

Sub-Arctic Economic Impact Model for Petroleum Activities in Alaska (Sub-Arctic IMPAK)

Final Technical Report



Technical Report No. 165

OCS Study MMS
2002-060

Final Technical Report

Sub-Arctic Economic Impact Model for Petroleum Activities in Alaska (Sub-Arctic IMPAK)

Prepared for:

U.S. Department of Interior
Minerals Management Service
Alaska Region
949 E. 36th Avenue
Anchorage, Alaska 99508

Prepared by:

Jack Faucett Associates, Inc
4550 Montgomery Avenue, Suite 300 North
Bethesda, Maryland 20814

In association with

Mr. John Schwochert
Great Northern Engineering

June 2003

This report has been reviewed by the Minerals Management Service and approved for publication. Approval does not signify that the contents necessarily reflect the view or policies of the Service, nor does mention of trade names or commercial products constitute endorsement or recommendations for use. The United States government assumes no liability for its contents or use thereof.

The study was funded by the Minerals Management Service, U.S. Department of the Interior, Washington, D.C. under Purchase Order Number 01-00-PO-17115 and Purchase Order Number 01-02-PO-85307.

Document is available to the public through the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, Fax: 703-605-6900, www.ntis.gov

STUDY TITLE: Sub-Arctic IMPAK Model

REPORT TITLE: Sub-Arctic Economic Impact Model for Petroleum Activities in Alaska
(Sub-Arctic IMPAK)

CONTRACT NUMBERS: Purchase Order Number 01-00-PO-17115
Purchase Order Number 01-02-PO-85307

SPONSORING OCS REGION: Alaska

APPLICABLE PLANNING AREAS: Alaska

FISCAL YEARS OF PRODUCT FUNDING: FY 2000 and 2002

COMPLETION DATE OF REPORT: June 2003

COST: FY 2000 \$76,363
FY 2001 \$29,955
FY 2002 \$12,869

CUMULATIVE PROJECT COST: \$119,187

PROJECT MANAGER: Jonathan Skolnik

AFFILIATION: Jack Faucett Associates, Inc.

ADDRESS: 4550 Montgomery Ave. Suite 300 North, Bethesda Maryland 20814

PRINCIPAL INVESTIGATORS: Jonathan Skolnik, Chris D. Holleyman, John Schwochert

KEY WORDS: IMPLAN, OCS Sub-Arctic Subregion, oil industry, economic impacts, employment, earnings, input-output, manpower.

BACKGROUND: Production of oil and gas in the offshore Alaskan Sub-Arctic relies upon a set of technologies unlike those used anywhere else in the world. Economic impact modeling of these activities also requires a set of methods that are unique. Readily available regional economic impact models contain production functions that are based on national averages. These national-level input coefficients cannot accurately reflect the unique Alaskan production function. These models are also unable to accurately trace the regional distribution of purchases made by the industry or the workers who commute to the site. Finally, these readily available models do not have enough detail to accurately model the differing impact of specific projects.

This report describes the development of a first step model that can be combined with a readily available regional model to produce more accurate estimates of economic impacts. The first step model utilizes vectors of purchases, disaggregated by both geographic area and activity, to allow a more accurate accounting of the inputs required for a specific project. The vectors are constructed by coding detailed engineering estimates of inputs to the individual activities. These direct inputs can then be used to stimulate the standard regional impact models.

OBJECTIVES: The Outer Continental Shelf Lands Act, as amended, established a policy for the management of oil and natural gas in the Outer Continental Shelf (OCS) and for protection of the marine and coastal environments. The Act authorizes the conduct of studies in areas or regions to determine the "environmental impacts on the marine and coastal environments of the OCS and the coastal areas which may be affected by oil and gas development." The U.S. Minerals Management Service (MMS) is the administrative agency responsible for leasing submerged Federal lands.

The National Environmental Policy Act (NEPA) of 1969 requires use of the natural and social sciences in any planning and decision making that may have an effect on the human environment. To this end, the MMS prepares

Environment Impact Statements (EIS) and environmental assessments (EA); acquires marine environmental data; analyzes data, literature surveys, socioeconomic studies, and special studies; and holds public conferences. These undertakings often call for assessing the regional economic impacts of a proposal such as a lease or a sale.

In the past, an assortment of models and methods were used to estimate economic impacts, and these typically varied by planning areas. At present, the existing models used to develop direct OCS and secondary employment projections for the Alaska OCS Region are outdated and do not produce results comparable to other OCS regions such as the Gulf of Mexico. As a result, regional comparisons are difficult to make. Section 18 of the OCS Lands Act, however, requires that the U.S. Department of the Interior prepare a 5-year schedule of lease sales that considers "an equitable sharing of developmental benefits and environmental risks among the various regions." For this reason, MMS decided to standardize the approach used to estimate regional economic impacts and has settled on IMPLAN, an economic input-output model, for that purpose.

To facilitate EIS work for Alaska's OCS Sub-Arctic sub-regions and to develop a tool for the "equitable sharing" analysis, a new model was developed. It can estimate industry employment and expenditures, by region, of offshore oil exploration and development (E&D) activities in the Alaskan Sub-Arctic. The new model is known as the Sub-Arctic Impact Model for Petroleum in Alaska (Sub-Arctic IMPAK). Unlike the current model, this new model is designed to produce a set of outputs that can be used to stimulate IMPLAN.

In a parallel but separate study, a similar model was developed for the Arctic Alaska. This second model is known as Arctic IMPAK.

DESCRIPTION: The Sub-Arctic IMPAK model forecasts the input requirements needed to carry out oil exploration and development on Alaska's Sub-Arctic OCS. A variety of primary and secondary data sources are utilized to develop vectors of commodity and labor input requirements on a per unit basis. Multiplying these vectors by projected annual activity levels developed from an E&D scenario generates estimates of the total input requirements for each year in the forecast horizon.

The Sub-Arctic IMPAK model is contained in a Microsoft Excel platform and is driven by data from the E&D report, as well as other data, which are manually input into the model. Since the activities listed in the E&D reports are not identical to those used in IMPAK, the model has to convert the E&D data into the corresponding IMPAK activity levels.

The model inputs are then transposed into a matrix compatible with the regional input-output matrices. An Excel array function is used to accomplish the task. The transposed input is then multiplied by each region's input-output matrix to yield the total direct impacts by region and IMPLAN sector. Again, an Excel array function is used to accomplish the matrix multiplication. Note that each year in the forecast horizon requires a separate formula.

STUDY RESULTS: The final output is a matrix that provides total input requirements by IMPLAN sector separately for each year and geographic area. This output then becomes the input for the Microsoft-Access model developed by the MMS. The MMS model estimates the ripple effects in each corresponding, proximate onshore area.

REPORTS: Jack Faucett Associates, Inc. 2003. Sub-Arctic Economic Impact Model for Petroleum Activities in Alaska (Sub-Arctic IMPAK), Final Technical Report. Prepared for the U.S. Department of Interior, Minerals Management Service, Alaska OCS Region, Anchorage, Alaska. Technical Report No. 165.

MODELS: SUB-ARCTIC IMPAK: An Economic Impact Model on CD-Rom

TABLE OF CONTENTS

GLOSSARY	VIII
1 INTRODUCTION	1
1.1 THE CURRENT MODELING PROCESS	2
1.2 PURPOSE AND OBJECTIVE	2
1.3 STUDY AREAS	3
1.4 ORGANIZATION OF THE REPORT	4
2 OVERVIEW OF OIL AND GAS ACTIVITIES.....	5
2.1 GEOLOGICAL SURVEY	10
2.2 SPILL CONTINGENCY RESPONSE.....	11
2.3 CONSTRUCT EXPLORATION SHORE BASE	12
2.4 OPERATE EXPLORATION SHORE BASE	13
2.5 INSTALL EXPLORATION PLATFORM	14
2.6 OPERATE EXPLORATION PLATFORM.....	15
2.7 DRILL EXPLORATION WELL	16
2.8 CONSTRUCT PRODUCTION SHORE BASE	17
2.9 OPERATE PRODUCTION SHORE BASE	19
2.10 INSTALL PRODUCTION PLATFORM	20
2.11 OPERATE PRODUCTION PLATFORM.....	21
2.12 DRILL PRODUCTION WELL	22
2.13 LAY OFFSHORE PIPE	23
2.14 LAY ONSHORE PIPE.....	25
2.15 CONSTRUCT ONSHORE PRODUCTION FACILITY	26
2.16 OPERATE PRODUCTION FACILITY	28
2.17 CONSTRUCT MARINE TERMINAL.....	29
2.18 OPERATE MARINE TERMINAL.....	30
2.19 MAJOR PLATFORM MAINTENANCE	31
2.20 WELL WORKOVER	32
2.21 HELICOPTER SUPPORT.....	33
2.22 BOAT SUPPORT (LARGE WORKBOATS).....	34
2.23 SMALL WORK BOAT	36
2.24 LANDING CRAFT.....	36
2.25 DIVE BOAT	37
2.26 CAMP SUPPORT.....	37
3 LABOR INPUTS	39
3.1 OVERVIEW	39
3.2 ESTIMATES OF PRODUCTION EMPLOYMENT	40
3.3 ESTIMATES OF NON-PRODUCTION EMPLOYMENT AND WAGES.....	45
3.4 WORKERS BY PLACE OF RESIDENCE	47
3.5 ESTIMATES OF SPENDING BY GEOGRAPHIC REGION.....	48
3.6 ESTIMATES OF TAXES, SAVINGS AND PERSONAL CONSUMPTION EXPENDITURES	49
3.7 FINAL ESTIMATES OF SPENDING BY AREA.....	50
3.8 OTHER EMPLOYEE RELATED COSTS	50
3.9 CONVERSION FACTORS	52
4 PURCHASED SERVICES.....	54
4.1 NATIONAL INPUT/OUTPUT DATA.....	54
4.2 THE CALCULATION OF TOTAL PURCHASED SERVICES	59
4.3 INVESTMENT FINANCE CHARGES.....	59
4.4 PURCHASED SERVICES BY GEOGRAPHIC AREA	60
4.5 FINAL ESTIMATES OF PURCHASED SERVICES	61

5	CAPITAL AND MATERIAL INPUTS	70
5.1	CAPITAL INPUTS.....	70
5.2	MATERIAL INPUTS.....	73
6.	GOVERNMENT VECTORS AND REAL ESTATE COSTS	75
6.1	GOVERNMENT VECTORS	75
6.2	REAL ESTATE COSTS.....	75
7.	DESCRIPTION OF THE MODEL.....	77
7.1	INSTALLATION	79
7.1	INSTALLATION	80
7.2	USER INTERFACE	80
7.2.1	Documentation Screen.....	80
7.2.2	Model Setup Screen.....	80
7.2.3	Parameters Screen.....	82
7.2.4	Data Entry Screen.....	89
7.2.5	Output Screens.....	90
7.2.6	Graphs	92
7.3	MODEL PROCESSING ENGINE.....	92
7.3.1	Conversion of Data Entry Input into IMPAK Activity Levels	92
7.3.2	Secondary Drivers Worksheet.....	99
7.3.3	TransposeInput Worksheet.....	100
7.3.4	Activity Cost Vectors.....	100
7.3.5	Generation of Model Output.....	100

TABLE OF EXHIBITS

EXHIBIT 2-1	SUB-ARCTIC PLANNING AREAS.....	6
EXHIBIT 2-2	ALASKA PLANNING AREAS	6
EXHIBIT 2-3	HYPOTHETICAL OIL DEVELOPMENT INFRASTRUCTURE	7
EXHIBIT 2-4	PRIMARY AND SECONDARY ACTIVITIES – DRIVERS AND DEFAULT FACTORS	9
EXHIBIT 2-5	EMPLOYMENT COMPENSATION – INSTALL EXPLORATION PLATFORM I.....	15
EXHIBIT 2-6	EMPLOYMENT COMPENSATION – INSTALL EXPLORATION PLATFORM II.....	15
EXHIBIT 2-7	EMPLOYMENT COMPENSATION – OPERATE EXPLORATION PLATFORM	16
EXHIBIT 2-8	EMPLOYMENT COMPENSATION – DRILL PRODUCTION WELL.....	16
EXHIBIT 2-9	EMPLOYMENT COMPENSATION – OPERATE PRODUCTION SHORE BASE	20
EXHIBIT 2-10	EMPLOYMENT COMPENSATION – INSTALL PRODUCTION PLATFORM I	21
EXHIBIT 2-11	EMPLOYMENT COMPENSATION – INSTALL PRODUCTION PLATFORM II.....	21
EXHIBIT 2-12	EMPLOYMENT COMPENSATION – OPERATE PRODUCTION PLATFORM	22
EXHIBIT 2-13	EMPLOYMENT COMPENSATION – LAY OFFSHORE PIPE, ONSHORE.....	24
EXHIBIT 2-14	EMPLOYMENT COMPENSATION – LAY OFFSHORE PIPE, OFFSHORE	25
EXHIBIT 2-15	EMPLOYMENT COMPENSATION – LAY ONSHORE PIPE.....	26
EXHIBIT 2-16	EMPLOYMENT COMPENSATION – CONSTRUCT ONSHORE PRODUCTION FACILITY	27
EXHIBIT 2-17	EMPLOYMENT COMPENSATION – OPERATE PRODUCTION FACILITY	29
EXHIBIT 2-18	EMPLOYMENT COMPENSATION – OPERATE MARINE TERMINAL	30
EXHIBIT 2-19	EMPLOYMENT COMPENSATION – MAJOR PLATFORM MAINTENANCE I.....	31
EXHIBIT 2-20	EMPLOYMENT COMPENSATION – MAJOR PLATFORM MAINTENANCE II.....	32
EXHIBIT 3-1	NUMBERS PRODUCTION WORKER MANPOWER ESTIMATES BY ACTIVITY	41
EXHIBIT 3-2	CALCULATION OF NON-PRODUCTION EMPLOYMENT AND PAYROLL	46
EXHIBIT 3-3	NUMBERS AND WAGES OF NON-PRODUCTION WORKERS.....	47
EXHIBIT 3-4	PERCENT OF PRODUCTION EMPLOYEES BY PLACE OF RESIDENCE.....	48
EXHIBIT 3-5	PERCENT OF SPENDING BY PLACE OF FULL-TIME RESIDENCE	50
EXHIBIT 3-6A	SPENDING BY ALL WORKERS BY AREA FOR COOK INLET PROJECTS.....	52
EXHIBIT 3-6B	SPENDING BY ALL WORKERS BY AREA FOR REMOTE PROJECTS	52
EXHIBIT 3-6C	SPENDING BY ALL WORKERS BY AREA FOR REMOTE PROJECTS NEAR A POP	53
EXHIBIT 3-7	CALCULATION OF PRODUCTION WORKER LODGING EXPENSES.....	54
EXHIBIT 3-8	CONVERSION FACTORS FOR PRODUCTION WORKER MAN-HOURS.....	55
EXHIBIT 4-1	OIL AND GAS INDUSTRY INPUT DATA FROM THE 1992 BEA I-O TABLE	57
EXHIBIT 4-2	MISCELLANEOUS SECTOR INPUT DATA FROM THE 1992 BEA I-O TABLE	58
EXHIBIT 4-3	PERCENTAGE ESTIMATES OF PURCHASED SERVICES BY SECTOR AND AREA I.....	61
EXHIBIT 4-4	PERCENTAGE ESTIMATES OF PURCHASED SERVICES BY SECTOR AND AREA II.....	61
EXHIBIT 4-5	ESTIMATES OF PURCHASED SERVICES BY SECTOR AND AREA	63
EXHIBIT 6-1	ESTIMATES OF REAL ESTATE AND EASEMENT COSTS	78
EXHIBIT 7-1	IMPAK ACTIVITIES AND THEIR RESPECTIVE UNITS.....	80
EXHIBIT 7-2	MODEL FLOWCHART.....	81
EXHIBIT 7-3	E&D DATA ENTRY REQUIREMENTS AND THEIR RESPECTIVE UNITS.....	92

GLOSSARY

BP	British Petroleum, Inc.
Cat	Caterpillar, Inc.
COTU	Crude Oil Topping Unit
CPU	Central Processing Unit
BEA	Bureau of Economic Analysis
E&D	Exploration and Development
GPS	Global Positioning System
IBT	Indirect Business Taxes
IFR	Instrument Flight Rules
IMPAK	Impact of Petroleum Activities in Alaska
I-O	Input-Output
KW	Kilowatt
KPB	Kenai Peninsula Borough
Margin	A cost category that splits the purchase price of a commodity into various cost components. These categories include the production margin, transportation margins (the cost of shipping a finished product from the factory gate to its ultimate destination), wholesale trade margins, and retail trade margins. A margin rate is a margin cost divided by the total purchase price of the commodity.
MLLWL	Mean Low Level Water Level
MMS	Minerals Management Service
NIPA	National Income and Product Accounts. A national accounting system published by the U.S. Bureau of Economic Analysis.
NSB	North Slope Borough
OCS	Outer Continental Shelf
PCE	Personal Consumption Expenditures. These numbers reflect household purchases of commodities and services in an area and should be used to estimate the induced impacts in a region. The figures are derived from estimates of disposable income (total income minus taxes and savings) and take into account differences between where income is earned and where it is spent.
PF	Permanent Fund
Production Coefficient	The cost of a production input divided by total industry output.

Production Manpower	This term is used to identify personnel directly involved in oil exploration, development and production activities. Management and overhead personnel who are not directly involved in the activities are not included.
RPC	Regional Purchase Coefficient. The percentage of demand accounted for by local production or a particular geographic region.
RTK	Real Time Kinematic
SIC	Standard Industrial Classification
SUV	Sport Utility Vehicle
TAPS	Trans-Alaska Pipeline System
TPI	Total Personal Income. The amount of earnings paid to workers for labor associated with E&D activities.
VP	Vibration Point. A geographic location used seismic surveys.
VSM	Vertical Support Member. A supporting framework used to elevate pipelines several feet above ground.

1 INTRODUCTION

The Outer Continental Shelf Lands Act, as amended, established a policy for the management of oil and natural gas in the Outer Continental Shelf (OCS) and for protection of the marine and coastal environments. The Act authorizes the conduct of studies in areas or regions to determine the “environmental impacts on the marine and coastal environments of the OCS and the coastal areas which may be affected by oil and gas development.” The Minerals Management Service (MMS) of the U.S. Department of the Interior (DOI) is the administrative agency responsible for leasing submerged Federal lands.

The National Environmental Policy Act (NEPA) of 1969 requires use of the natural and social sciences in any planning and decision making that may have an effect on the human environment. To this end the MMS prepares Environment Impact Statements (EIS) and environmental assessments (EA); acquires marine environmental data; analyzes data, literature surveys, socioeconomic studies, and special studies; and holds information transfer meetings and workshops. These undertakings often call for assessing the regional economic impacts of a lease or sales.

In the past, an assortment of models and methods were used to estimate economic impacts, and these typically varied by planning areas. As a result, comparisons MMS regions were often difficult to make. Section 18 of the OCS Lands Act, however, requires that DOI prepare a 5-year schedule of lease sales that considers “an equitable sharing of developmental benefits and environmental risks among the various regions.” For this reason, MMS decided to standardize the approach used to estimate regional economic impacts and has settled on IMPLAN, an economic input-output model, for that purpose. Using one model will help ensure consistency among MMS regions. IMPLAN, originally developed by the U.S. Forest Service, is the most widely used input-output model for estimating regional economic impacts.

