged in either oil and gas production or transportation of oil or gas via regulated pipeline must file an Alaska Oil and Gas Corporation Net Income Tax Return. Oil and gas corporations apportion income using an apportionment formula applied to worldwide income.

2.4.1.3.5 Mining License Tax

Alaska levies a mining license tax on mining net income and royalties received in connection with mining properties and activities in Alaska. The Alaska Tax Division collects mining license taxes primarily from businesses engaged in coal and hard rock mining. The mining license tax structure

operates on a progressive tax structure ranging from $1,200 plus 3 percent of net income, to $4,000 plus 7 percent of net income. In addition, the State collects a royalty of $0.50 per cubic yard of gravel extracted from State lands. The mining license tax and/or gravel royalty could be applied to Project-related gravel extraction as appropriate.

2.4.1.4 Other Taxes and Fees

Other State revenue sources that would be potentially affected by Project-related changes in population or economic activity, and, therefore, are included in the State fiscal impact model as follows:

Tobacco. Alaska levies a tax on cigarettes and other tobacco products. The cigarette tax is levied on cigarettes imported into the State for sale or personal consumption. The tobacco products tax is levied on other tobacco products (other than cigarettes) imported into the State for sale. The division collects tobacco taxes primarily from licensed wholesalers, distributors, and retailers.

Marijuana. Alaska levies a tax on the marijuana sold in the State. The tax, which is collected from licenses marijuana cultivation facilities, is imposed when marijuana is sold or traferred from a marijuana cultivation facility to a retail marijuana store or marijuana product manufacturing facility. The tax is $50 per ounce of marijuana.

Alcoholic Beverages. Alaska levies a tax on alcoholic beverages sold in Alaska. The tax is collected primarily from wholesalers and distributors of alcoholic beverages.

Motor Fuel. Alaska levies this tax on motor fuel sold, transferred or used within Alaska. The State collects motor fuel taxes primarily from wholesalers and distributors that hold “qualified dealer” licenses issued by the State.

Regulatory Cost Charges. Alaska levies regulatory cost charges on regulated utilities. The charges fund the Regulatory Commission of Alaska that regulates utilities and pipeline carriers in Alaska. Regulated utilities collect charges from consumers and remit the collections to the State. The Alaska Oil and Gas Conservation Commission, which regulates oil and gas field operations and protects correlative rights among different land owners, also charges fees to cover its costs, and those fees are also remitted to the State.

Vehicle Rental. Alaska levies an excise tax on fees and costs charged for the lease or rental of a passenger or recreational vehicle, if the lease period does not exceed 90 consecutive days. The tax is levied on individuals renting vehicles and is collected by the rental/lease agency.

Gaming. Under Alaska law, municipalities and qualified non-profit organizations may conduct certain gaming activities. The purpose of these activities is to derive public benefit in the form of money for non-profits and revenues for the State. The State maintains responsibility for audits, inspections, and investigations of gaming organizations.

Telephone Cooperative. Alaska levies a telephone cooperative tax on gross revenue of qualified telephone cooperatives under Alaska Statute 10.25. The Tax Division collects taxes from cooperatives.

Electric Cooperative. Alaska levies this tax on kilowatt-hours furnished by qualified electric cooperatives recognized under Alaska Statute 10.25. The electric cooperative tax is based on a rate per kilowatt-hour and on the length of time the cooperative has furnished electricity to consumers.

Tire Fee. Alaska imposes a tire fee on all new tires sold in Alaska. An additional tire fee is imposed on the sale of tires with metal studs weighing more than 1.1 grams each (heavy studs). The additional tire fee also applies to the installation of heavy studs in new or used tires. The division collects tire fees primarily from tire dealerships.

2.4.1.5 Expenditure Categories

The general expenditure categories included in the state fiscal impact model are listed below.

- General Government
- Education
- University
- Health and Human Services
- Law and Justice
- Public Protection
- Natural Resources
- Development
- Transportation
- Intergovernmental Revenue Sharing

State government expenditures could also increase as a result of the State's participation in the Project. These additional costs to the State are uncertain at this time. With the primary Project developer at this time being AGDC, the government of the State of Alaska and Alaska's local governments will be integrally involved in the decision making around the project benefits and costs of the Project to the State. As the ownership structure of the Project develops, AGDC will continue to work closely with the State to verify that the overall fiscal impact of the Project is generally positive. Key Project fiscal and investment decisions in regards to the State will be made by Executive and Legislative branch of State government with involvement from local government organizations such as MAGPB. Therefore, the fiscal impact analysis will focus on local government and community impacts, whether independent or as impacted by the State revenues and expenditures. Fiscal Impact Model Analysis

The fiscal effects of Project construction and operation can be divided into population-based effects and non-population-based effects. Population-based effects are changes in the revenue and expenditures of state and local governments that result from Project-driven population changes. For example, expenditures on public infrastructure and services are typically driven by population, as more people use the public good or service, the higher the capital, maintenance, and operation costs. Offsetting the costs associated with this increase in demand, the expanded population also would bring with it an increase in revenue from user fees and revenue sources such as sales and property taxes and education funding.