The existing models used to develop direct OCS and secondary employment projections for Alaska sub-Arctic regions are either outdated and/or do not produce results comparable to other MMS regions such as the Gulf of Mexico. However, MMS’ need for a new sub-arctic model is imminent. The analysis for development of the OCS Oil and Gas Leasing Program for 2002-2007, expected to take place in 2001, will require data on the possible impacts on coastal and offshore areas resulting from E&D activities in the Arctic Sub-region of the Alaska OCS.

To facilitate EIS work for Alaska’s North Slope Borough (NSB), the authors of this report recently revised a model that estimates industry employment and expenditures, by region, of offshore oil exploration and development (E&D) activities in the Beaufort Sea. The new model is known as the Arctic Impact Model for Petroleum in Alaska (Arctic IMPAK). Unlike the previous version of the models used to estimate economic impacts, the new model produces a set of output that can be used to stimulate IMPLAN. The purpose of this project will be to develop a similar model, SUB-ARCTIC IMPAK, which estimates economic impacts for the Sub-arctic regions of Alaska.

1.1 THE CURRENT MODELING PROCESS

Analysis of lease sales in all areas begins with the Exploration and Development (E&D) Scenarios. The first step model refers to any model that translates the E&D Scenario into direct effects. Direct effects are defined as those resulting from the first round of spending by companies working directly on an OCS project(s). The first-step model must estimate the level of industry expenditure, and employment and how that spending/employment is allocated to onshore geographic areas. The MMS calls the spending allocation to industry a “cost function” and these cost functions are used to customize the inputs for IMPLAN.

For Alaska, the original first-step model was called the Manpower model. It simply converted OCS activities levels (number of wells drilled, platforms installed, pipeline miles laid, etc.) into estimates of direct employment using ratios such as employees per mile of pipelines laid. It was developed in the late 1970s and then refined in the early 1980s. However, the model is now outdated and no formal documentation of the model exists. The main objective of this study is to update this model for the Sub-Arctic areas.

The second-step model is used to estimate the additional impacts that result as the initial spending reverberates throughout the economy. These secondary impacts are often referred to as indirect and induced effects. Such models are often developed specifically for OCS or customized to reflect the unique expenditure and commuting patterns of OCS-related companies and their employees.

For Alaska, the original second-step model that was used in conjunction with Manpower was the Rural Alaska Model (RAM), which was developed by the University of Alaska. Like Manpower, RAM is a set of spreadsheets that uses simple multipliers to estimate results. A drawback of this model is that it was only designed to estimate impacts at the local level and does not allow for the estimation of impacts at the national level, which are required by the MMS for the “equitable sharing” analysis.

1.2 PURPOSE AND OBJECTIVE

The purpose of this study is to describe the development of SUB-ARCTIC IMPAK, a model to replace the Manpower Model for E&D activities that take place in the Sub-Arctic OCS. Since the early 1980s, when the Manpower model was constructed, there have been significant technological changes in offshore E&D activities. As such, activities specified in the Manpower model were examined and revised as required. The model described in this study was specifically developed based on conditions and methods for E&D activities in the Cook Inlet/Shelikof Strait. A secondary purpose was to develop a methodology that would allow the model to estimate impacts in other Sub-Arctic planning areas, in particular the Gulf of Alaska.

In developing the new model, the latest available data are used to develop employment and expenditure factors for the revised E&D activities. With these updated factors, projections of direct and indirect employment impacts in the Sub-Arctic region will be more accurate. With

more accurate projections, stakeholders will have more confidence in the economic sections of an EIS. More accurate projections may also be used in decisions regarding post-lease mitigation.

The new first-step model converts E&D inputs into direct employment and expenditure impacts for the local project area, the Kenai Peninsula Borough (KPB), Anchorage, and the other United States. Expenditure impacts are itemized by IMPLAN sector. MMS analysts can use the model to estimate the direct impacts of a project and then enter these impacts into IMPLAN to estimate the indirect and induced effects.

1.3 STUDY AREAS

The sub-arctic model is intended to be used to estimate the economic impact of E&D scenarios that take place within the sub-arctic planning areas. The model provides the user with a choice of three study areas. These selections specify where the E&D scenario takes place in Sub-Arctic Alaska and the user must choose one. The three choices include (1) Cook Inlet, (2) semi-remote regions that are near population centers and (3) remote regions that are not close to a population center. Based upon the circumstances and location of the E&D scenario, the analyst will need to use his/her own judgment to determine which choice best applies to the scenario under consideration. The choice determines which matrices, manpower vectors, PCE vectors and TPI drivers are used in the model. It should be noted that only one type of scenario can be modeled at one time. It should be emphasized that the choices provided are not synonymous with MMS planning areas.

The following descriptions of the three study areas describe the proper application of each area:

- **Cook Inlet** – The development of data for this model was based on current information on the technologies and costs in the Cook Inlet where actual oil and gas development is taking place. It is considered the base model. This model is best applied for an E&D scenario which is taking place in close proximity to existing development. While at present this may only consist of developments actually in the Cook Inlet, in future years it may apply to any development that takes place near a series of other developments.
- **Semi-remote regions that are near population centers** – The purpose of this study area is to simulate the conditions that would be found for an E&D scenario that takes place in an area where little or no E&D activity is currently taking place. However, for this model it is assumed that there is a nearby population center that can supply and house some labor and provide some minimal materials, supplies and services. While this study area selection can be used in simulating any E&D scenario, it was designed primarily based on conditions in the Gulf of Alaska
- **Remote regions that are not close to a population center** - The purpose of this study area is also to simulate the conditions that would be found for an E&D scenario that takes place in an area where little or no E&D activity is currently taking place. However, for this model it is assumed that there are no nearby population centers that can provide significant labor or other resources. While this study area selection can be used in

simulating any E&D scenario, it was also designed primarily based on conditions in the Gulf of Alaska

1.4 ORGANIZATION OF THE REPORT

The economic impact of a particular set of oil and gas activities on the Sub-arctic Alaska depends on both the size of the project and the set of technologies chosen. In the second chapter of the report, an overview of oil and gas activities is provided, followed by a set of twenty-six activities chosen to be included in the model. Brief description of construction and operation practices most likely to be in use are provided, as appropriate, throughout the chapter. The activities are defined mainly through review of activities in the Arctic IMPACT model, where applicable, the expert knowledge of project staff, and interviews with oil company personnel, and owners and employees of various contractors involved in the construction and operation of existing facilities. The information and data in Chapter Two provides a basis for (or are inputs) to chapter Three, Four, and Five.

The third, fourth, and fifth chapters provide overviews of the methods used to develop the inputs to the 26 activities. In some sense, this study develops a production function for each activity, where the production function is defined in terms of expenditures for various types of inputs. These inputs can be broadly grouped into the following categories: labor, purchased services, capital and materials with the latter including raw, intermediate and energy material and inputs. Labor inputs are discussed in Chapter Three, purchased services in Chapter Four and capital and material inputs in Chapter Five.

Chapter Six provides an overview of the inputs and outputs of the Sub-Arctic IMPAK model.

2 OVERVIEW OF OIL AND GAS ACTIVITIES

The development of offshore oil and gas involves a series of distinct economic activities. These activities are generally categorized into two phases, exploration and development/production with multiple activities occurring under each phase. Specific activities include the following:

Exploration:

- Seismic Surveys - Exploratory seismic surveys collect data used to interpret subsurface geology. These surveys also occur during production.
- Exploration Drilling - Exploration drilling, including the development of exploration shore bases and exploration platforms, is conducted to confirm the presence of recoverable resources, and to evaluate potential volumes. Several wells are typically required to provide sufficient data to prepare a development/production plan.

Development/Production:

- Development/Production Drilling - This set of activities typically involves the installation of several oil production wells and platforms. In addition, reservoir development may require water or gas injection wells. Operation of production wells involves routine well and platform maintenance procedures.
- Oil and Gas Processing - Processing facilities may be located at the production site if sufficient space is available, or they may be located at a distant site. Sometimes produced fluids are only partially separated into oil, gas, and produced water components prior to transport to offsite processing facilities.
- Transportation of Produced Fluids - Produced fluids may be transported from offshore sites by pipeline, marine tankers, or barges during open water, and pipelines or trucks during winter. Pipelines, railroad, and trucks may be used year-round at onshore locations. In the Alaskan OCS, pipelines are presently the most widely used method of moving fluids in both offshore and onshore areas.

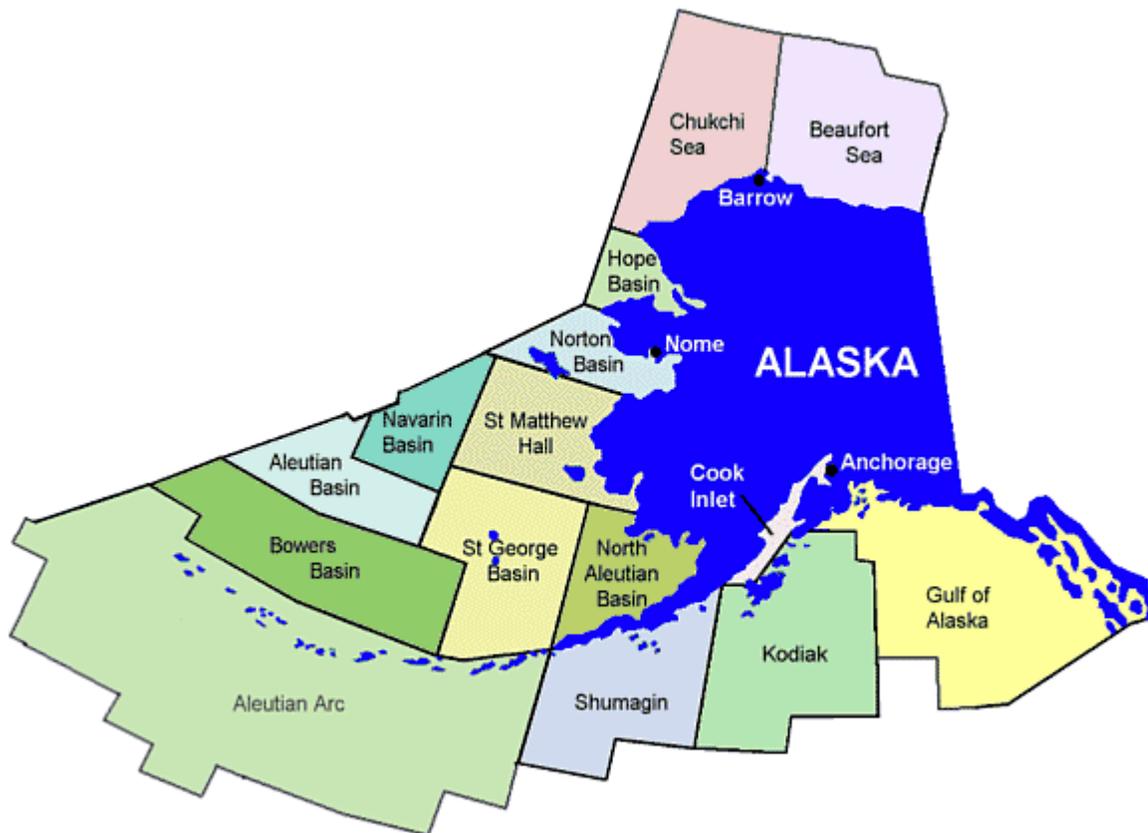
Planning Areas

There are twelve planning areas that are included in the Sub-Arctic area analyzed in this report. However, as discussed in section 1.3, above, the study areas used in the model do not necessarily correspond with planning area boundaries. These areas are listed in Exhibit 2-1. All of Alaska's planning areas are illustrated in Exhibit 2-2. Exhibit 2-1 also provides information on likely marine and air base locations. Exhibit 2-3 provides an illustration of hypothetical oil development infrastructure and transportation routes used in the 1995 national resource assessment conducted by MMS.

Exhibit 2-1: Sub-Arctic Planning Areas

Planning Area	Assumed Marine & Air Base
Cook Inlet/Shelikof Strait	Anchorage/Kenai
Navarin Basin	St. Paul Island
St. George Basin	St. Paul Island
Norton Basin	Nome
St. Mathew-Hall	Nome
Gulf of Alaska	Yakutat
Shumagin Basin	City of Kodiak
Kodiak Basin	City of Kodiak
Aleutian Basin	Adak Island
Bowers Basin	Adak Island
Aleutian Arc Basin	Adak Island
North Aleutian Basin	Moratorium on leasing until 2012

Exhibit 2-2: Alaskan Planning Areas



Overview of Cook Inlet and Gulf of Alaska

There are two main planning areas that are of primary importance for this study. However, as discussed in section 1.3, above, the study areas used in the model do not necessarily correspond with planning area boundaries. The two planning areas are the Cook Inlet/Shelikof Strait and the Gulf of Alaska. Conditions vary greatly between the two.

The Cook Inlet has some of the highest tides in the world. These tides tend to move ice rapidly up and down the inlet in the winter and stir silt year-round, making visibility almost zero for divers. The winter ice is never stable or stationary. Consequently, ice roads, surveys on ice or any ice related activities are not applicable for this model. The Shelikof Strait, Price William Sound and the Inland Passage of Southeastern Alaska are similar to the Cook Inlet area.

The Gulf of Alaska is fairly ice free, except for occasional icebergs. Wind, high seas, and varying water depths, however, create conditions similar to the North Sea. Existing shore-based communities, road, and railroad accesses are few and far between along the Gulf. For the most part, rugged shoreline and mountains border the Gulf. According to engineering staff, the remote nature of this location will increase transportation costs by approximately 50 percent.

Oil and gas production in the Cook Inlet has been ongoing for over thirty years and is in the process of expanding outward into the Shelikof Strait. The tasks used in this model are based on actual data for the Cook Inlet and were adapted for the Gulf and other areas by using multiples of units such as feet, miles, barrels per day, remote area multipliers etc.

Road and marine highway systems offer direct transportation of supplies to the Kenai based warehousing facilities. Anchorage is not as important as a hub, like it is for North Slope based operations, even though it is much closer geographically.

The Cook Inlet oil and gas is processed and sold in five ways:

- 1) Oil is processed at the Tesoro refinery and transported via the Tesoro pipeline to Anchorage to supply the International Airport, military bases, and domestic gasoline and heating oil outlets. Some supplemental crude oil is shipped in from the Valdez terminal.
- 2) Natural gas is processed on the platforms and transported via the Enstar gas line to service the Anchorage and surrounding areas with natural gas.
- 3) The Marathon Kenai gas facility services the peninsula communities with natural gas.
- 4) Philips Petroleum has a liquefaction plant in North Kenai and ships liquid natural gas to Japan and other Pacific Rim countries.
- 5) Unichem (recently sold to Agrium) processes natural gas into fertilizer to be used all over the world.

Offshore helicopters and boats service platforms. Survey crews, specialty crews and onshore support personal are housed in hotels in the Kenai area. Most hotels have crew rates and make boxed lunches for the noon meal.

The Kenai Peninsula Borough Oil and Gas Industry

During 1980 there were 1,233 employees in the Kenai oil and gas extraction and production industry with about one quarter of them in petroleum product manufacturing. This was 16 percent of the Kenai Peninsula Borough (KPB) total employment. In 1999, there were 1,454 positions accounting for 8.9 percent of the total employment accounting for 12.9 percent of the total KPB payroll. Development of other industries caused the decline in the percentages. Industry property taxes account for less than one percent of KPB totals. In 1999, the average monthly wages for oil and gas workers was \$6,040 compared to \$2,544 in other KPB jobs. The oil and gas industry average monthly wage remained stable from 1993 to 1998, at around \$5,000, and then increased to around \$6,000 in 1999. Although the 1999 information is preliminary, it might indicate that wage data collected for older projects may have slightly lower wage rates than newer projects. This data was reported by the KPB Economic Analyst and the Executive Director of the Kenai Peninsula Economic Development District, Inc.

Brief descriptions of the activities that are considered to be part of the typical exploration and development process in the Sub-Arctic area are presented in the following subsections. Out of twenty-six activities, twenty-three of them are primary activities. The other six activities are secondary support activities. These activities, the unit of measure (e.g. miles of pipeline, barrels of oil) in which they are expressed, and the interrelationship between primary and secondary activities are shown in Exhibit 2-4.

Exhibit 2-4: Primary and Secondary Activities - Drivers and Default Factors							
Primary Activities	Units	Secondary Activities					
		21. Helicopter Support	22. Large Workboat	23. Small Workboat	24. Landing Craft	25. Dive Boat	26. Camp Support
1. Geological Survey	Per Month	X		X			X
2. Spill Contingency Response	Per Year	X		X			X
3. Construct Exploration Shore Base	Per Shore Base						X
4. Operate Exploration Shore Base	Per Year						X
5. Install Exploration Platform	Per Platform	X	X	X			
6. Operate Exploration Platform	Per Year	X	X	X			
7. Drill Exploration Well	Per Well	X	X				
8. Construct Production Shore Base	Per Shore Base						X
9. Operate Production Shore Base	Per Year						X
10. Install Production Platform	Per Platform	X	X	X			
11. Operate Production Platform	Per Year	X	X	X			
12. Drill Production Well	Per Well	X	X				
13. Lay Offshore Pipeline	Per Mile	X		X		X	X
14. Lay Onshore Pipeline	Per Mile						X
15. Construct Onshore Production Facility	Per Facility						X
16. Operate Production Facility	Per Year	X	X				X
17. Construct Marine Terminal	Per Facility	X					X
18. Operate Marine Terminal	Per Year	X			X		X
19. Major Platform Maintenance	Per Platform	X					
20. Well Workover	Per Well Workover	X	X				
27. Abandonment	Per Platform	X	X	X			

2.1 GEOLOGICAL SURVEY

This task was developed primarily from an interview with a construction manager for VECO, at Kenai. VECO is one of the major support contractors in this state and is very active in the Cook Inlet area. Unlike the arctic surveys, Cook Inlet offshore surveys are conducted from boats.

The crews are much smaller than in the Arctic due to size constraints on the boat. Hence, a longer time is needed to survey an area. Tides are a major factor in the Cook Inlet surveys. Twenty hours of daylight and a short summer season requires work to continue around the clock. Part of the survey crew will remain onboard for the duration of a survey and the labor portion of the crew will be shuttled back and forth to shore in twelve-hour shifts. The boat crews also remain onboard.

Equipment

All of the survey equipment is loaded on the survey boat at the Offshore Systems-Kenai (OSK) dock before it leaves for the site. Total cost of the equipment used by surveyors for location on water, including RTK (Real Time Kinematics) and GPS (Global Positioning Satellite), is \$300,000.

The seismic equipment includes one CPU data collection unit in a skid mounted doghouse, five sets of 15,000 feet seismic recording lines, and one ultra-sound generator to be located on the dive boat. The seismic equipment is purchased from a Louisiana or Texas based company as a complete unit including anchors, reels and associated hardware. The cost is \$2,000 a channel or about \$5 million per setup. As technology advances, the equipment will be replaced every ten years.

The survey will use two of the boats described in the sections describing the ocean marine services. The smaller work boat will be staffed and used as described. It will lease for \$10,000 per day due to a 24-hour workday. A dive boat will also be leased at \$4,000 per day.

The five seismic recording lines (jug lines) are reeled off the work boat by the workers known as jug hounds, with the surveyors guiding the captain. The lines are laid about a quarter mile apart, then attached to the CPU doghouse on the now anchored workboat. The dive boat has the ultra sound unit and operator aboard. The dive boat guided by the surveyor travels up and down the Inlet over the lines operating the ultra-sound generator at vibration points (VPs). The data is received and recorded by the CPU and operator in the doghouse. The lines are then reeled up and reset until the entire site has been surveyed.

Personnel

The survey crew is composed of one oil company representative, two surveyors, two CPU operators/foreman, eight jug hounds, two divers, and two ultra-sound operators. The representative is paid \$80,000 to \$120,000 annually. The two surveyors are paid \$400 per day and provide 24-hour coverage as needed. Each of the CPU operators, jug hounds, and ultra-

sound operators has a 12-hour shift, and has an hourly wage of \$18, \$16, and \$18 respectively. The two divers stay on the dive boat and are used as necessary. They are paid \$600 per day on average.

The offshore personnel are shuttled to shore-based facilities described in section 2.26. Approximately 25 percent of them are local hire in the KPB and can drive their own vehicles to their residences when their shift is over.

2.2 SPILL CONTINGENCY RESPONSE

This task was developed primarily from an interview with a materials specialist in the Kenai area for 20 years. This example is based on the ARCO facility that housed the ARCO spill contingency equipment. The production shore base crew was trained to assist the permanent spill contingency employees. Oil company employees are also trained and used to assist in case of the oil spill. Established production areas with multiple oil companies involved will contribute to a fund for one central spill team that covers the whole area. The Cook Inlet area spill response company is called the Cook Inlet Spill Prevention & Response, Inc. (CISPRI). CISPRI is a non-profit corporation formed in 1990 to provide oil spill prevention and response capabilities in Cook Inlet.

Equipment

Special equipment used for spill management consist of two 28 foot aluminum boats, one 18 foot inflatable boat and motor, three skimmers, one oil water separator, and several conex and chassis containers full of booms, recovery supplies, and other equipment.

The cost of the equipment used is as follows. The two aluminum boats cost \$85,000 each, while the inflatable boat costs \$16,000. The three Shawnacy skimmers cost \$20,000 each. The portable oil water separator costs \$150,000. Each forty-foot conex, which are storage trailers often found at construction sites, costs \$20,000. Three of them will be filled with various length plastic booms and eight anchor systems costing \$40,000 per conex. The other will be full of recovery supplies such as oily waste bags, absorbent rolls, booms and pads, visqueen and 55 gallon barrels, also costing \$40,000. In addition, the twenty-foot conex will have a 7Kw generator, wildlife capture and stabilization equipment, also costing \$40,000 total.

The rolling stock used in operating the production shore base (Section 2.3) will also contribute about ten percent to spill response. Those equipment include one 966 Caterpillar loader, one propane fueled inside forklift, one five-ton flatbed delivery truck, and two pickup trucks.

Personnel

All shore-based personnel work a standard 40-hour week, with 24 hour, seven day a week, on-call coverage, including one spill response coordinator at \$40,000 to \$65,000 annually and one maintenance technician at \$18 to \$20 per hour. In addition, shore based operations support

personnel are also trained and used for spill response. About seven percent of their time is dedicated to this task.

2.3 CONSTRUCT EXPLORATION SHORE BASE

This task was developed primarily from interviews with the Kenai-Soldotna area material specialist, a local contractor, and a structural engineer. This example is based on the ARCO facility. There are about five other similar facilities servicing the Cook Inlet area during peak exploration periods.

A typical exploration shore base requires about 3,000 square feet of warehouse under roof with an office and 5 acres of outside storage.

Land

In the ARCO example, ten acres of raw land was purchased for \$7,500 per acre for a total of \$75,000. The well was contracted locally for \$5,200. The commercial septic system was contracted locally for \$4,800.

Warehouse Pad

The total installation cost of the pad was \$165,785. The cost of the complete task included the following subtasks. A D8 Caterpillar dozer with operator was employed to clear the pad of stumps and topsoil at \$120 per hour for forty hours. The stumps and topsoil were pushed to a low area on the property. The trees were removed for the wood. Three operators with two dump trucks and one 966 loader were employed to place 16,178 cubic yard of gravel at \$10 per cubic yard.

Concrete

The total cost of the concrete work was \$12,500. The task required two finishers and two laborers working ten-hour days for six days to pour the concrete. Their labor, equipment, trucks, and the delivered concrete was contracted on a per cubic yard basis. The foundation was contracted at \$150 per cubic yard for \$7,500. The 60-foot by 50 foot by five-inch slab was contracted at \$100 per cubic yard for a total of \$5,000.

Prefabricated Metal Building

The total construction cost of this building was \$396,286. This facility will be used, in part, as an operations shore base. The building was contracted as a basic shell to be erected in place. Local contractors added doors, windows, insulation and interior carpentry.

The cost of each of the components of the building was as follows. The basic prefabricated metal building was erected at \$10 per square feet for a total of \$30,000. The door window and insulation package was installed at \$6 per square feet for a total of \$18,000. The mechanical, the

carpentry, and the painting were contracted locally at \$15,389, \$15,390, and \$2,600 respectively. The electrical installation cost \$24,622 in total, which required two journeymen and two apprentices who worked 80 hours at \$38.85 and \$29.14 per hour, respectively for a total of \$10,878.40. Electrical materials were purchased locally for \$13,744.

Equipment

Equipment used for this activity will include an office with a \$20,000 computer system, about \$100,000 worth of pipe racks, pallet racks, and shelving, and approximately \$10,000 worth of office supplies and furniture.

Additional equipment used for this activity include a portable banding station purchased for \$1,000, one pallet jack purchased for \$600, and 75 pallets at \$25 each.

Rolling Stock

The 966 Caterpillar loader with forks and bucket cost \$260,000 base plus \$5,000 Alaska upgrade. The propane fueled inside forklift was leased from NC Cat for \$800 a month. A five-ton flatbed delivery truck and two pickup trucks were purchased from a local fleet dealer for \$35,000 and \$25,000 each, respectively. One of the pickup trucks was equipped with a \$3,000 snowplow.

Personnel

The constitution and setup of the exploration shore base is mainly contracted out to local builders. As a result, no labor was originally specified. However, engineering staff for this study indicated that some staff would be required for planning, construction, supervision and setup. Therefore, it has assumed that operating personnel would be hired one year before operations began to perform these functions and their cost for that year were added to this task. These personnel are described in the following section.

2.4 OPERATE EXPLORATION SHORE BASE

The sources of information for this activity were similar to the previous construction activity. They include a Kenai-Soldotna area material specialist, a local contractor, and a structural engineer.

Supplies

Annual supplies for this activity will include \$5,000 worth of computer equipment replacement, \$10,000 of replacement or additional racks and shelving, \$5,000 of replacement office supplies, and five to ten pallets every month. In addition, each pallet jack will require \$60 in maintenance per year.

Utilities

Utility costs for the structure will include \$75 per month for heating, \$250 for interior lighting, \$400 for exterior lighting and \$100 for fuel to operate the water and garbage systems. Fuel will cost \$1.50 per gallon for the fuel plus 10 cents per gallon for delivery.

Local Transport

One or two contracted trucks and drivers will be required to haul materials from their source to the warehouse. The source may be the Marine Highway or local manufacturers. These trucks may also be used to haul large loads to the service boat dock. These trucks are generally owner operated and are hired for around \$75 per hour for both the truck and driver.

Personnel

All shore-based personnel work a standard 40-hour week, with on-call coverage on weekends. The staff will be composed of one materials manager or supervisor salaried at \$70,000 to \$80,000 annually, two materials specialist or coordinator salaried at \$40,000 to \$65,000 annually, two warehousemen at \$18 to \$20 per hour, and one expediter at \$15 to \$18 per hour.

Employees of the company that is performing the exploration drilling often staff the exploration shore bases. These employees will likely move from one exploration project to the next along with the other drilling company employees.

2.5 INSTALL EXPLORATION PLATFORM

This task was developed primarily from an interview with a project manager for Udelhoven Oilfield Services. This example is based on the Osprey platform used on the Redoubt Shoals area of the Cook Inlet. The Osprey was built in Hyundai Korea and delivered to the site for a total of \$35 million. The Osprey is a very small 100 by 100-foot platform. Aboard the platform are a 52-man camp, a water maker, two generators, and a sewerage disposal plant.

Osprey Installation

The Osprey that was modeled for this task was towed in place and held with anchors while the legs were lowered to the sea floor. The platform installation required 33 workers working thirty-five days for 12 hours each day. The composition of the installation labor is provided in Exhibit 2-5. Platform-based personnel work 12 hour days, seven days a week for two weeks and then take two weeks off. As a result, half of them will be on the platform at a time.

Exhibit 2-5 Employment Compensation - Install Exploration Platform, Osprey Installation

Title	Hourly Wage	Total for Each	Number
Welding Foreman	\$37.50	\$18,375	2
Welders	\$34.20	\$16,758	4
Fitters	\$32.50	\$15,145	4
Helpers	\$22.00	\$10,780	6
Electricians	\$38.86	\$19,041	2
Apprentices	\$32.50	\$15,145	2
Mechanical	\$34.20	\$16,758	2
Carpenters	\$34.20	\$16,758	2
General Labor	\$22.00	\$10,780	6
Cook	\$22.00	\$10,780	1
Bull Cook	\$18.00	\$8,820	2

Drilling Support Personnel for Osprey Platform

Before drilling actually begins, for about 30 days, drilling support personnel are used to install the drilling equipment. The costs for the actual drilling are shown on related activities for exploration well and production well drilling. Labor costs, for the drilling support crew time for equipment installation on the Osprey platform, are shown in Exhibit 2-6. Costs shown are for one month.

Exhibit 2-6 Employment Compensation - Install Exploration Platform, Osprey Drilling Support

Title	Hourly Wage	Total for Each	Number
Support foreman	\$37.50	\$7,350	2
Welder	\$34.20	\$6,703	2
Fitters	\$32.50	\$6,370	4
Maintenance man	\$32.50	\$6,370	2
SDS and systems operator	\$32.50	\$6,370	2
Laborers	\$22.00	\$4,312	6

2.6 OPERATE EXPLORATION PLATFORM

Information on the costs for operating a production platform was developed primarily from an interview with the Alaska Planning Manager for Forest Oil Corporation. Forrest Oil is drilling the Redoubt Shoals development in the lower Cook Inlet and operates the Osprey platform described in Section 2.5.

Data were actually collected for operating a shallow-water production platform. For the purposes of this study, a shallow-water platform is defined as a platform operating in water depths of up to 150 feet. However, according to the information sources, the Osprey is used for a production platform as well as an exploratory platform and OCS deep-water production platforms double the operating costs and required personnel of the Osprey.

Personnel

Employees are permanent and the operating crews work 12-hour days, two weeks on and two weeks off, so one-half of them will be on the platform at one time. There is only one shift,

however, skeleton crew of two operators (one onshore), a cook and a maintenance technician work the night shift. The composition and compensation rates for operating an exploration platform are provided in Exhibit 2-7.

Exhibit 2-7 Employment Compensation - Operate Exploration Platform

Title	Hourly Wage	Annual Wage	Number
Production Superintendents		\$87,000	2
Operators (6 on shore)	\$37.50		10
Logistic personnel	\$32.20		4
Maintenance technicians	\$34.50		4
General Labor	\$22.00		4
Cook	\$22.00		2
Bull Cook	\$18.00		2

Operating Costs

The cost to provide food, laundry, water, and sewer facilities is estimated to be \$37 a day per person. Helicopter and boat support costs are transferred out and handled as separate activities. They are discussed in Sections 2.21 through 2.25.

2.7 DRILL EXPLORATION WELL

This task was also developed primarily from an interview the Alaska Planning Manager for Forest Oil Corporation.

Personnel

Drilling employees are permanent are in addition to the platform operating staff (section 2.6) and the drilling support crew (section 2.5). The crews work two 12-hour shifts per day with two weeks on and two weeks off. Therefore, half of them will be on the platform at one time and eight will be working each 12-hour shift. Details of personnel including their titles, wage rates and numbers are provided in Exhibit 2-8.

Exhibit 2-8 Employment Compensation - Drill Production Well

Title	Hourly Wage	Annual Wage	Number
Drilling Pushers (Supr	\$37.50	\$87,000	2
Drillers	\$32.20		4
Floor hands	\$32.50		16
Motormen	\$32.50		4
Mudmen	\$32.50		4
Electricians	\$34.50		2

There will also be technical support people on call 24 hours a day. Most of the time they can analyze problems over the phone or on-line and have the platform or drilling personnel make repairs. Sometimes they must be flown out to make repairs. Technical support costs can be expected to average about \$1,200 a month.

Operating Costs

The cost to provide food, laundry, water, and sewer facilities is estimated to be \$37 a day per person. Helicopter and boat support costs are transferred out and handled as separate activities. They are discussed in Sections 2.21 through 2.25.

Each exploration well costs approximately \$10 million to drill and test. At minimum, four to five exploration wells are drilled per location. For example, ten exploration wells were drilled at Redoubt Shoals. The wells are usually abandoned in place and all exploration costs are lost. Of the \$10 million in total costs, \$1.5 million will be platform-related expenses. Another \$800,000 of the well cost are durable costs, or permanent to the well, like casing, production tubing, valves and blowout prevention equipment. In addition, \$400,000 will generally be required for nondurable costs, including drilling mud, chemicals and consumables. The remaining costs are for labor and testing, with about half of them being direct to the well drilling and about the other half being indirect, to order, handle, and transport materials to the drilling location and process test results.

2.8 CONSTRUCT PRODUCTION SHORE BASE

This task was developed primarily from interviews with the Kenai area material specialist, a local contractor, and a structural engineer. This example is based on the ARCO facility, however, there are other similar facilities servicing the Cook Inlet area.

The production shore base is modeled as an expansion of the exploration shore base (see Section 2.3). About 75 percent of the exploration shore bases assets are used as part of the production shore base. This conversion is part of natural process of maturation of an oil and gas development as the exploration phase slows and the production phase begins. To expand the shore base for the production phase an additional 2.5 acres pad will be required along with an additional 7,200 square feet of warehouse and office space. The total construction cost of this addition at the ARCO facility was \$387,552. Including 75 percent of the contracted construction cost of the exploration shore base, at \$276,965, the total cost of the production shore base would have been \$655,517.

Warehouse Pad

As discussed above, the existing five-acre pad was expanded by 2.5 acres. The total installed cost of the pad extension was \$82,893. One operator with D8 Caterpillar bulldozer spent twenty hours to clear the pad of stumps and topsoil at \$120 per hour for a total of \$2,000. The stumps and topsoil were pushed to a low area on the property. The trees were removed previously for the wood. Three operators with two dump trucks and one 966 loader placed 8,089 cubic yards of gravel at \$10 per cubic yard.

Concrete

Four finishers and four laborers worked ten-hours a day for seven days to pour the concrete. Their labor, equipment, trucks, and the delivered concrete was contracted on a per cubic yard basis. The total cost of the concrete work was \$29,900. The foundation cost \$150 per cubic yard for a total of \$16,500 and the slab cost \$100 per cubic yard for a total of \$13,400.

Prefabricated Metal Building

The basic prefabricated metal building was erected at \$10 per square feet for a total of \$72,000. The door and window and insulation package was installed for \$6 per square feet for \$43,200 total. Roughly 50 percent of this cost was for the insulation and the remainder for the doors and windows. The total installed cost for the electrical systems was \$56,116. This included the labor of four journeymen and four apprentices working for eighty hours at \$38.85 and \$29.14 per hour, respectively. In addition, locally purchased electrical supplies and materials totaled \$34,360. The mechanical, the carpentry, and the painting were contracted locally at \$38,473, \$46,170, and \$7,800, respectively. The mechanical costs included installation.

Paving

A total of 4,000 square feet of paving was installed for entrance roads, storage and parking. The paving was two inches thick with two inches of D1, which is a base course consisting of gravel of less than one inch diameter. The paving was contracted locally at \$1.20 per square feet for a total of \$4,800.

Landscaping

A local contractor planted lawn, flowerbeds, and trees in planters between the highway and office entrance for a total of \$6,200.

Equipment

Equipment used for this activity will include a \$50,000 upgrade to the office computer system, an additional \$100,000 worth of pipe racks, pallet racks, and shelving, and approximately \$100,000 worth of additional office supplies and furniture installed.

Additional equipment used for this activity include two portable banding stations at a cost of \$1,000 each, two pallet jacks at \$600 each, and 100 pallets at \$25 each.

Rolling Stock

Five additional pieces of rolling stock were added along with the production phase of the shore base. A 966 Caterpillar loader with forks and bucket cost \$260,000 for the base vehicle plus \$5,000 for Alaska upgrades. A propane-fueled inside forklift was leased from NC Cat for \$800 a month. A five-ton flatbed delivery truck and two pickup trucks were purchased from a local

fleet dealer for \$35,000 and \$25,000 each, respectively. One of the pickup trucks was equipped with a \$3,000 snowplow.

Personnel

The constitution and setup of the production shore base is mainly contracted out to local builders. As a result, no labor was originally specified. However, engineering staff for this study indicated that some staff would be required for planning, construction, supervision and setup. Therefore, it has assumed that operating personnel would be hired one year before operations began to perform these functions and their cost for that year were added to this task. These personnel are described in the following section.

2.9 OPERATE PRODUCTION SHORE BASE

This task was developed primarily from an interview with a materials specialist with 20 years experience in the Kenai area. This example once again is based on the ARCO facility. There are several other similar facilities servicing the Cook Inlet area.

As described in section 2.8, this production shore base was built on the same property as the exploration shore base and utilized 75 percent of the existing 3,000 square feet of warehouse, with an office, and the 5 acres of outside storage. Addition required to upgrade the facility to compete the production shore base included an additional 2.5 acres of pad and 7,000 square feet of building. Nine offices and a conference room were sheltered in the building addition. \$100,000 worth of pipe racks, pallet racks, and shelving was added. \$100,000 worth of office supplies and furniture was installed. A \$50,000 computer system upgrade was also required.

This shore base also housed the spill contingency equipment and the facility crew that were trained to assist the spill crew during spill response. An estimate 10 percent of the rolling stock capitalization and 7 percent of personnel time of this task will be dedicated to the spill contingency task.

Supplies

Annual supplies for this activity will include \$12,500 worth of computer equipment replacement, \$10,000 of replacement or additional racks and shelving, \$10,000 of replacement office supplies, and ten to 15 additional pallets every month. In addition, each pallet jack will require \$60 in maintenance per year.

Utilities

Utility costs for the structure will include \$150 per month for heating, \$475 for interior lighting, \$400 for exterior lighting and \$200 for fuel to operate the water and garbage systems. Fuel will cost \$1.50 per gallon for the fuel plus 10 cents per gallon for delivery.

Local Transport

One or two contracted trucks and drivers will be required to haul materials from their source to the warehouse. The source may be the Marine Highway or local manufacturers. These trucks may also be used to haul large loads to the service boat dock. These trucks are generally owner operated and are hired for around \$75 per hour for both the truck and driver.

Personnel

All shore-based personnel work a standard 40-hour week. One specialist and one expediter will rotate days that are off to provide coverage on weekends. The composition of labor for this task is provided in Exhibit 2-9.