In general, most population-based fiscal effects are calculated by multiplying estimates of State and borough population changes generated by the REMI model or community population changes generated by the radiation or community distribution models by per capita coefficients developed for revenue and expenditure categories based on 2013 baseline data. Per capita costs are assumed to increase 2.5 percent per year due to inflation. However, estimates of changes in some categories of revenues and expenditures are calculated using alternative methods, as described below.

- The State fiscal impact model projects collections of State taxes, such as corporate income tax, based on a linear regression equation that predicts corporate income tax revenue given estimated changes in State gross domestic product generated by the REMI model. The municipal fiscal model uses a similar linear regression approach to estimate real and personal property taxes based on population.
- For municipalities that have car rental and bed taxes, the municipal fiscal impact model multiplies baseline taxes for each category by the estimated percent change in output for the accommodation sector estimated by the REMI model.

- The municipal fiscal impact model estimates education expenditures by multiplying school-age population estimates (for each jurisdiction) as reported by REMI and average daily membership cost (by district).
- The municipal fiscal model calculates per capita coefficients for revenue and expenditure categories contained within each municipality's general fund and proprietary funds. The general fund is used to account for resources traditionally associated with government which are not required to be accounted for in another fund. Proprietary funds report the activities the municipality operates like a business, where the cost of providing goods or services is primarily financed by fees charged to the users of their services. Proprietary funds include enterprise and internal service funds. Enterprise funds report activities that provide supplies or services to the general public; internal service funds report activities that provide supplies and services for the municipality's programs and activities. In addition, the municipal fiscal model includes special revenue fund revenues and expenditures for the Kenai Peninsula Borough only, which did not exceed this analysis' threshold reporting requirements.

It is important to note that State revenue and expenditure patterns could change in the future. For example, the Alaska Legislature could enact a sales and/or income tax to offset the State's current financial shortfall due to declining oil production and lower oil prices. Such changes would require revisions or cause inaccuracies in the current state fiscal impact model.

The major non-population-based fiscal effects of Project construction and operation would depend on the terms of the agreements negotiated by the Project, agencies within the State, and the municipalities that would be potentially affected by the Project. These impacts are not currently estimated in the model.

2.5 INTEGRATION OF MODELS

Addressing FERC requirements for analyzing Project impacts requires the integration of all three models. The REMI model generates projections of employment, population, income, economic output, and other economic indicators resulting from the Project at the regional level. Given the regional level results from the REMI model, the community distribution and radiation models generate community-level estimates of population changes. The fiscal impact models use the information from the community distribution and radiation models to estimate population-based revenues and expenditures. The fiscal impact models also require inputs from the REMI model.

2.6 SUMMARY OF INFORMATION NEEDS

The REMI model requires the following inputs:

- Existing and projected population by region from ADOLWD;
- Existing and projected employment by region and by industrial sector from ADOLWD;
- Project data on direct employment and payroll;
- Project data on CAPEX and OPEX; and
- Economic data (employment and spending) on non-jurisdictional facilities.

The fiscal impact models require the following inputs:

- Existing and projected population for the State and each community (from REMI model and community distribution and radiation models);
- Existing and projected industry output (from REMI model);
- Existing State and municipal government revenues and expenditures (from audited financial statements);
- Existing tax structure (Alaska Department of Revenue and Alaska Taxable);
- Fiscal terms relevant to the State, if known;
- Financial information from tribal governments, regional and village corporations; and
- Cost of non-jurisdictional facilities.

The community distribution model requires the following inputs:

- Population data for boroughs, census areas, and communities from ADOLWD;
- Employment data for boroughs and census areas from ADOLWD and BEA; and
- Regional level population and employment projections from the REMI model.

The radiation model requires the following inputs:

- Estimates of driving times for all communities in the KPB;
- Travel time to work data for all communities in the KPB;
- Population data for the census designated places in the KPB;
- Employment data from ADOLWD; and
- Regional level population and employment projections from the REMI model.