Exhibit 2-9 Employment Compensation - Operate Production Shore Base

Title	Hourly Wage	Annual Wage	Number
Production/Operations Manager		80-120K	1
Engineers		70-100K	2
Safety engineer		60-90K	1
Materials Manager/Supervisor		70-80K	1
Materials Specialist/Coordinator		40-65K	1
Warehousemen	18-20		2
Expediter	15-18		1
Secretary	14-17		1
Receptionist	37K		1

2.10 INSTALL PRODUCTION PLATFORM

This task was also developed primarily from an interview the Alaska Planning Manager for Forest Oil Corporation.

OCS deep-water production platforms double the construction and installation costs of the shallow-water Osprey (\$35 million) for a total of approximately \$70 million. Project engineering staff estimates that over the next decade approximately 80 percent of the platforms used in the Alaskan OCS will be U.S. made while 20 percent will be foreign made.

Each production platform supports about 28 wells. Two caissons can be added for \$10 million each to bring the total up to approximately 45 wells. Production wells are drilled one for every 80-acre tract, with one injection well drilled for every four production wells that are drilled. Enhanced recovery may require a higher ratio of production to injection wells later in a field's life.

Personnel

Installing (or commissioning) a platform requires 66 workers for up to one year. They work 12-hour days, two weeks on and two weeks off, so one-half of them will be on the platform at one time. The numbers, titles and wages of the staff used to install a production platform are provided in Exhibit 2-10.

Exhibit 2-10 Employment Compensation - Install Production Platform

Title	Hourly Wage	Annual Wage	Number
Welding Foreman	\$37.50		4
Welders	\$34.20		8
Fitters	\$32.50		8
Helpers	\$22.00		12
Electricians	\$38.86		4
Apprentices	\$32.50		4
Mechanical	\$34.20		4
Carpenters	\$34.20		4
General Labor	\$22.00		12
Cook	\$22.00		2
Bull Cook	\$18.00		4

Drilling Support Personnel

Before drilling actually begins, for about 60 days, drilling support personnel are used to install the drilling equipment. The costs for the actual drilling are shown on the related activity for production well drilling. Labor costs, for the drilling support crew time for equipment installation, are shown in Exhibit 2-11. Costs shown are for two months.

Exhibit 2-11 Employment Compensation - Install Production Platform, Drilling Support

Title	Hourly Wage	Total for Each	Number
Support foreman	\$37.50	\$14,700	2
Welder	\$34.20	\$13,406	2
Fitters	\$32.50	\$12,740	4
Maintenance man	\$32.50	\$12,740	2
SDS and systems operator	\$32.50	\$12,740	2
Laborers	\$22.00	\$8,624	6

2.11 OPERATE PRODUCTION PLATFORM

This task was developed primarily from an interview with the Alaska Planning Manager for Forrest Oil Corporation. Data were collected for an actual operating shallow-water production platform. However, according to the information sources, OCS deep-water production platforms double the operating costs and required personnel. The actual production vector is constructed based on data for a shallow water platform and the model doubles the costs for deep-water platforms.

Personnel

Employees are permanent and operating crews work 12-hour days, two weeks on and two weeks off, so one-half of them will be on the platform at one time. There is only one shift, however, skeleton crew of four operators (two onshore), two cooks and two maintenance technicians work the night shift. The composition of the production platform operating crew is provided in Exhibit 2-12.

Exhibit 2-12 Employment Compensation - Operate Production Platform

Title	Hourly Wage	Annual Wage	Number
Production Superintendents		\$87,000	2
Operators (6 on shore)	\$37.50		10
Logistic personnel	\$32.20		4
Maintenance technicians	\$34.50		4
General Labor	\$22.00		4
Cook	\$22.00		2
Bull Cook	\$18.00		2

Operating Costs

The cost to provide food, laundry, water, and sewer facilities is estimated to be \$37 a day per person. Helicopter and boat support costs are transferred out and handled as separate activities. They are discussed in Sections 2.21 through 2.25.

2.12 DRILL PRODUCTION WELL

This task was also developed primarily from an interview with the Alaska Planning Manager for Forest Oil Corporation. Each production well costs \$4 million according to oil company accounting methods, which allocate platform plus other development costs to the well. Of the \$4 million, approximately \$1.5 million will be platform-related expenses.

Of the true well costs, approximately \$800,000 of the well cost is durable, or permanent to the well, like casing, production tubing, valves and blowout prevention equipment. Another \$400,000 is for nondurables, like drilling mud, chemicals and consumables. The remaining cost (about \$1.3 million) is labor, with about half being direct to the well drilling and about half being indirect. Indirect labor is employed to order, handle, and transport materials to the drilling location. These indirect labor costs are covered as separate activities in this model and include the production shore base construction and operations activities and the helicopter and boat activities.

The length of time required to drill a production well will vary considerably based on the circumstances. However, drilling a well every 30 to 45 days is common and the midpoint of this range was used in the IMPAK model.

During oil production, lifting costs including the \$4 million for drilling costs spread out over a five to seven year period, are assigned by the oil company to each barrel produced. This accounting is necessary to establish the cost of production versus the profit. The total cost for current Cook Inlet production is allocated at \$1.57 per barrel, while gas production costs are allocated at \$1.62 per 5,000 cubic feet.

Personnel

Personnel for this task are identical to those required for drilling an exploration well. For a full description of the composition of the drilling crew see Section 2.7.

Drilling Costs

The costs discussed above for durable items (\$800,000 for casing, production tubing, valves and blowout prevention equipment) and nondurable items (\$400,000 for drilling mud, chemicals and consumables) are included in this activity.

2.13 LAY OFFSHORE PIPE

This task was developed primarily from an interview with the Alaska Planning Manager for Forest Oil Corporation. Forrest Oil is drilling the Redoubt Shoals development in the lower Cook Inlet and operates the Osprey platform. The information for this task is based on offshore pipeline construction for that project.

The pipelines to the Osprey will be assembled on shore and pulled with tugs to the platform. OCS deep-water production platforms will require a lay-barge, as the pipe can not be pulled. The cost per unit will be about the same for either method. However, the lay-barge and crews are all from the lower 48 states, as no lay-barges are licensed in Alaska. Cook Inlet pipelines vary in diameter from eight to 16 inches.

Specific installed costs are listed below. Using a chart of weights and dimensions of seamless welded pipe, an estimating formula was developed by project engineering staff for pipeline fabrication. This will cover various coatings, geographic considerations and equipment variations. The formula is as follows:

$$\begin{aligned} \text{Installation Cost Per Foot} = & \text{(pipe weight per foot in pounds @\$2.00 per pound) +} \\ & \text{(\$60.00 per foot for fabrication) +} \\ & \text{(\$37.50 per foot for offshore installation)} \end{aligned}$$

As discussed in the preceding paragraph, these costs will not vary for deep-water operations.

Data on real estate easement purchases or permitting, as they vary greatly per installation, were not available from the sources used to collect information for this activity. Instead real estate and easement costs were collected separately and are discussed in Chapter 6.

Pipeline Installation

According to the estimation formula, pipelines of 8, 10, and 16 inches in diameter can be installed at \$140.50, \$168.50, and \$263.50 per foot.

Onshore Equipment

The onshore fabrication equipment has a ten-year lifetime and therefore costs will be capitalized over a ten-year period and will prorate at about \$ 0.32 per foot per \$100,000 of original investment or about \$29.50 per foot for this example.

Equipment used onshore for pipe fabrication includes the following. One 966 Caterpillar loader with forks and bucket that costs \$260,000 for the base model plus \$5,000 for Alaska upgrade. Four D6 side boom caterpillars that cost \$330,000 each for the base model plus \$5,000 for Alaska upgrade. Two pickup trucks at \$25,000 each from a local fleet dealer. Two 20 ton cranes at a cost of \$260,000 each. Two welding trucks (fully equipped with welders, torches, and tools) at \$34,000 each.

Offshore Equipment

Offshore equipment such as tugs, dive boats, and lay-barges are leased by the day for pipeline installation. Some of these boats have been in service for over 30 years, so that calculation of lifetimes and capitalization of costs would be difficult. Each of four tugs has two 55 hundred horse engines and two generators. The fuel consumption is 180 per hour at \$1.50 per gallon. This tug leases for \$10,000 per day. Each of the two 50 feet by 12 feet dive boats has two 1000 horsepower engines, a generator and an air compressor. The dive boats consume 40 gallons of fuel an hour.

This activity involves “dragging” the pipelines from shore to the platform. A large onshore staging area is prepared where the pipe will come ashore. Four 40-foot pieces of pipe are welded in sections and their joints are coated and wrapped. The 160-foot sections are stacked in the staging area until they are to be dragged off shore. The sections of pipe welded onshore are carried to cribs on the beach by the side boom D6 Cats. Two side by side cribs are used as two pipelines, one for oil and one for gas, are pulled at one time. The 20-ton cranes hold the ends being joined until they are welded and the joints coated and wrapped.

The pipes are then pulled by the tugs towards the platform they serve. Several platforms may manifold to one that has pipelines going ashore. The divers look for abnormalities in the ocean bottom that could stress the pipe. The Cook Inlet ocean floor is mostly silt and causes few bedding problems. Each set is 160 feet long and about five sets on each pipeline can be placed in a 12-hour day. The onshore equipment is serviced and fueled before and after work and at lunchtime if necessary. The equipment uses about 600 gallons of fuel per day at \$1.50 per gallon.

Personnel

Onshore personnel supporting offshore piping laying work a 72-hour week during pipeline construction. Detailed information on their compensation is provided in Exhibit 2-13.

Exhibit 2-13 Employee Compensation - Lay Offshore Pipe, Onshore Support Personnel

Title	Hourly Wage	Annual Wage	Number
Construction Manager		\$80,000	1
Operators	\$24		6
Welders	\$26		2
Pipe Fitter / Welder Helpers	\$22		2
Laborers	\$18		2
Dive Boat Diver	\$66.67		4

Offshore crew that operate and live aboard the tugs work a two week on and two week off schedule averaging 12 hours per day. Their compensation is detailed in Exhibit 2-14. Note that the crew listed below is for one shift only and must be multiplied by two for the second shift.

Exhibit 2-14 Employee Compensation - Lay Offshore Pipe, Offshore Personnel

Title	Hourly Wage	Annual Salary	Number
Captain		\$85,000	1
Mates	\$28		2
Engineers	\$28		1
Engineer Helper	\$18		1
Able Bodied Seamer	\$18		2
Cook	\$18		1

The crew of the dive boats consists of a Captain, Mate and Engineer. It leases for \$4,000 per day. In this case, two divers per boat at \$800 per day each will be used. In the model, this activity will lease the boats from the various boat sectors. Only the onshore crews and the divers will be considered to be part of this activity.

If a lay-barge is used, the onshore crews and equipment will work on the barge. As discussed above, the costs per unit for the two construction techniques are very similar.

2.14 LAY ONSHORE PIPE

This task was developed primarily from an interview with a construction manager for VECO-Kenai. VECO is a major support contractor for the Cook Inlet area and has installed several of the onshore pipelines in the area. Cook Inlet pipelines are constructed from pipe that varies from 8 to 16 inches in diameter.

The costs modeled for this activity are based on various sizes of pipelines that have been installed and their cost per foot. The costs for equipment and personnel assume that the easement has been prepared. Data on real estate easement purchases or permitting, as they vary greatly per installation, were not available from the sources used to collect information for this activity. Instead real estate and easement costs were collected separately and are discussed in Chapter 6.

Pipeline Installation

Using a chart of weights and dimensions of seamless welded pipe, an estimating formula has been developed by project engineering staff for underground onshore pipelines. The formula is as follows:

$$\text{Installation Cost Per Foot} = (\text{pipe weight per foot in pounds} @ \$2.00 \text{ per pound}) + (\$60.00 \text{ per foot for fabrication})$$

This formula will cover various coatings, geographic considerations and equipment variations. According to the estimation formula, pipelines of 8, 10, and 16 inches can be installed at \$103, \$131, and \$226 per foot.

Equipment

The equipment costs will be capitalized over a ten-year period and will be prorated at about \$0.32 per foot per \$100,000 of original investment. For this example, about \$29.50 per foot may be used in cost allocation.

Equipment used onshore for pipe fabrication includes the following. One 966 Caterpillar loader with forks and bucket that costs \$260,000 for the base model plus \$5,000 for Alaska upgrade. Five D6 side boom caterpillars that cost \$330,000 each for the base model plus \$5,000 for Alaska upgrade. One crawler backhoe (Cat 215) for \$400,000. Two pickup trucks at \$25,000 each from a local fleet dealer. Two 20 ton cranes at a cost of \$260,000 each. Two welding trucks (fully equipped with welders, torches, and tools) at \$34,000 each.

A trench is dug with the crawler backhoe. Four previously welded sections of pipe are carried to the trench by the five side boom D6 Cats. The ends that are being joined are held together using the two 20 ton cranes while they are welded and the joints are coated. Then the pipe is lowered in the ditch, bedded with sand and covered by the 966 loader. Each set is 160 feet long and about ten sets can be placed in a ten-hour day. The equipment is serviced and fueled before and after work and at lunchtime if necessary. The equipment uses about 700 gallons of fuel per day at \$1.50 per gallon.

Personnel

All personnel work a 60-hour week at ten hours a day for six days a week. The composition of the crew including titles and wages is provided in Exhibit 2-15.

Exhibit 2-15 Employee Compensation - Lay Onshore Pipe

Title	Hourly Wage	Annual Wage	Number
Construction Manager		\$80,000	1
Operators	\$24		9
Welders	\$26		2
Pipe Fitter / Welder H	\$22		2
Laborers	\$18		2

2.15 CONSTRUCT ONSHORE PRODUCTION FACILITY

This task was developed primarily from an interview with a procurement buyer and QC inspector on the Alpine Production Facility module construction who was contracted through Alaska Petroleum Contractors (APC). These modules were constructed in Kenai and used on the North Slope. However, Philips and BP spokesmen say that this facility will be a “cookie cutter” model for future on-shore production facilities. These spokesmen also state that the production philosophy has changed primarily due to environmental concerns and offshore support costs.

Platforms in the past contained the production equipment and processed oil and gas was piped to shore. Future plans call for minimum equipment and personnel on the platforms and wellhead gas and oil being piped ashore and processed in these facilities. Future facilities will basically be the same; with modifications for each the production needs of the specific area, such as pressures, flow rates and viscosity.

This project spanned a four-year period with the first year used for design and permitting. Six procurement agents worked for one year certifying vendors and buying materials, before construction began. Construction took one year and placement and start up took another. The total cost of this initial facility is about \$200 million. The advantage of duplication, using these pre-constructed modules, is expected to save up to 40 percent and two years of time in future installations.

The modules and oil trains were constructed in north Kenai. The gas train was constructed in Corpus Christi Texas and shipped to the slope on skids to be installed in the modules. Oil and gas trains refer to the process where a series of vessels and heaters separate out the impurities from the gas or oil and prepare it for shipping. Future Cook Inlet and Shelikof Strait facilities would likely be constructed in their entirety on site. Construction personnel peaked at 350 in Kenai on the oil train and modules and 250 in Texas on the gas train.

Personnel

The estimates of employee compensation that are provided in Exhibit 2-16 reflect average operations. Over 230 employees involved in construction of the production facility.

Exhibit 2-16 Employment Compensation - Construct Onshore Production Facility

Title	Hourly Wage	Annual Wage	Number
Procurement buyers (40hr/wk*2yr)	\$30.00		5
Superintendentents (1.5yr)		\$90,000	5
Foremen (60hr/wk*1.5yr)	\$35.00		15
Craftsmen and apprentices	\$22.00		125
Laborers (60hr/wk*1.5yr)	\$18.00		75
Inspectors (60hr/wk*2yr)	\$30.00		8

The total labor cost was \$52,042,000, with \$32,526,250 for the Kenai labor and \$19,515,750 for the Corpus Christi labor. Eighty-five percent of the Kenai labor is local hire, the other 15 percent are hired from the lower 48 states.

Other Expenditures

About \$8 million was spent on various items including welding machines, rod, hardware, tools and expendables. Eighty percent of this amount was purchased locally while the other 20 percent was bought from the lower 48 states.

Materials cost approximately \$79 million. Most of the vessels, piping and rotating equipment were purchased outside of the local area. About 20 percent of the materials were local Kenai purchase, consisting of structural steel, hardware and accessories.

For the shipping and setup portion of the activity, the North Slope costs were \$50 million for the Alpine project. Shipping the gas train to the North Slope cost around \$11 million. In the Cook Inlet area the cost of setup and tie-ins would be less than \$10 million.

As discussed above, a duplicated facility, built on site on the Kenai Peninsula or Kodiak Island, would cost about 65 percent of the original Alpine facility.

2.16 OPERATE PRODUCTION FACILITY

This task was developed primarily from an interview with a VECO construction manager for the Kenai area. VECO is a major support contractor for the Cook Inlet area. The construction manager has been involved in major re-construction and maintenance of Drift River, Granite Point, and Trading Bay production facilities and oil terminals. These facilities are on the West Side of the Cook Inlet and are not accessible by road.

Granite Point, and Trading Bay are primarily production facilities while Drift River is more of a combined production facility and oil terminal. According to the construction manager the operation requirements of the Granite Point and Trading Bay are similar to that of the Drift River except one more operator and labor technician will be required.

DRIFT RIVER: The onshore Drift River facility consists of a tank farm, offshore dock, camp and runway, and services platforms that have primary separation. This is the least likely type of terminal to be used in the future.

The total cost of this facility was about \$50 million with that cost made up of the following components. Installing four crude oil storage tanks cost \$3 million each. These tanks are 200-foot diameter by 40-feet tall. Four 1000 horsepower turbine electric generators cost \$250,000 each. Shipping pumps, piping, valves and vessels cost a total of \$25 million. The helicopter hanger cost \$200,000. The 3,000 feet by 75 feet lighted runway cost \$2.00 per square feet for a total of \$450,000. The offshore dock cost \$3 million.

The total installed camp cost was about \$1.2 million, including one 12-room staff camp, one 12-room construction camp, dinning room, wash room and utility areas. During construction the camps accommodated 50 construction workers using double occupancy.

GRANITE POINT AND TRADING BAY: These onshore terminals are likely to be expanded and used for future lower Cook Inlet development.

The construction varies from above due to the fact the crude and gas primary separation is accomplished at the facility and gas and oil pipelines run in and out reducing the need for tank storage. A total of \$9 million less was required for tanks and \$20 million each for two primary separation trains had to be added. The offshore loading dock (\$3 million) was not needed. These facilities cost an additional \$28 million to construct. The cost of the metal buildings covering the trains is included in the above cost. These buildings have gravel floors, however, any future construction would require concrete or steel floors with containment.

Personnel

All of the personnel below are permanent and work a two week on and two week off schedule. The estimated staffing for the operation of a production facility is provided in Exhibit 2-17. In order to develop an estimate of staffing for both rotations the following crew would need to be multiplied by two.

Exhibit 2-17 Employment Compensation - Operate Production Facility

Title	Hourly Wage	Annual Wage	Number
Production foreman		\$90,000	1
Mechanic		\$75,000	1
Electrician		\$80,000	1
Operators	\$24.00		3
Labor technicians	\$18.00		3
Cook	\$18.00		1
Bull Cook	\$16.00		1

Additional Expenditures

Meals and camp service run about \$38.00 per day per employee. The helicopter and pilot on site cost \$28,000 per month. The helicopter shuttles most of the personnel for shift change and hauls some supplies. About four chartered aircraft flights at \$600 per flight can be expected each month.

2.17 CONSTRUCT MARINE TERMINAL

This task was developed primarily from interviews with a VECO construction manager for the Kenai and with the Superintendent of Pipelines and Terminals for Tesoro Alaska.

Unfortunately, no examples of modern stand-alone oil terminals were available to directly collect construction cost estimates from. The closest example was the Drift River facility. Consequently, the major components of the Drift River facility, as detailed in the previous section, were used as a starting point. Where possible, the costs of the major components were updated with more recent construction cost data from a recent facility. For, example, the cost of the airstrip was available from the interview with the Superintendent of Pipelines and Terminals for Tesoro Alaska.

The costs of the components of the facility were collected and summed. Labor costs were based on the percentages and distributions of skills required for the construction of the production facility.

2.18 OPERATE MARINE TERMINAL

This task was developed primarily from an interview with the Superintendent of Pipelines and Terminals for Tesoro Alaska. According to this source, the existing pipelines and onshore production facilities have the capacity for all projected increases of oil and gas production in the Cook Inlet for many years to come.

New onshore production facilities would require about two to five years just for the permitting process. This process would include the following permitting: land and land use, pipeline right of ways, facility, utility, tankage and containment, ballast water, spill and shipping risk studies, and tide water and draft studies.

Dock construction would run about \$30 million. The dock would be capable of handling tankers of size (length and barrels of oil). A tank farm with one million barrels of crude storage, ballast water storage and treatment, vapor recovery, crew quarters, and piping, pumps and controls would cost about \$25 million. An airstrip would cost about \$2 million.

Oil is pumped ashore from platforms that have primary separation onboard. The crude oil is stored in the tanks. Once a week a tanker is loaded at the off shore dock and hauls the crude to market.

Personnel

The staff modeled in this activity is based on the staff that currently operates the Kenai Pipeline (KPL), the Tesoro dock and marine terminal. The estimated staffing for the operation of a marine terminal is provided in Exhibit 2-18. All of the personnel below are permanent, live at home, and work a 12 hour day, two week on and two week off schedule; consequently, they must be multiplied by four.

Exhibit 2-18 Employment Compensation - Operate Marine Terminal

Title	Hourly Wage	Annual Wage	Number
Managers (indirectly involved)		\$50,000	2
Instrument technician		\$85,000	1
Electrician		\$85,000	1
Operators (Coast Guard licensed)	\$34.00		6
Dock hands (Coast Guard licensed)	\$28.00		2
Cook	\$18.00		1
Bull Cook	\$16.00		1

There are about ten more “on call” consultants for logistics, on call support, environmental and engineering services. These services run about \$400,000 annually.

Oil is pumped ashore from platforms or from a West Side production facility that have primary separation. The crude oil is stored in the tank farm. Tankers are loaded at the dock and haul the crude to market. Tidewater lease for the dock costs \$600 per month.

2.19 MAJOR PLATFORM MAINTENANCE

This task was developed primarily from interviews with a Project Manager for Udelhoven Oilfield System Services, the Alaska Planning Manager for Forest Oil Corporation, and a Construction Manager for VECO Kenai. VECO and Udelhoven supply craftsmen, labor and equipment for major maintenance. Forest operates the Osprey platform. They also have fabrication shops for pre-turnaround work.

Major platform maintenance is performed annually. OCS deep-water production platforms at depths more than 150 feet double the operating costs and required personnel of the Osprey. A deep-water platform is modeled in this task.

Personnel

Major platform maintenance causes an interruption of production. Consequently, the shutdown portion of the maintenance is held to a maximum of one week. Multiple tasks must be accomplished simultaneously. About 60 people are used during the turn-around week. Thirty people are used 20 days before turn-around for preparation and prefabrication and 10 days after turn-around for cleanup.

Labor for this activity includes platform staff, prefabrication and cleanup personnel, and onsite turnaround personnel. The platform staff works several months before a turn-around ordering parts and planning the shut down. During the shut down they issue permits and monitor systems for safety. Related costs associated with platform operation have been discussed in section 2.11. This part focuses only on prefabrication and cleanup personnel and onsite turnaround personnel.

Prefabrication and cleanup personnel work six ten-hour days per week in the fabrication shops. The composition of the prefabrication and cleanup workforce is provided in Exhibit 2-19.

Exhibit 2-19 Employment Compensation - Major Platform Maintenance, Prefabrication and Cleanup

Title	Hourly Wage	Annual Wage	Number
Welding Foreman	\$37.50		2
Welders	\$34.20		8
Fitters	\$32.50		8
Helpers	\$22.00		10
Electricians	\$38.86		1
Apprentices	\$32.50		1

Onsite turnaround personnel work two 12-hour shifts per day for one week. During each shift, half of them are on the job and the other half are sleeping. The composition of the onsite turnaround workforce is provided in Exhibit 2-20.

Exhibit 2-20 Employment Compensation - Major Platform Maintenance, Onsite Turnaround

Title	Hourly Wage	Annual Wage	Number
Welding Foreman	\$37.50		4
Welders	\$34.20		16
Fitters	\$32.50		12
Helpers	\$22.00		8
Electricians	\$38.86		4
Apprentices	\$32.50		2
Instrument Technicians	\$34.20		2
Mechanical	\$34.20		2
Carpenters	\$34.20		2
General Labor	\$22.00		6
Extra Cook	\$22.00		1
Extra Bull Cook	\$18.00		1

In addition, it is estimated that the platform operations personnel devote two weeks of their time to this activity. Therefore, 50 weeks of their wages were assigned to the platform operations task and two weeks to this task.

2.20 WELL WORKOVER

This task was developed primarily from interviews the Alaska Planning Manager for Forest Oil Corporation. Well workovers are performed every five years after initial construction and generally take 10 to 20 days to perform. In a well workover, the wells themselves undergo maintenance. This maintenance will almost never require replacing the casing, but usually replaces or repairs production tubing, packing, etc. (the “jewelry”). Well workovers are a distinct operation from a platform maintenance which involves maintaining the platform.

Personnel

Drilling personnel have already been listed in Section 2.7, Exhibit 2-8. Crews work two 12-hour shifts per day, two week on and two weeks off so one-half of them will be on the platform at one time and eight will be working each 12-hour shift.

There will also be technical support people on call 24 hours a day. Most of the time they can analyze problems over the phone or on-line and have the platform or drilling personnel make repairs. Occasionally they must be flown out to make repairs. Technical support costs average about \$1,200 a month.

Operating Costs

The cost to provide food, laundry, water, and sewer facilities is estimated to be \$37 a day per person. Helicopter and boat support costs are transferred out and handled as separate activities. They are discussed in Sections 2.21 through 2.25.

Each production well workover costs between \$100,000 and \$2 million, with the average being about \$ 1 million. If the costs go over half (\$2 million) of new well costs (\$4 million), a new

well will be drilled. One third of the workover costs will be platform related expenses. One eighth of the well cost is tangible, or permanent to the well, like casing, production tubing, valves and blowout prevention equipment. One eighth is for intangibles, like drilling mud, chemicals and consumables. The remaining cost is labor, with about one half being direct to the well drilling and the other half being indirect, to order, handle, and transport materials to the drilling location.

Completing a workover every 10 to 20 days is common. According to project engineering staff, the midpoint estimate of 15 days, a one shift per day, would work well for the model.

2.21 HELICOPTER SUPPORT

This task was developed primarily from an interview with the Vice President/General Manager of Kenai Air. Kenai Air is an independent company that provides 25 percent to 35 percent of the service to offshore platforms. Seventy-five percent of their business is oil and gas related. Offshore Systems Kenai (OSK) provides the remaining 65 percent to 75 percent of the service. Oil companies and the helicopters lease the OSK shore base and pilots are leased from ERA Helicopter. Kenai Air will be a typical example of future offshore support.

Equipment

The Kenai Air leased its facility from the city of Kenai. The 6,000 square foot hanger space, including offices and waiting room, cost \$203,390 to build originally and are leased for \$850 per month. The terminal space leased for \$1.65 per square foot. The one-acre ramp with a fueling facility is leased for \$600 per month. The fuel facility has been upgraded to last for 10 years at a cost of \$120,000. Portable fuel trucks have been decommissioned and sold due to environmental considerations.

The helicopters are 20 to 25 years old. They have to be maintained in accordance with Bell Helicopters standards and FAA regulations. Given the amount of major maintenance and parts replaced, capitalization is applied every six to ten years. They have three Bell 206 Long Rangers (\$700,000 each) and three Bell Jet Rangers (\$450,000 each) in service. Each of the six helicopters flies about 60 to 100 hours per month. The Bell 206 Long Ranger has an hourly rate of \$900, while the Bell Jet Ranger has an hourly rate of \$685. These rates include pilots and long term contracts may reduce the hourly rate by 10 percent.

On average, a Jet Ranger uses 28 gallons per hour and a 206 Long Ranger uses 35 gallons per hour. The fuel costs \$2.25 per gallon. Kenai Air also has one extra Bell 206 Long Ranger and two extra Bell Jet Rangers that are not used at this time due to a decline in Cook Inlet requirements.

Kenai Air has two pickup trucks, two vans, two cars, and two three-quarter ton flatbed trucks. Their respective values are \$18,000, \$20,000, \$17,000, and \$21,000 each. Kenai Air replaces their vehicles about every ten years. Gasoline is \$1.83 a gallon and their gas bill is about \$160 per week.

Additionally, Kenai Air spent \$100,000 in the purchase of special tools to maintain Bell helicopters. About \$10,000 is spent annually on replacements and upgrades of these tools. The two helicopter dollies cost \$20,000 each and have an estimated life of ten years. General tools and equipment for maintenance cost \$100,000 and their annual replacement and upgrades cost \$5,000.

Personnel

Currently there are two managers, four full time pilots, three shop mechanics and one office manager. The two managers are also pilots and will fly when needed. The manger pilots are paid \$50,000 to \$60,000 annually, while the full time pilots are paid \$40,000. Each of the three mechanics has an annual salary of \$35,000. The office manager is paid a wage of \$12 to \$14 per hour. All of the employees are local, except one pilot who lives in Anchorage and works a week on and week off schedule. Pilots are paid by the day and flight time. Kenai Air peaked at 30 employees in the early eighties.

2.22 BOAT SUPPORT (LARGE WORKBOATS)

The model has four activities for boat support, one for each type of boat. In the model there is a general overhead cost vector for boat support, but the labor and selected other inputs vary for the different boats. In this section, general information on the boat activities is provided along with information on the large work boats. The following sections provide crew information for the small work boat (Section 2.23), the landing craft (Section 2.24), and the dive boat (Section 2.25).

This activity was developed primarily from an interview with the operations manager of the Offshore Systems-Kenai (OSK) facility. OSK owns and manages the dock, office building and cargo storage area. Their primary responsibility is the storage and handling of cargo. About 90 percent of their business is supporting the oil company platforms and Cook Inlet west side operations (there is no road structure connecting the west side of the Cook Inlet to the main road system in the rest of Alaska). Ten percent of their business supports fishing, timber and private enterprise. Sister companies own and repair five of the boats: Nikiski Ship Repair and Ocean Marine Services.

Tidewater Marine is contracted from the Gulf of Mexico area and has two boats and one landing craft, which are manned by crews from Louisiana. Sea Bulk is another company that is hired for specific jobs. They are based on the West Coast of the lower 48 states and are manned by out of state crews. Presently they provide the spill response vessel.

Facility

The facility is built on 89 acres purchased for \$3,500 per acre. The dock was constructed from two ship hulls and fill for a cost of \$1.5 million. The dock requires a state tidewater lease of \$600 per month. The dock is about four acres and has a warehouse measuring 80 feet by 250 on it.

The construction of the 80 feet by 250 feet warehouse cost \$30 per square feet for a total of \$500,000. The construction of the 60 feet by 80 feet office complex cost \$45 per square feet for a total of \$216,000. The original construction cost for the outside storage pad was \$331,570.

Boats

The fuel used by these boats cost about \$1.50 per gallon.

Ocean Marine Service

There are two workboats, one landing craft, and two dive boats used for marine service.

The large workboat is 217 feet long and 56 feet wide, equipped with two 55 hundred horse engines and two generators. It can haul 400 tons of cargo and 16 passengers. The fuel consumption is 180 gallons per hour This boat can be leased for \$10,000 per day.

The smaller workboat is 170 feet and 36 feet wide, equipped with two 39 hundred horsepower engines and two generators. It can haul 280 tons and 16 passengers. It consumes 127 gallons of fuel per hour. It can be leased for \$8,000 per day.

The landing craft is 100 feet long and 40 feet wide, equipped with two 2800 HP engines and a generator. It can haul 200 tons and consumes 90 gallons of fuel per hour. It can be leased for \$6,000 per day.

The two dive boats are 50 long and 12 feet wide, equipped with two one thousand horse engines, a generator and an air compressor. It consumes 40 gallons of fuel an hour and can be leased for \$4,000 per day.

Tidewater Marine and Seabulk Boats

These boats are very similar in size, rates, and fuel consumption as Ocean Marines boats. Seabulk boats have a contract to assist spill response and support the survey crew.

Personnel

At Facility

There are twelve permanent longshoremen dock personnel working 50 hours per week. Their hourly wages range from \$20 to \$22. Staff size peaks at twenty during summer months. In addition, the operations manager and the office manager are salaried at \$85,000 and \$40,000 annually.

Boat Crew

The crew lives abroad and works two weeks on and two weeks off schedule averaging ten hours per day. These are the crew in a single shift. If both shifts are considered, then the numbers of personnel will need to be multiplied by two. A Captain, a Mate, and an Engineer generally operate a boat. The captain has an annual salary of \$85,000. The mate and the engineer are paid hourly wage of \$28, with monthly average of \$5,600.

The workboats are additionally served with one Engineer helper, two Able Bodied seamen (AB), and one cook. The engineer helper, the seamen, and the cook are paid \$18 per hour for a monthly average of \$3,600. The large boat takes two mates, while the smaller boat has only one mate working abroad.

The landing craft is additionally crewed with one engineer helper and one AB. The crews in Tidewater marine boats and Seabulk boats are similar, except that those in Tidewater boats are from out of state and those in Seabulk boats are from the West Coast. Crews of Seabulk boats also provide spill response personnel.

2.23 SMALL WORK BOAT

The smaller workboat is 170 feet and 36 feet wide, equipped with two 39 hundred horsepower engines and two generators. It can haul 280 tons and 16 passengers. It consumes 127 gallons of fuel per hour. It can be leased for \$8,000 per day.

A Captain, a Mate, and an Engineer operate the small workboat. The captain has an annual salary of \$85,000. The mate and the engineer are paid hourly wage of \$28, with monthly average of \$5,600. Additional crew for the small workboat includes an engineer helper, two Able Bodied seamen (AB), one cook. The engineer helper, the seamen, and the cook are paid \$18 per hour for a monthly average of \$3,600. The small boat also has one mate working abroad.

2.24 LANDING CRAFT

The landing craft is 100 feet long and 40 feet wide, equipped with two 2800 HP engines and a generator. It can haul 200 tons and consumes 90 gallons of fuel per hour. It can be leased for \$6,000 per day.

A Captain, a Mate, and an Engineer operate the landing craft. The captain has an annual salary of \$85,000. The mate and the engineer are paid hourly wage of \$28, with monthly average of \$5,600. Additional crew for the small workboat includes an engineer helper and an Able Bodied seaman (AB). The engineer helper and the seamen are paid \$18 per hour for a monthly average of \$3,600.

2.25 DIVE BOAT

The dive boats are 50 long and 12 feet wide, equipped with two one thousand horse engines, a generator and an air compressor. It consumes 40 gallons of fuel an hour and can be leased for \$4,000 per day.

A Captain, a Mate, and an Engineer operate the dive boat. The captain has an annual salary of \$85,000. The mate and the engineer are paid hourly wage of \$28, with monthly average of \$5,600.

2.26 CAMP SUPPORT

This task was developed primarily from an interview with a hotel owner in North Kenai for 15 years. This example is the Place Hotel and Restaurant facility. There are several other hotels servicing the Kenai area with varying rates. The conventional hotels have higher rates and only about 20 percent of their business is oil and gas related. There are some camp type hotels that have multiple rooms per bath and serve limited menu, chow line type meals. This example is typical, as about 70 percent of the Place's business is oil and gas related. Some of the offshore companies have provided helicopter service direct from the Place to their offshore operations. The Place has 22 double rooms (each with a bathroom), a restaurant and a bar.

The rates in the Kenai area vary seasonally due to construction, tourism and the famous Kenai area fishing. On average, summer rates are \$79.50 for single occupancy plus \$10 for double, while winter rates are \$59.50 for single occupancy plus \$7.50 for double. Long term negotiated contractor rates average \$69 in the summer to \$59 in winter with no additional charge for double occupancy.

The restaurant menu is reasonable. A couple of examples would be the Prime Rib special at \$10.95, roasted top sirloin at \$7.95 and breakfast at \$6.95. Crew meals can be purchased for \$20 per day, per man, including a box lunch for the noon meal.

Rolling Stock

There is one Limousine available for rent or crew transportation of up to 10 people at \$50 per hour. The Limousine was bought for \$60,000 with 15 years of estimated remaining life. In addition, one nine passenger courtesy van, which was also used to haul supplies, was bought for \$25,000 with a 10 year estimated remaining life.

Supplies

Kitchen supplies and food are purchased locally from Country Foods and Echo Lake Supply. Supply costs are around \$100 per day, with labor at \$140 and the gross return around \$320 per day.

Bar supplies are delivered by Anchorage based companies that service the Kenai area, Anchorage Cold and K&L. The bar can gross up to \$800 per day, with costs about 60 percent of gross. The owner offers a payroll check cashing service.

Personnel

Employees are local hire and permanent. Personnel work a variety of shifts to provide coverage as needed. The Owner Manager makes \$80,000 to \$120,000 annually. The cleaning person works \$8 to \$9 per hour plus tips. The Swammer/maintenance man/morning bar tender works \$8 to \$9 per hour plus tips and housing. Two Bartenders have hourly wage of \$8 to \$10 plus tips. Tips vary; however can go as high as \$100 per shift.

The owner normally has the kitchen leased to keep his daily activities at a manageable level. Personnel serving the kitchen include two combination cooks and servers and one breakfast cook and serve. Their hourly wages are \$8 to \$10 plus tips.

3 LABOR INPUTS

The purpose of this chapter is to provide an overview of the methods used to develop the labor inputs to the various activities in the Sub-Artic IMPAK model that comprise oil exploration, development and production. Subsequent chapters provide similar discussions for purchased services, materials and equipment. In some sense, this study is developing a production function for each activity, where the production function is defined in terms of expenditures for various types of inputs. These inputs can be broadly grouped into the following categories: labor, purchased services, capital, and materials with the latter including raw, intermediate and energy material and inputs.

The data developed in this study are based on information collected in the year 2000 for projects installed in the 1997-2000 period, and published reports providing data for various years, but mostly for the years 1997 to 1999. As such, the estimates provided in this study should be considered to be reported in 1999 dollars.