2.7 IMPACTS ON TRANSPORTATION INFRASTRUCTURE

Section 5.3 of Resource Report No. 5 describes the current state of the transportation infrastructure that is likely going to be impacted by Project activities during the construction and operation phases. Estimating Project impacts during construction and operation on ports, highways, roads, railroad, and airports requires information from the Project that is currently being developed.

This analysis includes among others:

- Direct effects to the traveling public related to increases in traffic resulting in congestion, traffic delays, and potential conflicts with seasonal ice roads and ice road users;
- Access/limitation restrictions to the various Project facilities; and
- Indirect effects due to redirection of other rail traffic.

The following summarizes the information used to determine Project impacts on each transportation facility:

2.7.1 Highways

- Type, number, and frequency of truck trips (average annual daily traffic [AADT]) that would be used for delivery of supplies and materials on each highway during construction
- Type and number of vehicles and vehicle trips required to transport workers to and from work camps

2.7.2 Railroads

- The Project's expected demand for rail cars of various types (e.g. flatcars for transporting pipe, hopper cars for transporting gravel)
- Number and frequency of trips by rail required during the Project's construction phase
- Capacity and limitations of the Alaska Railroad system

2.7.3 Ports, Harbors, and Marine Shipping

- Number, and frequency of trips by ships and tug and barge sets during construction
- Description of transfer of supplies and materials from the vessels through the ports and onto other modes of transportation
- Description of marine shipping routes to be used
- Description of improvements or expansion of existing ports and harbors or construction of new facilities required to support the Project's construction activities

2.7.4 Air Transportation

- List of airports that would be used by the Project during construction and operation phases
- Description of improvements or expansion of existing airports or construction of new facilities that may be required to support the Project's construction activities
- Description of aircraft to be used and number of flights between origin and destination points