The question of dollar wages is complicated by a recent change from a labor surplus situation to a labor shortage situation. According to the KPB Borough Economic Analyst, oil and gas related wages remained stable at an average of around \$5,000 per month from 1993 to 1998, and then jumped to \$6,000 in 1999. Based on this data, an initial option that was considered was to multiply wage rates for years before 1999 by a twenty percent factor to reflect the recent tight labor market.

However, further research, based on data from the State of Alaska's Employment and Earnings Summary Reports for the years 1997 through 2001, reveals that the jump in earnings did not occur until 2000 and further revealed that wages declined in 2001. Therefore, in consultation with MMS staff, it was determined that this adjusting the original data would skew wages to reflect a tight labor market rather than an average labor market. As a result, it was decided to simply report wages as they were collected.

The model developed in this study is designed to be stimulated by activity levels contained in the MMS E&D scenarios. These activity levels then activate input vectors for each activity. This chapter and those that follow describe the general methods used to develop the expenditure estimates for each of the major input categories. The vectors themselves, which are tabulated by activity, are provided in the Sub-arctic IMPAK spreadsheet model. This chapter provides an overview of the techniques used to develop later inputs as well as describing some common data and data development techniques used in the following chapters.

3.1 OVERVIEW

Labor inputs include the direct labor used in the construction and operation of the oil and gas facilities as well as the overhead or headquarter salaried non-production staff that provides support functions over a range of operations. As a result, estimates of labor inputs considered not only employment in the field, but also in local and regional offices and headquarters.

Estimates are made for both man-weeks of employment and employee compensation, in order to allow for easier updating of the data in future studies and for use in estimating lodging and food costs.

In calculating estimates of economic impact in cases where workers are commuting, it is necessary to consider both where the employee works and where the employee spends their income and pays their taxes. Therefore, while data is initially developed based on the location of the workplace of the individual, these estimates are then converted to estimates of the location in which the expenditures of wages and payment of taxes are made.

3.2 ESTIMATES OF PRODUCTION EMPLOYMENT

The first step is to estimate the actual labor used in the field. These direct construction labor inputs are estimated through interviews with representatives of construction contractors and oil companies that have experience in constructing or operating the structures under consideration. These estimates are often the most clearly defined, since the work efforts of these types of employees are most easily assignable to a particular activity. These estimates, developed separately for each individual activity, are discussed in detail in the previous chapter. In most cases, data were collected by activity on the number of employees by trade, wages for employees by trade, task crew size, duration of task, number of shifts, shift duration and rotation pattern.

These data were tabulated and are presented in Exhibit 3-1. For each activity, the crew members are listed by trade. For hourly employees, the wage rate is recorded along with the hours worked per day and days per week to calculate a weekly wage. For salaried employees the hourly wage is found based on hours per day, days per week, and rotation pattern. Weekly wages are converted to total wages based on crew sizes, shift factors, number of crews, rotation patterns and the length of the activity in weeks. Note that for some activities this is simplified as all the crew members work the same schedule, while for other tasks these calculations must be made at the crew member level. For those tasks where all crew members work the same schedule large areas of the tables are blank, as the detail at the crew member level was not necessary.

Wages are then adjusted to include an estimate of the value of fringe benefits. Data for this purpose are from the 1997 Census of Mineral Industries. The U.S. Oil and Gas Industry volume contains data on fringe benefits used in the analysis. According to data provided in that publication, fringe benefits not included in payroll amount to 20.4 percent of take home wages for U.S. oil and gas industry employees.

Some fragmentary data on fringe benefits were reported in the industry interviews conducted for this study. However, these data were incomplete and therefore, the Census data were believed to be more accurate. Note that although the Census data represent an accurate average for the industry as a whole, actual rates may vary among activities.

3.3 ESTIMATES OF NON-PRODUCTION EMPLOYMENT AND WAGES

While data on field or production employees by activity could be estimated directly from primary sources, estimates of office and headquarters personnel attributable to each activity were developed using secondary data sources. These estimates are based on industry-level ratios of total to production employees. Note that these employees are not necessarily associated with an individual activity, but rather represent an allocation of an overhead type function.

The numbers of headquarters and support staff are estimated based on published Census data on the ratio of total workers to production workers. Exhibit 3-2 provides these ratios from the 1997 Census of Mineral Industries, U.S. Department of Commerce, for a variety of areas and industries for which data are available. Data are also provided on the ratio of total to production employee wages and average payroll per non-production employee. All data are presented on a North American Industry Classification System (NAICS) code basis.

Exhibit 3-2: Calculation of Non-Production Employment and Payroll

Region	North American Industry Classification System (NAICS) Code	Number * of Total Employees	Number* of Production, Development, and Exploration Workers	Ratio: Total to Production Employees	Payroll* for All Employees (\$, 1,000)	Wages* for Production, Development, and Exploration Workers (\$, 1,000)	Ratio: Total to Production Employee Wages	Number* of Production Employees	Payroll* for Non-Production Employees (\$, 1,000)	Average Payroll Per Non-Production Employee (\$, 1,000)
Alaska	211	2,389	1,715		247,884	173,143				
	213111	1,023	791		54,802	46,364				
	213112	5,071	3,782		284,113	231,417				
	Total	8,483	6,288	1.35	586,799	450,924	1.30	2,195	135,875	61,902
U.S.	211111	100,308	58,289		4,968,722	2,717,588				
	211112	10,549	8,870		541,593	456,083				
	213111	53,865	45,219		1,918,086	1,539,296				
	213112	106,339	80,734		3,628,416	2,821,468				
	Total	271,061	193,112	1.40	11,056,817	7,534,435	1.47	77,949	3,522,382	45,188

Source: 1997 Census of Mineral Industries, U.S. Department of Commerce.

The ratios for the sum of the NAICS codes 21111, 213111 and 213112, which combines exploration, drilling and extraction, were selected to be used in this study, as comparable data were available for both Alaska and the U.S. Note that non-production employment within Alaska is 35 percent of direct production employment, while non-production employment within the U.S. is 40 percent of the direct production employment. It is assumed that the difference between the 35 and 40 percent ratios are due to Alaska-related non-production work located in other parts of the country, not a difference in the number of employees required to accomplish equivalent tasks. Therefore, it is estimated that for every 100 production workers on an Alaska OCS project, there are 35 non-production workers in Alaska and five non-production workers in the other 49 states.

Non-production employment within Alaska is assigned to Anchorage based on data provided by industry sources. Based on these interviews, all of the Alaskan non-production employment related to sub-arctic activities is assigned to Other Alaska.

Exhibit 3-3 provides the estimates of non-production workers and their wages. The number of full time equivalent (FTE) production workers is estimated as the product of the task work force and task length. The resulting estimates of non-production workers are then derived for Alaska

Exhibit 3-3: Calculation of the Numbers and Wages of Non-Production Workers by Activity by Geographic Area

Activity	Total Task Force	Task Length (weeks)	Number of Alaskan Non-Production Workers			Wages for Alaskan Non-Production Workers			Wages for U.S. Non-Production Workers			U.S. Non-Production Wages and Benefits	
			(FTE)	Production Workers	Non-Production Workers	Alaskan Non-Production Wages	Technical Support Wages	Including Technical Support Wages	U.S. Non-Production Wages	Technical Support Wages	Including Technical Support Wages		
1. Geological Survey	29	4	2.4	0.8	51,647	51,647	10,536	62,183	0.1	5,894	6,883.72	1,202	7,086
2. Spill Contingency Response	2	52	2.0	0.7	43,217	43,217	8,816	52,034	0.1	4,932	4,931.76		
3. Construct Exploration Shore Base	6	52	6.0	2.1	129,652	129,652	26,449	156,101	0.3	14,795	14,795.27	3,018	17,814
4. Operate Exploration Shore Base	6	52	6.0	2.1	129,652	129,652	26,449	156,101	0.3	14,795	14,795.27	3,018	17,814
5. Install Exploration Platform	41	5.0	3.9	1.4	85,188	85,188	17,378	102,566	0.2	9,721	9,721.25	1,983	11,704
6. Operate Exploration Platform	18	52	18.0	6.3	388,955	388,955	79,347	468,302	1.0	44,386	44,385.82	9,055	53,441
7. Drill Exploration Well	32	12.9	7.9	2.8	172,898	172,898	35,271	208,169	0.4	19,510	21,438.82		
8. Construct Production Shore Base	12	52	12.0	4.2	259,303	259,303	52,898	312,201	0.7	29,591	29,590.55		
9. Operate Production Shore Base	12	52	12.0	4.2	259,303	259,303	52,898	312,201	0.7	29,591	29,590.55		
10. Install Production Platform	82	52	82.0	28.6	1,771,907	1,771,907	361,469	2,133,376	4.5	202,202	202,202.07	41,249	243,451
11. Operate Production Platform	18	50	17.3	6.0	373,995	373,995	76,295	450,290	0.9	42,679	42,678.67	8,706	51,385
12. Drill Production Well	36	5	3.7	1.3	80,142	80,142	16,349	96,491	0.2	9,145	9,145.43	1,866	11,011
13. Lay Offshore Pipeline	21	1	0.4	0.1	8,228	8,228	1,678	9,906	0.0	939	938.93	192	1,130
14. Lay Onshore Pipeline	16	0	0.1	0.1	3,134	3,134	639	3,774	0.0	358	357.69	73	431
15. Construct Onshore Production Facility	233	78	349.5	122.0	7,552,213	7,552,213	1,540,651	9,092,864	19.1	861,825	861,824.67	175,812	1,037,637
16. Operate Production Facility	44	52	44.0	15.4	950,779	950,779	193,959	1,144,738	2.4	108,499	108,498.67	22,134	130,632
17. Construct Marine Terminal	44	52	44.0	15.4	950,779	950,779	193,959	1,144,738	2.4	108,499	108,498.67	22,134	130,632
18. Operate Marine Terminal	56	52	56.0	19.5	1,210,083	1,210,083	287,657	1,697,740	3.1	138,089	338,089.22	68,970	407,059
19. Major Platform Maintenance	128	2	4.9	1.7	106,381	106,381	21,702	128,083	0.3	12,140	12,139.71	2,477	14,616
20. Well Worker	32	2.1	1.3	0.5	28,495	28,495	5,879	34,695	0.1	3,252	3,573.14	729	4,302
21. Helicopter Support	10	0	0.0	0.0	34	34	7	42	0.0	4	3.94	1	5
22. Large Workboat	8	0	0.0	0.0	69	69	14	83	0.0	8	7.89	2	10
23. Small Workboat	7	0	0.0	0.0	61	61	12	73	0.0	7	6.94	1	8
24. Landing Craft	5	0	0.0	0.0	44	44	9	53	0.0	5	5.05	1	6
25. Dive Boat	6	0	0.0	0.0	53	53	11	63	0.0	6	5.99	1	7
26. Camp Support	8	52	8.0	2.8	172,869	172,869	35,265	208,134	0.4	19,727	19,727.03	4,024	23,751

by applying the 35 percent factor and for the U.S. by applying the five percent factor. The number of non-production FTE are then multiplied by the Alaskan and U.S. wage rates from Exhibit 3-2. Technical support wages are split equally between the two areas. Fringe benefits are then calculated and added to the total for each area.

3.4 WORKERS BY PLACE OF RESIDENCE

Due to the remote location of many E&D activities in Alaska, a large percentage of the workforce commutes to the project area. Because the geographic spending patterns of workers depends heavily on their primary place of residence, an important first step in estimating worker spending by area is to establish the primary place of residence for the components of the workforce.

According to expert project staff and based on their interviews with industry, oil and gas industry related workers in existing or new production areas are anticipated to be primarily drawn from existing pools of workers in the Kenai, the Anchorage area, and the other 49 states. For projects in the Cook Inlet area, it is assumed that labor will continue to be drawn from the various areas in the current percentages. These percentages, estimated by project staff, are presented in Exhibit 3-4. Note that for all tasks other than geological surveys, a large percentage of workers at present, 50 to 100, are drawn from the Kenai itself. The concentration of projects in this area has slowly induced workers to move to the Kenai for long-term assignments and to avoid commuting. The remaining workers are drawn in roughly equal percentages, from Anchorage and the rest of the U.S. These represent more specialized workers and those hired for shorter term assignments. As a result, more specialized and shorter-term assignments such as geological surveys, off-shore pipeline construction, and major platform maintenance tend to utilize higher non-local labor percentages.

Exhibit 3-4: Estimated Percent of Production Employees By Place of Residence and Activity

Activity	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
	Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (if Near Labor Supply)	Kenai	Anchorage	Other U.S.
1. Geological Survey	25	25	50	25	25	50	0	25	25	50
2. Spill Contingency Response	100	0	0	100	0	0	0	100	0	0
3. Construct Exploration Shore Base	100	0	0	50	50	0	20	40	40	0
4. Operate Exploration Shore Base	100	0	0	50	50	0	20	40	40	0
5. Install Exploration Platform	90	10	0	40	40	20	0	40	40	20
6. Operate Exploration Platform	90	10	0	40	40	20	0	40	40	20
7. Drill Exploration Well	60	20	20	50	25	25	0	50	25	25
8. Construct Production Shore Base	100	0	0	50	50	0	20	40	40	0
9. Operate Production Shore Base	100	0	0	50	50	0	0	50	50	0
10. Install Production Platform	90	10	0	40	40	20	0	40	40	20
11. Operate Production Platform	90	10	0	40	40	20	0	40	40	20
12. Drill Production Well	70	20	10	60	20	20	0	60	20	20
13. Lay Offshore Pipeline	50	10	40	45	10	45	0	45	10	45
14. Lay Onshore Pipeline	80	15	5	60	15	25	0	60	15	25
15. Construct Onshore Production Facility	70	15	15	40	45	15	0	40	45	15
16. Operate Production Facility	80	15	5	15	65	20	10	10	60	20
17. Construct Marine Terminal	80	15	5	40	45	15	0	40	45	15
18. Operate Marine Terminal	80	15	5	15	65	20	10	10	60	20
19. Major Platform Maintenance	50	30	20	20	50	30	0	10	50	30
20. Well Workover	70	20	10	60	20	20	0	60	20	20
21. Helicopter Support	90	10	0	50	50	0	10	40	50	0
22. Large Workboat	60	30	10	40	40	20	20	30	30	20
23. Small Workboat	60	30	10	40	40	20	20	30	30	20
24. Landing Craft	60	30	10	40	40	20	20	30	30	20
25. Dive Boat	60	30	10	40	40	20	20	30	30	20
26. Camp Support	85	10	5	45	50	5	10	40	45	5

Labor percentages outside of the Cook Inlet are more hypothetical due to the lack of actual examples. (See the discussion of the MMS Planning Areas in Chapter 2 and the section entitled “Overview of Cook Inlet and Gulf of Alaska.”) However, it is the opinion of expert project staff, that these projects will draw labor from the existing areas. In addition, it is further hypothesized that at least in the short run, these workers will tend to commute, due to the remote location of these projects. However, projects that are near some labor supplies or town will tend to draw some local relatively unskilled labor and will cause some experienced oil and gas industry personnel to relocate. For that reason, two separate sets of estimates were made for projects that are remote from current development. The first set is for projects that are both remote from current development and remote from any significant population centers. The second set is for projects that are remote from current development, but are located near a source of labor supply and housing.

While in some cases labor will be flown in for the early work and then workers may settle locally for operations, this process may not always occur for the remotest areas and for the more specialized technical tasks. For example, for Cook Inlet projects, workers have settled on the Kenai, while resettlement to the Arctic areas has been rare. Similarly, activities such as construction will have higher local percentages than operations.

Exhibit 3-4 also provides employee place of residence percentages for these types of projects. For remote projects, the pattern of residence is somewhat similar to that for the Cook Inlet projects, except that the percentages of labor supply have shifted away from the Kenai and towards Anchorage and the rest of the United States. For remote projects near a labor supply, the pattern for remote projects holds, with the exception that selected tasks are assumed to draw 10-20 percent of their workforce from the local area. Labor supplies near remote projects in the Gulf of Alaska would be the communities of Ualdey, Condova, Yukutat and possibly other communities in southeast Alaska.

3.5 ESTIMATES OF SPENDING BY GEOGRAPHIC REGION

As discussed above, where an employee spends his/her income will depend to a large extent on where their primary place of residence is located. Since food and lodging are part of a commuting employee's total compensation package, it is unlikely that non-residents will spend much of their disposable income in the project area. This is especially true given the long hours of work and minimum amount of time for personal leisure. Study team members with extensive experience working in the area estimate that perhaps 5-15 percent of total income of commuting employees is spent at local businesses. Some of these are “portable” businesses operating on barges that move along with the E&D projects. Since most employees make in the range of \$500 per day, it is assumed that \$25 to \$75 per day is spent on locally provided goods and services.

Full time local residents, on the other hand, will be inclined to spend most of their disposable income in the local area. The extent of those expenditures in the local area will depend upon cultural factors and the availability of goods and services. Since there is little or no manufacturing in many local areas, the impacts of personal consumption there will be felt primarily in the retail, wholesale, transportation, and service sectors. Expert project staff

estimated for each category of project location (Cook Inlet and Shelikof Strait, Gulf of Alaska near population centers) the percentages spent in each area for workers who reside in each area. These percentages are provided in Exhibit 3-5.

Exhibit 3-5: Estimated Percent of Spending By Place of Full-Time Residence

Place of Full-Time Residence	Place of Spending by Project Location										
	Cook Inlet Projects			Remote Projects				Remote Projects Near Population Center			
	Kenai	Anchorage	Other U.S.	Local	Kenai	Anchorage	Other U.S.	Local	Kenai	Anchorage	Other U.S.
Remote Area								100	0	0	0
Kenai	85	10	5	5	80	10	5	10	80	5	5
Anchorage	10	85	5	5	0	90	5	10	0	85	5
Other U.S.	15	5	80	5	0	5	90	10	0	5	85

In stimulating the PCE vectors in IMPLAN, it may be desirable to modify these vectors to take into account the atypical expenditure patterns of these employees. For example, in the state model, the food and lodging expenditures of non-residents can be adjusted downward to avoid potential double counting of the food and lodging provided as compensation.

3.6 ESTIMATES OF TAXES, SAVINGS AND PERSONAL CONSUMPTION EXPENDITURES

Once employees are paid wages, they will pay taxes, save a small part of these wages, and then spend the rest on goods and services, generating induced impacts. To capture the induced impacts, the wages will need to be converted into disposable income which can then be used to stimulate IMPLAN's PCE vectors. Note that wages as defined here include fringe benefits, which is compatible with IMPLAN PCE definitions and standard I-O model conventions.

For the purposes of this study, disposable wages are calculated by reducing Total Personal Income by 20.5 percent. Of this, 2 percent reflects savings. This figure was estimated from a trend analysis of personal income data published in the U.S. Statistical Abstract and compiled by the U.S. Bureau of Economic Analysis. Due to the modeling complexities involved and the speed at which financial capital can move across geographic boundaries, IMPAK currently does not provide a way for estimating the regional economic impacts associated with savings. However, the amounts devoted to savings, by residence, are provided on the output screens and can be used along with other resources to develop estimates of such impacts.

The combination of taxes paid to local, state and federal government entities reflects the remaining 18.5 percent. These payments, captured in the model by multiplying tax rate parameters by estimates of total personal income, are used to stimulate the government expenditure vectors (See the "Government" section in 7.3.1 for more details).

As an input into the IMPLAN modeling system, the estimates of PCE can be used to estimate the induced impacts that are generated as employees spend their earnings. The preferred way to estimate such impacts would be to allocate IMPAK's PCE estimates to consumer bundles using IMPLAN's PCE data to develop the allocation ratios. The resulting vectors would then be used to stimulate the outputs of the associated industries in IMPLAN. Note that IMPLAN provides PCE vectors for several different income groups. Therefore, it will be up to the analyst running

the IMPLAN model to allocate disposable income to these income groups, or to assume that all employees fall within the same income group.

In addition, the analyst should be aware that IMPAK's PCE estimates reflect where goods are purchased, not where they are produced. As such, the estimates are different than the business expenditure estimates, which do indicate not only where a good is produced but also where the associated margins accrue. This means that the two types of expenditures will have to be handled differently when they are input into IMPLAN. With IMPAK's business expenditures, the user should not use IMPLAN to apply either margins or RPCs to the expenditure inputs. However, just the opposite is the case with IMPAK's PCE estimates, which do need to be converted into margins and further divided into production regions.

In some cases it seems as if we have already allocated PCE to consumer bundles since some of impacted sectors in IMPAK are "consumer oriented". This is only an appearance and is due to the fact that several activities (e.g., seismic surveys, production operations, and camp support) involve house-keeping operations that make purchases similar to those conducted by households. Like all other industry impacts reported on the output screens, these impacts are still direct impacts and will generate indirect impacts if used to stimulate IMPLAN.

3.7 FINAL ESTIMATES OF SPENDING BY AREA

In order to develop the final estimates of spending by area, estimates of wages by production and non-production workers are combined and then place of residence and place of spending percentages are applied and the results summed. The derivations of the final estimates are provided in Exhibit 3-6a, 3-6b and 3-6c.

Each of the three exhibits is roughly similar, except that they report results for the different areas of potential project location. Exhibit 3-6a presents results for the Cook Inlet. Exhibit 3-6b presents results for remote projects. Exhibit 3-6c presents results for remote projects near a population center.

In each exhibit production worker wages including fringe benefits are transcribed from Exhibit 3-1 and distributed to place of residence based on percentages from Exhibit 3-4. Non-production wages, which were already distributed by place of residence, are taken from Exhibit 3-3. Production and non-production worker wages are then summed to provide total wages by place of residence. These wages are then converted to spending by area based on the percentages from Exhibit 3-5.

3.8 OTHER EMPLOYEE RELATED COSTS

In addition to direct compensation, several contractors provided estimates of additional employee related costs such as housing and meals for commuting employees. While these costs are theoretically not part of employee compensation, but rather part of overhead costs, their levels are dependent upon the numbers and of employees and are therefore most accurately estimated

along with employee compensation. They are assumed not to be included in Bureau of the Census’ estimates of fringe benefits and are coded directly to the appropriate IMPLAN sectors.

Interviews with several contractors conducted for this study revealed employee related costs of \$68.00 per day for food and lodging at local hotels and \$37.50 per day on the platforms. These overhead costs are assumed to apply to only production personnel working on-site who do not normally reside in the local area. They are housed at hotel type facilities that provide meals including a bag lunch. Employees who reside locally normally commute to the job site on a daily basis and prepare their own meals and lunches.

Exhibit 3-7 provides estimates of production worker camp expenses. First, place of residence by activity is provided. Workers in all tasks are assumed to reside at the camp with the exception of the platform and drilling related tasks. For the production and marine terminal activities the camp may be located on-site. Next, the number of man-nights is calculated as the product of the typical number of days in a workweek for the activity and the number of production worker man weeks for the activity. The number of room nights is then derived by multiplying man-nights by the percent non-local work force. Camp spending is the product of room nights and the \$37.50 per night cost. Camp spending is calculated separately for Cook Inlet projects and remote projects both near and not near a local labor supply.

Exhibit 3-7: Calculation of Production Worker Lodging Expenses

Activity	Place of Residence for Non-Local Production Employees	Days/Week	Production Worker Man-Weeks	Man-Nights	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply		
					Non-Local Work Force (%)	Number of Room Nights	Camp Spending	Non-Local Work Force (%)	Number of Room Nights	Camp Spending	Non-Local Work Force (%)	Number of Room Nights	Camp Spending
1. Geological Survey	Camp	7	124.3	870.0	75	652.50	24,469	100	870.00	59,160	100	870.00	59,160
2. Spill Contingency Response	Camp	5	104.0	520.0	-	-	-	100	520	35,360	100	520	35,360
3. Construct Exploration Shore Base	Camp	5	312.0	1560.0	-	-	-	100	1,560	106,080	80	1,248	84,864
4. Operate Exploration Shore Base	Camp	5	312.0	1560.0	-	-	-	100	1,560	106,080	80	1,248	84,864
5. Install Exploration Platform	Platform	7	205.0	1435.0	10	144	5,381	100	1,435	53,813	100	1,435	53,813
6. Operate Exploration Platform	Platform	7	468.0	3276.0	10	328	12,285	100	3,276	122,850	100	3,276	122,850
7. Drill Exploration Well	Platform	7	205.7	1440.0	40	576	21,600	100	1,440	54,000	100	1,440	54,000
8. Construct Production Shore Base	Camp	5	624.0	3120.0	-	-	-	100	3,120	212,160	80	2,496	169,728
9. Operate Production Shore Base	Camp	5	624.0	3120.0	-	-	-	100	3,120	212,160	100	3,120	212,160
10. Install Production Platform	Platform	7	1784.6	12492.0	10	1,249	46,845	100	12,492	468,450	100	12,492	468,450
11. Operate Production Platform	Platform	7	450.0	3150.0	10	315	11,813	100	3,150	118,125	100	3,150	118,125
12. Drill Production Well	Platform	7	96.4	675.0	30	203	7,594	100	675	25,313	100	675	25,313
13. Lay Offshore Pipeline	Camp	6	16.0	96.2	50	48	3,270	100	96	6,540	100	96	6,540
14. Lay Onshore Pipeline	Camp	6	7.5	45.3	20	9	615	100	45	3,077	100	45	3,077
15. Construct Onshore Production Facility	Camp	6	18512.0	111072.0	30	33,322	2,265,869	100	111,072	7,552,896	100	111,072	7,552,896
16. Operate Production Facility	Camp	7	1144.0	8008.0	20	1,602	108,909	100	8,008	544,544	90	7,207	490,090
17. Construct Marine Terminal	Camp	6	14741.3	88448.1	20	17,690	1,202,894	100	88,448	6,014,471	100	88,448	6,014,471
18. Operate Marine Terminal	Camp	7	1456.0	10192.0	20	2,038	138,611	100	10,192	693,056	90	9,173	623,750
19. Major Platform Maintenance	Platform	7	212.6	1488.0	50	744	27,900	100	1,488	55,800	90	1,339	50,220
20. Well Workover	Platform	7	34.3	240.0	30	72	2,700	100	240	9,000	100	240	9,000
21. Helicopter Support	Camp	5	0.1	0.4	10	0	3	100	0	28	90	0	25
22. Large Workboat	Camp	5	0.2	0.8	40	0	23	100	1	57	80	1	45
23. Small Workboat	Camp	5	0.1	0.7	40	0	20	100	1	50	80	1	40
24. Landing Craft	Camp	5	0.1	0.5	40	0	14	100	1	36	80	0	29
25. Dive Boat	Camp	5	0.1	0.6	40	0	17	100	1	43	80	1	34
26. Camp Support	Camp	5	416.0	2080.0	15	312	21,216	100	2,080	141,440	90	1,872	127,296

3.9 CONVERSION FACTORS

In some instances, analysts may wish to produce estimates of the amount of production labor that is utilized or compare the estimates of production labor generated by the model with data from another source. For this purpose a set of conversion factors, provided in Exhibit 3-8, were developed that allow the model to convert estimates of production labor from person-weeks to person-hours, person-days or person-years. These estimates are developed by activity and are based on the schedules for the majority of workers within that activity. Note that in the Arctic

model, conversion factors by activity were not necessary as the vast majority of the workers operated under the same schedule.

Exhibit 3-8: Conversion Factors for Calculation of Production Worker Man-Hours, Man-Days, Man Weeks and ManYears			
Activity	Hours/ Day	Days/ Week	Weeks/ Year
1. Geological Survey	12	7	52
2. Spill Contingency Response	8	5	52
3. Construct Exploration Shore Base	8	5	52
4. Operate Exploration Shore Base	8	5	52
5. Install Exploration Platform	12	7	52
6. Operate Exploration Platform	12	7	26
7. Drill Exploration Well	12	7	26
8. Construct Production Shore Base	8	5	52
9. Operate Production Shore Base	8	5	52
10. Install Production Platform	12	7	26
11. Operate Production Platform	12	7	26
12. Drill Production Well	12	7	26
13. Lay Offshore Pipeline	12	6	52
14. Lay Onshore Pipeline	10	6	52
15. Construct Onshore Production Facility	10	6	52
16. Operate Production Facility	12	7	26
17. Construct Marine Terminal	10	6	52
18. Operate Marine Terminal	12	7	26
19. Major Platform Maintenance	12	7	52
20. Well Workover	12	7	26
21. Helicopter Support	8	5	52
22. Large Workboat	10	5	52
23. Small Workboat	10	5	52
24. Landing Craft	10	5	52
25. Dive Boat	10	5	52
26. Camp Support	8	5	52

4 PURCHASED SERVICES

Purchases from service sectors represent overhead types of costs that are usually not separately specified in the type of engineering cost estimates used in this study. If they are considered, they are generally lumped together in a common overhead category. Moreover, while these purchases are part of the real costs of doing business, no data is available to directly allocate them to the different activities. Part of the problem is that these costs represent common overhead components. The amount of advertising that is purchased by a large oil company, for example, is probably fairly independent of the miles of pipelines constructed, but is probably somewhat related to gallons of oil produced. On the other hand, a smaller company specializing in pipeline construction, although likely to have a small advertising budget, is likely to have spending fairly related to the miles of pipelines it constructs in a year.

The assignment of these costs by area is also problematic. The oil and gas industry is an amalgamation of a large number of companies, not just the big oil companies. For example, the 1992 Census of Mineral Industries, U.S. Department of Commerce, estimates that almost 17,000 companies were involved in the Crude Petroleum and Natural Gas and Oil and Gas Field Services industries. Therefore, one can not simply ask the large oil companies where they spend their overhead dollar, even assuming they would be willing to provide an answer. Instead, estimates must be made of where the aggregate of all companies make their expenditures.

4.1 NATIONAL INPUT/OUTPUT DATA

As discussed above, most major inputs to the IMPAK model were estimated based on information on cost and quantity gathered in the industry interviews or based on the expert engineering knowledge of project staff. However, in order to determine what purchased services are utilized in quantities that are significant enough to warrant estimation, data from the latest national-level input-output table of the U.S. economy were tabulated and analyzed. The latest table available is for the year 1992, as developed by the U.S. Bureau of Economic Analysis, and published in September 1998. As the relationships between industries represented in the input output models change slowly over time, the slight lag in these data are of minimal importance. Moreover, the data are used to calculate percentages rather than absolute values. While there maybe some changes in the absolute levels of the data over time, the percentages will not change significantly. Data from this table are tabulated and presented in Exhibits 4-1 and 4-2.

The data for the oil and gas industry, provided in Exhibit 4-1 are used for all of the activities except for camp support, helicopter support and boat support. These activities are secondary support activities that are not part of the oil and gas industry as traditionally defined by input-output models. As a result, purchased services data for these activities were based on the input-output data for hotels, air transport, and water transport, respectively. These data are shown in Exhibit 4-2.

Exhibit 4-1: Selected Oil and Gas Industry Input Data From the 1992 BEA Input-Output Table for All E&D Activities Except those Relating to Water Transport, Air Transport and Hotels (\$, Millions)					
BEA I-O Industry Number	BEA I-O Industry Name	BEA #8.0001 Mining: Crude Petroleum and Natural Gas	BEA #11.0601 Construction: Petroleum and Natural Gas Well Drilling	BEA #11.0602 Construction: Petroleum, Natural Gas, and Solid Mineral Exploration	BEA #12.0215 Construction: Maintenance and Repair of Petroleum and Natural Gas Wells
MAJOR INTERMEDIATE INPUTS					
27.0100	Industrial inorganic and organic chemicals	853	394	7	25
27.0406	Chemicals and chemical preparations, n.e.c.	321	62	1	4
29.0203	Polishes and sanitation goods	5	0	0	27
31.0101	Petroleum refining	386	254	25	14
31.0102	Lubricating oils and greases	244	81	1	0
31.0200	Asphalt paving mixtures and blocks	0	0	0	23
36.0100	Cement, hydraulic	187	88	0	33
36.1100	Concrete products, except block and brick	0	0	0	14
36.1900	Minerals, ground or treated	0	108	0	3
37.0101	Blast furnaces and steel mills	1079	221	16	21
37.0103	Steel wiredrawing and steel nails and spikes	112	14	1	0
40.0400	Fabricated structural metal	19	138	7	9
42.0800	Pipe, valves, and pipe fittings	434	15	0	24
45.0100	Construction machinery and equipment	200	139	10	0
46.0300	Hoists, cranes, and monorails	0	0	0	16
50.0400	Industrial and commercial machinery and equipment, n.e.c.	157	127	0	0
53.0500	Relays and industrial controls	66	0	0	0
62.0200	Mechanical measuring devices	1	22	7	0
65.0100	Railroads and related services	99	76	0	7
65.0200	Local and suburban transit and interurban highway passenger transportation	61	6	1	1
65.0301	Trucking and courier services, except air	251	101	1	31
65.0400	Water transportation	264	32	0	1
65.0500	Air transportation	246	29	5	6
66.0100	Telephone and telegraph communications, and communications services, n.e.c.	196	45	11	4
68.0100	Electric services (utilities)	1626	55	12	8
68.0201	Natural gas transportation	2303	0	0	0
68.0202	Natural gas distribution	518	103	10	0
68.0301	Water supply and sewerage systems	82	5	0	0
69.0100	Wholesale trade	935	301	10	40
69.0200	Retail trade, except eating and drinking	126	15	1	1
70.0100	Banking	567	64	9	12
70.0400	Insurance carriers	113	11	3	3
71.0201	Real estate agents, managers, operators, and lessors	521	85	24	11
71.0202	Royalties	16661	5	152	1
72.0101	Hotels	264	30	5	5
73.0103	Personnel supply services	154	18	3	3
73.0104	Computer and data processing	115	16	1	4
73.0111	Management and consulting services	135	17	3	3
73.0200	Advertising	128	25	5	4
73.0301	Legal services	980	93	9	4
73.0302	Engineering, architectural, and surveying services	874	0	0	0
73.0303	Accounting, auditing, and bookkeeping, and miscellaneous services, n.e.c.	28	5	0	15
74.0000	Eating and drinking places	312	35	6	7
75.0001	Automotive rental and leasing, without drivers	96	12	1	2
77.0501	Business associations and professional membership organizations	62	6	1	1
Total		31781	2853	348	387
INTRA-INDUSTRY PURCHASES					
8.0001	Crude petroleum and natural gas	20296	0	0	0
11.0601	Petroleum and natural gas well drilling	0	107	0	0
11.0602	Petroleum, natural gas and solid mineral exploration	0	0	63	0
12.0215	Maintenance and repair of petroleum and natural gas wells	1719	0	0	0
Total		22015	107	63	0
OTHER COMPONENTS OF OUTPUT					
80.0000	Noncomparable imports	1033	0	0	0
88.0000	Compensation of employees	14127	6529	1042	1019
89.0000	Indirect business tax and nontax liability	4729	515	56	37
90.0000	Other value added	30457	1337	143	201
Total		50346	8381	1241	1257
TOTAL OUTPUT		105369	11633	1673	1719
Percentage of all Inputs Accounted for		98.84%	97.49%	98.74%	95.64%
Percentage of all Intermediate Inputs Accounted for		96.28%	90.72%	94.31%	83.77%

Exhibit 4-2: Selected Miscellaneous Input Data from the 1992 BEA Input-Output Table for E&D Activities Relating to Water Transport, Air Transport and Hotels (\$, Millions)					
BEA I-O Industry Number	BEA I-O Industry Name	BEA # 65.0200 Local Transport	BEA # 65.0400 Water Transport	BEA # 65.0500 Air Transport	BEA # 72.0101 Hotels
MAJOR INTERMEDIATE INPUTS					
12.0300	Other maintenance and repair	-	-	-	1,390
19.0200	Housefurnishings, n.e.c.	-	-	-	483
31.0101	Petroleum refining	1,352	727	9,432	-
32.0100	Tires and inner tubes	135	-	-	-
32.0500	Rubber and plastics hose and belting	103	-	-	-
42.0800	Pipe, valves, and pipe fittings	151	-	-	-
43.0200	Internal combustion engines, n.e.c.	191	217	-	-
49.0200	Ball and roller bearings	177	184	-	-
59.0302	Motor Vehicle parts and accessories	374	-	-	-
60.0200	Aircraft and missile engines and engine parts	-	-	1,375	-
60.0400	Aircraft and missile equipment, n.e.c.	-	-	921	-
61.0100	Ship building and repairing	-	585	-	-
65.0301	Trucking and courier services, except air	269	-	-	279
65.0701	Freight forwarders and other transportation services	-	873	734	-
65.0702	Arrangement of passenger transportation	-	525	6,967	793
66.0100	Telephone and telegraph communications, and communications services, n.e.c.	346	-	1,204	363
66.0200	Cable and other pay television services	-	-	-	369
68.0100	Electric services (utilities)	-	-	-	1,830
68.0202	Natural gas distribution	-	-	-	318
68.0302	Sanitary services, steam supply, and irrigation systems	-	-	-	621
69.0100	Wholesale trade	1,120	505	1,462	402
69.0200	Retail trade, except eating and drinking	162	-	-	-
70.0100	Banking	169	469	601	1,670
70.0200	Credit agencies other than banks	-	526	784	1,335
70.0400	Insurance carriers	158	-	-	-
71.0201	Real estate agents, managers, operators, and lessors	301	877	1,425	1,353
73.0102	Services to dwellings and other buildings	-	-	-	619
73.0103	Personnel supply services	430	-	-	504
73.0104	Computer and data processing	-	280	2,224	341
73.0106	Detective and protective services	-	-	-	406
73.0107	Miscellaneous equipment rental and leasing	-	186	675	-
73.0109	Other business services	-	198	-	941
73.0111	Management and consulting services	-	911	-	971
73.0112	Testing and research labs	-	743	-	-
73.0200	Advertising	-	1,244	1,389	974
73.0301	Legal services	189	164	944	289
73.0302	Engineering, architectural, and surveying services	-	302	-	-
73.0303	Accounting, auditing, and bookkeeping, and miscellaneous services, n.e.c.	-	217	-	-
74.0000	Eating and drinking places	-	-	1,832	298
75.0001	Automotive rental and leasing, without drivers	325	-	-	-
78.0100	U.S. Postal Service	-	-	-	264
Total		5,952	9,733	31,969	16,813
INTRA-INDUSTRY PURCHASES					
65.0200	Local transportation	-	-	-	-
65.0400	Water transportation	-	4,282	-	-
65.0500	Air transportation	-	-	6,064	-
72.0101	Hotels	-	-	-	-
Total		0	4282	6064	0
OTHER COMPONENTS OF OUTPUT					
80.0000	Noncomparable imports	-	2,954	8,827	-
88.0000	Compensation of employees	8,704	7,140	32,761	19,934
89.0000	Indirect business tax and nontax liability	169	583	5,696	4,999
90.0000	Other value added	3,515	5,073	3,709	6,159
Total		12388	15750	50993	31092
TOTAL OUTPUT		20166	32440	94141	52407
Percentage of all Inputs Accounted for		90.95%	91.75%	94.57%	91.41%
Percentage of all Intermediate Inputs Accounted for		76.52%	78.44%	86.21%	78.88%

As shown in Exhibit 4-1 under column headings, the various activities that comprise the oil and gas industry are subsumed within four sectors in the national I-O table. The largest of these sectors is mining Sector 8.0001, Crude Petroleum and Natural Gas. The three smaller sectors are

all construction industries. These include Sector 11.0601 (Petroleum and Natural Gas Well Drilling), Sector 11.0602 (Petroleum, Natural Gas, and Solid Mineral Exploration), and Sector 12.0215 (Maintenance and Repair of Petroleum and Natural Gas Wells).