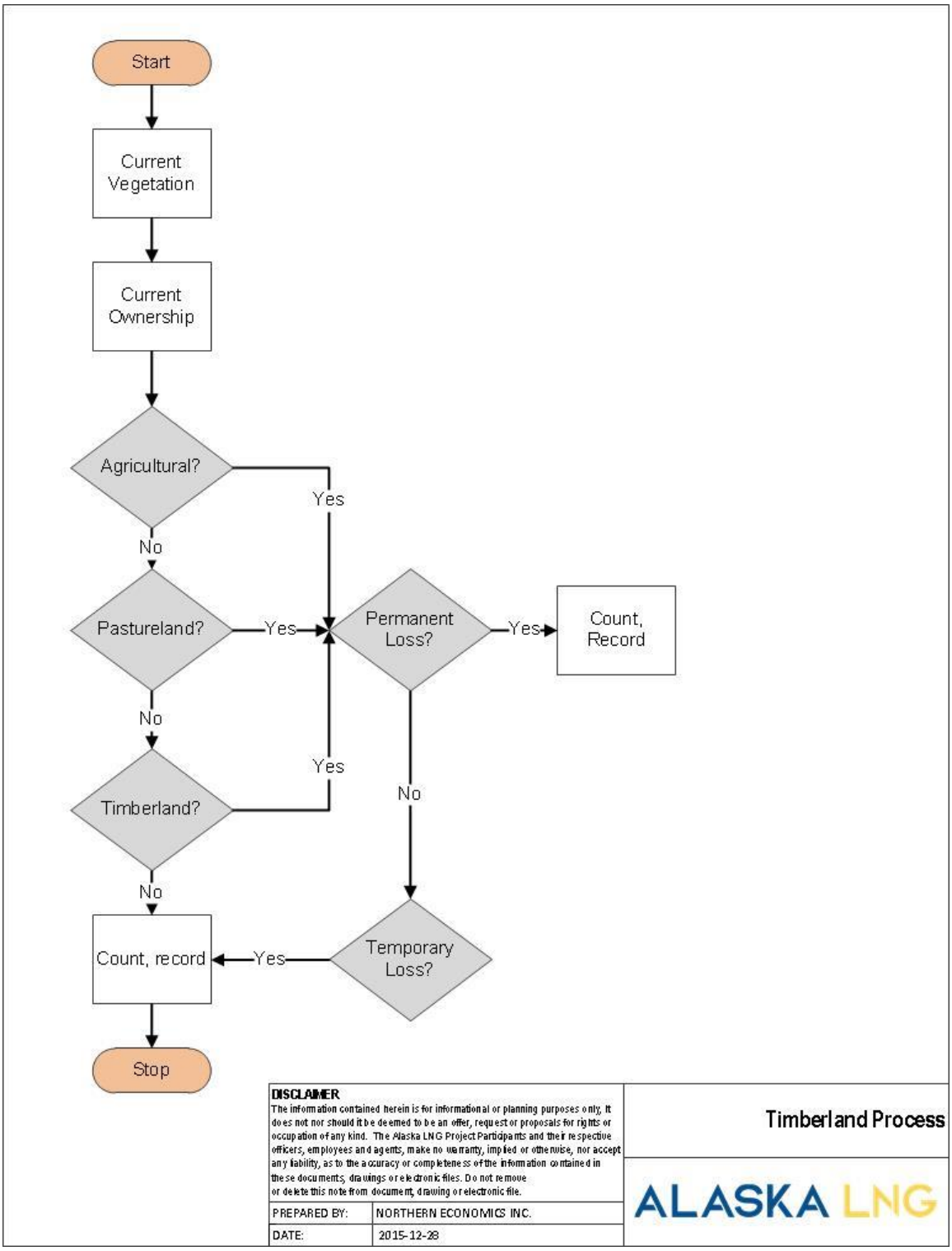
2.8 IMPACTS OF LOSS OF PRODUCTION IN AGRICULTURAL/PASTURE LAND OR TIMBERLAND

FERC requirements for Resource Report No. 5 include the following:

- Identify acreage temporarily and permanently removed from production during construction and operation of facilities.
- Include a discussion of effect of loss of production on the local or regional economy and compensation to be paid for loss of production for the life of the facility or until land regains former production.

Figure 6 provides an overview of the process used to address this FERC requirement. Additional information on this process is provided in the sections below.

Figure 6: Process for Determining Economic Impacts Due to Loss of Production in Agricultural/Pasture Land or Timberland



2.8.1 Resource Identification

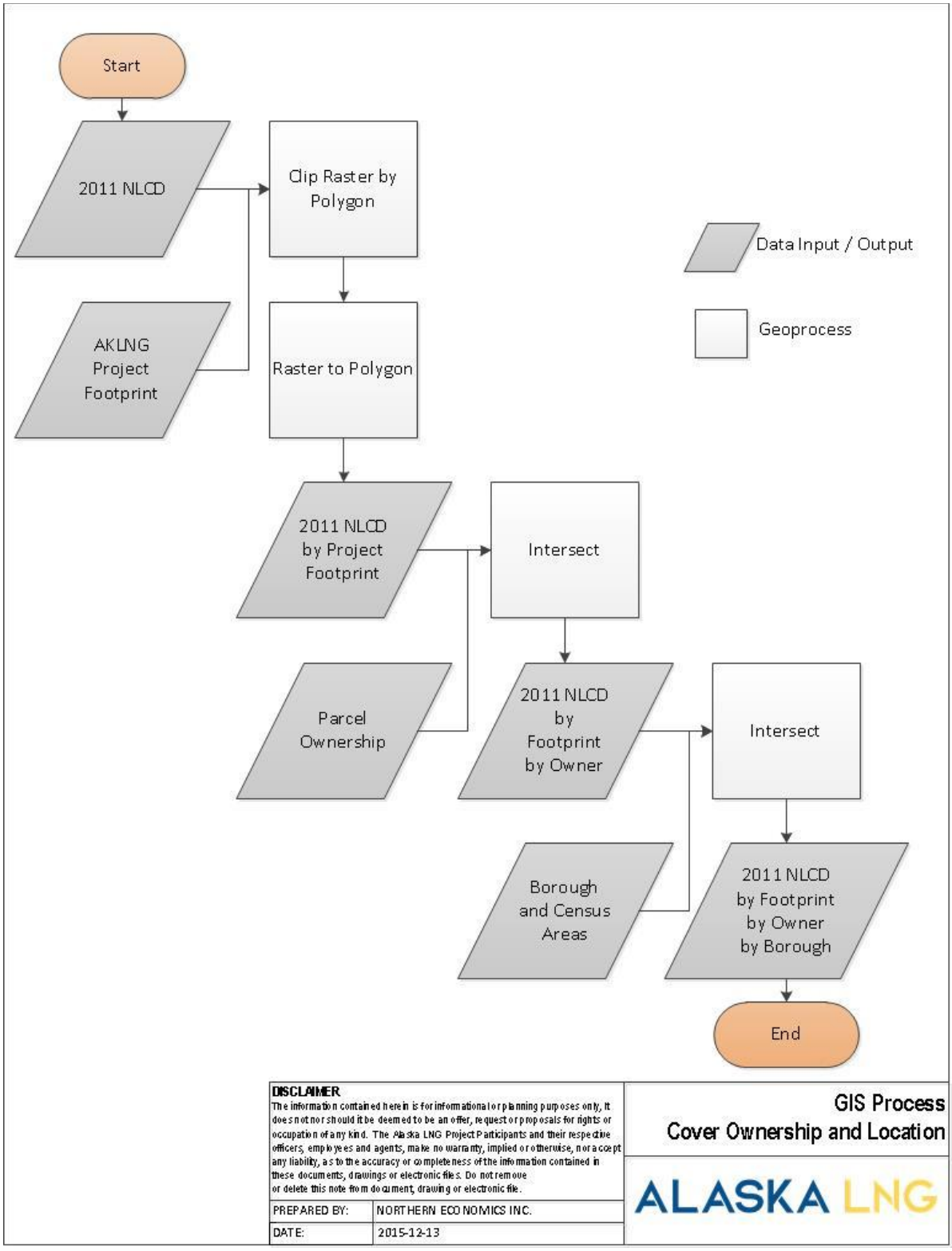
The first steps involve geographic information system (GIS) tools in identifying timberland and agricultural land (pastures included) surrounding the Project facilities and determining vegetative acres by ownership. Three primary sources of GIS data are used for identification:

- The 2011 National Land Cover Database (NLCD) (Homer et al. 2015);
- Parcel ownership provided by the Project; and
- Project facilities including, but not limited to, the Mainline corridor, Liquefaction Facility, GTP, other permanent and temporary facilities such as construction camps, and roads.

Current vegetation is defined by three forest types (deciduous, coniferous, and mixed species), one agricultural type (pasture) and an “other” category (water, developed land, wetlands, grassland etc.). Figure 7 shows the GIS process for determining land cover by ownership by location within the Project footprint.

Ground inspection and verification is an important step in confirming that NLCD defined vegetation types are correct. Several foot-accessible ground points were selected off of the Parks highway near Petersville, and off of the Elliott Highway near Livengood. Independent observations of vegetation type, density, height, diameter, and ratio with other vegetation were noted and reported alongside their respective NLCD definitions.

Figure 7: GIS Process for Determining Vegetative Acres by Owner in the Project Footprint



2.8.2 Volume and Value of Production Loss

The next steps involve determining the volume and value of agricultural/pasture land or timberland affected. Once the mapping type is confirmed and recorded, volumes by species and values are determined. There are two sources of on-the-ground field forestry data—a detailed forest inventory for the Matanuska-Susitna Borough (Sanders Forest Consulting 2006), and a forest inventory on Alaska Division of Forestry lands near Fairbanks (Hanson 2013). These two sources have field samples on or near the proposed Mainline right-of-way. The field inventories provide an average volume per acre (both gross and net) by species, along with an estimate of quality.

For purposes of calculating the economic value of cut timber, the value of timber from areas with access to local or regional forest product markets is based on actual sales prices offered by the Alaska Division of Forestry and MSB, while the value of timber from areas with no market access is based on a base price for timber stumpage that represents the cost to the Alaska Division of Forestry of administering the timber sale contract after purchase. Some timberlands, such as those belonging to the U.S. Bureau of Land Management, would require a formal appraisal before purchase by the Project. Appraised value at the time of purchase may differ from the value derived from the estimation techniques discussed above.

Direct impacts of Project facilities on land resources are determined and coordinated with the land advisor for the Project. Generally, the acreage affected would include land cleared for construction of Project facilities and the adjacent road clearing, borrow pits, and potential vegetation removal for fire hazard reduction, and access routes.

3.0 ACRONYMS AND TERMS

ADCCED	Alaska Department of Commerce, Community, and Economic Development
ADEED	Alaska Department of Education and Early Development
ADHSS	Alaska Department of Health and Social Services
ADOA	Alaska Department of Administration
ADOLWD	Alaska Department of Labor and Workforce Development
ADOR	Alaska Department of Revenue
ADOT&PF	Alaska Department of Transportation and Public Facilities
ADPS	Alaska Department of Public Safety
AOI	Area of Interest
BEA	U.S. Bureau of Economic Analysis
CAFR	Comprehensive Annual Financial Report
CAPEX	Capital Expenditures
CFR	Code of Federal Regulations
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
GDP	Gross Domestic Product
GIS	Geographic Information System
GTP	Gas Treatment Plant
IRS	Internal Revenue Service
LNG	Liquefied Natural Gas
NGO	Non-Governmental Organization
NJF	Non-jurisdictional Facilities
O&M	Operations and Maintenance
OPEX	Operating Expenditures
PBTL	Prudhoe Bay Transmission Line
PBU	Prudhoe Bay Unit
PTTL	Point Thomson Transmission Line
USACE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation

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