Of these four sectors, the total output for the mining sector, Crude Petroleum and Natural Gas, is far larger than the others combined with output of over \$100 billion. This compares to total output of just over \$10 billion for Petroleum and Natural Gas Well Drilling sector and between \$1 and \$2 billion for the other two sectors.

Exhibit 4-1 provides the dollars of purchases for all input sectors that accounted for at least one half of one percent of industry output for any of the four sectors. In total, there were 53 sectors that met these criteria. Note that as shown at the bottom of Exhibit 4-1, the purchases from these 53 sectors account for 96 to 99 percent of the total purchases of the four oil and gas sectors.

Many of these sectors were not relevant in the analysis of purchased services and were therefore dropped from the analysis. These sectors can be classified into seven groups. One such group of sectors is those that represent intra-industry purchases, such as the purchases the Crude Petroleum and Natural sector makes from itself and the other three oil and gas sectors listed in the table.

A second group of sectors includes those that represent other components of output such as compensation of employees, and non-comparable imports. Estimates for these sectors were made from primary sources. Non-comparable imports are estimated as foreign purchased equipment.

A third set of industries that are not important in the analysis of purchased services are those that are often referred to as margin industries. In input-output analysis, the value of a purchase is apportioned among the amount paid for the actual good, the amount paid others to transport, and wholesale and retail the good. Examples of margin industries in the BEA I-O table that are shown in Exhibit 4-2 include Trucking (industry code 65.0301), Freight Forwarders (industry code 65.0701) and Wholesale Trade (industry code 69.0100). While the values of purchases from these sectors are estimated as part of this study, these estimates are derived and subtracted from the estimates made for purchases of capital and materials. The estimation of capital and material purchases and the assignment of transport, wholesale and retail margins are provided in Chapter 5.

A fourth set of sectors are selected utility sectors such as electricity, natural gas, and water and sewer. Since the oil and gas production in Alaska is so isolated, the production process normally generates its own power and waste disposal and does not separately purchase these inputs.

A fifth set of industries are those that supply or are related to the capital goods that are purchased. Capital goods purchases from these sectors are derived from primary data sources and are discussed in Chapter 5.

A sixth set of industries are those that provide material inputs. These include the following sectors:

- 27.0100 Industrial inorganic and organic chemicals
- 27.0406 Chemicals and chemical preparations, n.e.c.
- 29.0203 Polishes and sanitation goods
- 31.0101 Petroleum refining
- 31.0102 Lubricating oils and greases
- 31.0200 Asphalt paving mixtures and blocks
- 36.0100 Cement, hydraulic
- 36.1100 Concrete products, except block and brick
- 36.1900 Minerals, ground or treated

These inputs are also derived from primary sources and are discussed in Chapter 5, Section 5.2.

Two final sectors that were eliminated were sectors 89.0000 Indirect Business Taxes and 71.0202 Royalties. The calculation of the values associated with these sectors is addressed in Section 7.3.1 under “Government.”

After eliminating these seven types of sectors, the 16 sectors that remain are considered to be the types of sectors supplying the purchased services that are of interest here. These include the following BEA I-O codes and sectors:

- 66.0100 Telephone and telegraph communications, and communications services, n.e.c.
- 70.0100 Banking
- 70.0400 Insurance carriers
- 71.0201 Real estate agents, managers, operators, and lessors
- 72.0101 Hotels
- 73.0103 Personnel supply services
- 73.0104 Computer and data processing
- 73.0111 Management and consulting services
- 73.0200 Advertising
- 73.0301 Legal services
- 73.0302 Engineering, architectural, and surveying services
- 73.0303 Accounting, auditing, and bookkeeping, and miscellaneous services, n.e.c.
- 74.0000 Eating and drinking places
- 75.0001 Automotive rental and leasing, without drivers
- 77.0501 Business associations and professional membership organizations
- 90.0000 Other value added.

As was the case with the oil and gas input-output sectors, Exhibit 4-2 provides information for inputs that accounted for at least one half of one percent. The list of included sectors is slightly different than for Exhibit 4-1. Once again, sectors that were not considered purchased services were eliminated from consideration.

4.2 THE CALCULATION OF TOTAL PURCHASED SERVICES

The calculation of total overhead or purchased services expenditures is based on the ratio of these expenditures to labor compensation. The choice of labor compensation is based on the relative quality of the labor data and the availability of labor data for all of the activities including the secondary, non-oil and non-gas industry sectors.

Exhibits 4-3 and 4-4 list the purchased services sectors and their ratio to labor compensation from the national input-output tables. The BEA I-O sector number and name is provided along with the corresponding IMPLAN sector number. Exhibit 4-3 provides this data all E&D activities except those relating to water transportation, air transportation and hotels. Exhibit 4-4 provides this data for R&D support activities relating to the water, air, and hotel sectors. The ratios provided in these exhibits are multiplied by the total labor compensation for each of the activities to generate estimates of purchased services inputs.

Exhibit 4-3: Percentage Estimates of Purchased Services by Sector and Geographic Area for All E&D Activities Except Those Relating to Water Transport, Air Transport, and Hotels

BEA I-O Sector Number	BEA I-O Sector Name	Corresponding IMPLAN Sector	Percent of Labor Compensation	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	1.13	70	20	10	20	60	20	40	10	30	20
70.0100	Banking	456	2.87	70	20	10	5	60	35	32.5	2.5	30	35
70.0400	Insurance carriers	459	0.57	70	20	10	5	60	35	32.5	2.5	30	35
71.0201	Real estate agents	462	2.82	70	20	10	5	60	35	32.5	2.5	30	35
72.0101	Hotels	463	1.34	60	20	20	5	50	45	27.5	2.5	25	45
73.0103	Personnel supply	474	0.78	60	20	20	5	50	45	27.5	2.5	25	45
73.0104	Computers & data processing	475	0.60	70	20	10	5	60	35	32.5	2.5	30	35
73.0111	Management & consulting	508	0.70	20	50	30	10	50	40	30	5	25	40
73.0200	Advertising	469	0.71	40	40	20	0	40	60	20	0	20	60
73.0301	Legal services	494	4.78	50	30	20	5	60	35	32.5	2.5	30	35
73.0302	Engineering, architectural & surveying	506	3.85	50	30	20	5	60	35	32.5	2.5	30	35
73.0303	Accounting, auditing & bookkeeping	507	0.21	50	30	20	5	60	35	32.5	2.5	30	35
74.0000	Eating & drinking places	454	1.58	50	30	20	5	60	35	32.5	2.5	30	35
75.0001	Automotive rental & leasing	477	0.49	40	20	40	10	40	50	25	5	20	50
77.0501	Associations & professional org.	503	0.31	20	30	50	0	40	60	20	0	20	60
90.0000	Other value added	n.a.	141.47	10	10	80	0	20	80	10	0	10	80

Exhibit 4-4: Percentage Estimates of Purchased Services by Sector and Geographic Area for E&D Support Activities Relating to Water Transport, Air Transport, and Hotels

BEA I-O Sector Number	BEA I-O Sector Name	Corresponding IMPLAN Sector	Percent of Labor Compensation			Cook Inlet Projects			Remote Projects			Remote Projects	
			65.0400 Water Transport	65.0500 Air Transport	72.0101 Hotels	Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai
66.0100	Telephone communications	441	-	3.68	1.82	70	20	10	20	60	20	40	10
66.0200	Cable TV	441	-	-	1.85	15	-	15	70	10	20	70	15
70.0100	Banking	456	6.57	1.83	8.38	70	20	10	5	60	35	32.5	2.5
70.0200	Credit agencies	457	7.37	2.39	6.70	70	20	10	5	60	35	32.5	2.5
70.0400	Insurance carriers	459	-	-	-	70	20	10	5	60	35	32.5	2.5
71.0201	Real estate agents	462	12.28	4.35	6.79	70	20	10	5	60	35	32.5	2.5
73.0102	Services to dwellings/buildings	472	-	-	3.11	60	20	20	5	50	45	27.5	2.5
73.0103	Personnel supply	474	-	-	2.53	60	20	20	5	50	45	27.5	2.5
73.0104	Computers & data processing	475	3.92	6.79	1.71	70	20	10	5	60	35	32.5	2.5
73.0106	Detective services	476	-	-	2.04	50	30	20	5	60	35	32.5	2.5
73.0107	Equipment rental & leasing	473	2.61	2.06	-	50	30	20	5	45	50	25	2.5
73.0109	Other business services	470	2.77	-	4.72	50	30	20	5	60	35	32.5	2.5
73.0111	Management & consulting	508	12.76	-	4.87	20	50	30	10	50	40	30	5
73.0112	Testing and research labs	509	10.41	-	-	40	20	40	5	25	70	15	2.5
73.0200	Advertising	469	17.42	4.24	4.89	40	40	20	0	40	60	20	0
73.0301	Legal services	494	2.30	2.88	1.45	50	30	20	5	60	35	32.5	2.5
73.0302	Engineering, architectural & surveying	506	4.23	-	-	50	30	20	5	60	35	32.5	2.5
73.0303	Accounting, auditing & bookkeeping	507	3.04	-	-	50	30	20	5	60	35	32.5	2.5
74.0000	Eating & drinking places	454	-	5.59	1.49	50	30	20	5	60	35	32.5	2.5
75.0001	Automotive rental & leasing	477	-	-	-	40	20	40	10	40	50	25	5
78.0100	U.S. Postal Service	513	-	-	1.32	60	20	20	10	60	30	35	5
90.0000	Other value added	n.a.	71.05	11.32	30.90	0	20	80	0	20	80	10	0

4.3 INVESTMENT FINANCE CHARGES

Note that one BEA sector, "Other Value Added", is not assigned directly to an IMPLAN sector. This category is comprised of capital depreciation and finance charges. Mining industries are

different from other production oriented industries (e.g., manufacturing) in that they are very capital intensive and a large percentage of their total expenditures falls under research and development (R&D), which can be capitalized. As a result, mining industries incur relative high finance charges to cover these capital and R&D expenditures. In the National Input-Output Accounts, these types of finance charges are grouped with depreciation charges under the category called "Other Value Added."

In Chapter 5, capital depreciation was explicitly addressed by spreading equipment expenditures over the lives of the assets and taking into account usage rates. To account for finance charges, we started by calculating total other value added for each activity. This was accomplished by multiplying each activity's employee compensation estimate by a corresponding ratio of Other Value Added to Employee Compensation (calculated using the National Input-Output tables). The results were then divided in half to eliminate the depreciation charges (this is based on the assumption that finance charges are paid monthly over a 20 year period at an 8 percent interest rate). The resulting interest payments were further divided and assigned to the sources of the funds. Some of the charges reflect a return to personal savings and were assigned to PCE accordingly. The remaining charges represent returns to financial service industries and were distributed between the banking industry (IMPLAN sector 456), credit agencies (IMPLAN Sector 457) and security/commodity brokers (IMPLAN sector 458).

It should be noted that some of the finance charges occur only in one time period whereas others span a number of years. This is to be expected and reflects the different nature of capital investments being financed. The first case is generally associated with the use of equipment to carry out a specific project: for example, using a bulldozer to help build an ice road. In this example, a small fraction of the total finance charges the contractor incurred when he purchased the bulldozer are expensed to the project based upon how much the machine is used. Finance charges paid over multiple years include not only equipment usage, but also the capitalization of labor, materials and installed equipment needed to conduct research and development. In IMPAK, such charges are tied to oil production operations.

4.4 PURCHASED SERVICES BY GEOGRAPHIC AREA

The estimates of purchased services by activity and IMPLAN sector are then split among the local area, the rest of Alaska and the 49 states. This disaggregation is based on percentage distributions developed by engineering study staff, based on their familiarity with the area and the production process. These percentages are provided in Exhibits 4-3 and 4-4. The percentage estimates provided in Exhibit 4-3 are for all E&D activities except those relating to water transportation, air transportation and hotels. Those in Exhibit 4-4 provides this data for R&D support activities relating to the water, air, and hotel sectors. In each exhibit, separate percentages are provided for projects located in the Cook Inlet, remote locations and remote location near areas of labor availability.

The costs of purchased services are assumed to be the same regardless of the location of the project. This is because the bulks of these costs are assumed to be of the overhead variety and are thus assumed to occur where the operations and/or headquarters of the enterprises are

located. Note that in the remote scenario, all of these costs are assumed to remain in the Kenai, Anchorage or the Other U.S. For a remote operation near a population center, some of the costs are assumed to be switched to the local area, as companies set up local operations offices.

4.5 FINAL ESTIMATES OF PURCHASED SERVICES

The final estimates of purchased services inputs by E&D activity, input sector and geographic area are found by multiplying the national input-output ratios by the labor compensation calculated for sub-arctic Alaska and the percentages for geographic areas. These final estimates are provided in Exhibit 4-5. Exhibit 4-5 includes a specific table of results for each of the 26 E&D activities included in the IMPAK model with the exception of the abandonment activity which is based on a combination of data from the platform installation and well workover activities.

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 1. Geological Survey

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	2,910	2,037	582	291	582	1,746	582	1,164	291	873	582
70.0100	Banking	456	7,411	5,188	1,482	741	371	4,447	2,594	2,409	185	2,223	2,594
70.0400	Insurance carriers	459	1,478	1,034	296	148	74	887	517	480	37	443	517
71.0201	Real estate agents	462	7,286	5,100	1,457	729	364	4,372	2,550	2,368	182	2,186	2,550
72.0101	Hotels	463	3,456	2,073	691	691	173	1,728	1,555	950	86	864	1,555
73.0103	Personnel supply	474	2,023	1,214	405	405	101	1,012	911	556	51	506	911
73.0104	Computers & data processing	475	1,546	1,082	309	155	77	928	541	502	39	464	541
73.0111	Management & consulting	508	1,796	359	898	539	180	898	718	539	90	449	718
73.0200	Advertising	469	1,841	737	737	368	-	737	1,105	368	-	368	1,105
73.0301	Legal services	494	12,345	6,172	3,703	2,469	617	7,407	4,321	4,012	309	3,703	4,321
73.0302	Engineering, architectural & surveying	506	9,935	4,967	2,980	1,987	497	5,961	3,477	3,229	248	2,980	3,477
73.0303	Accounting, auditing & bookkeeping	507	546	273	164	109	27	327	191	177	14	164	191
74.0000	Eating & drinking places	454	4,092	2,046	1,228	818	205	2,455	1,432	1,330	102	1,228	1,432
75.0001	Automotive rental & leasing	477	1,262	505	252	505	126	505	631	315	63	252	631
77.0501	Associations & professional org.	503	796	159	239	398	-	318	477	159	-	159	477
90.0000	Other value added	n.a.	365,321	36,532	36,532	292,257	-	73,064	292,257	36,532	-	36,532	292,257
88.0000	Compensation of Employees	n.a.	258,230	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			69,480	51,955	302,609	3,394	106,791	313,860	55,092	1,697	53,395	313,860

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 2. Spill Contingency Response

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	1,459	1,021	292	146	292	875	292	583	146	438	292
70.0100	Banking	456	3,715	2,601	743	372	186	2,229	1,300	1,207	93	1,115	1,300
70.0400	Insurance carriers	459	741	519	148	74	37	444	259	241	19	222	259
71.0201	Real estate agents	462	3,653	2,557	731	365	183	2,192	1,278	1,187	91	1,096	1,278
72.0101	Hotels	463	1,732	1,039	346	346	87	866	780	476	43	433	780
73.0103	Personnel supply	474	1,014	609	203	203	51	507	456	279	25	254	456
73.0104	Computers & data processing	475	775	542	155	77	39	465	271	252	19	232	271
73.0111	Management & consulting	508	900	180	450	270	90	450	360	270	45	225	360
73.0200	Advertising	469	923	369	369	185	-	369	554	185	-	185	554
73.0301	Legal services	494	6,188	3,094	1,856	1,238	309	3,713	2,166	2,011	155	1,856	2,166
73.0302	Engineering, architectural & surveying	506	4,980	2,490	1,494	996	249	2,988	1,743	1,619	125	1,494	1,743
73.0303	Accounting, auditing & bookkeeping	507	274	137	82	55	14	164	96	89	7	82	96
74.0000	Eating & drinking places	454	2,051	1,026	615	410	103	1,231	718	667	51	615	718
75.0001	Automotive rental & leasing	477	633	253	127	253	63	253	316	158	32	127	316
77.0501	Associations & professional org.	503	399	80	120	199	-	160	239	80	-	80	239
90.0000	Other value added	n.a.	183,129	18,313	18,313	146,503	-	36,626	146,503	18,313	-	18,313	146,503
88.0000	Compensation of Employees	n.a.	129,446	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			34,829	26,044	151,693	1,701	53,532	157,333	27,617	851	26,766	157,333

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 3. Construct Exploration Shore Base

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	4,722	3,306	944	472	944	2,833	944	1,889	472	1,417	944
70.0100	Banking	456	12,027	8,419	2,405	1,203	601	7,216	4,210	3,909	301	3,608	4,210
70.0400	Insurance carriers	459	2,398	1,679	480	240	120	1,439	839	779	60	719	839
71.0201	Real estate agents	462	11,825	8,277	2,365	1,182	591	7,095	4,139	3,843	296	3,547	4,139
72.0101	Hotels	463	5,608	3,365	1,122	1,122	280	2,804	2,524	1,542	140	1,402	2,524
73.0103	Personnel supply	474	3,284	1,970	657	657	164	1,642	1,478	903	82	821	1,478
73.0104	Computers & data processing	475	2,509	1,756	502	251	125	1,505	878	815	63	753	878
73.0111	Management & consulting	508	2,915	583	1,457	874	291	1,457	1,166	874	146	729	1,166
73.0200	Advertising	469	2,988	1,195	1,195	598	-	1,195	1,793	598	-	598	1,793
73.0301	Legal services	494	20,033	10,017	6,010	4,007	1,002	12,020	7,012	6,511	501	6,010	7,012
73.0302	Engineering, architectural & surveying	506	16,123	8,061	4,837	3,225	806	9,674	5,643	5,240	403	4,837	5,643
73.0303	Accounting, auditing & bookkeeping	507	885	443	266	177	44	531	310	288	22	266	310
74.0000	Eating & drinking places	454	6,641	3,320	1,992	1,328	332	3,985	2,324	2,158	166	1,992	2,324
75.0001	Automotive rental & leasing	477	2,048	819	410	819	205	819	1,024	512	102	410	1,024
77.0501	Associations & professional org.	503	1,291	258	387	646	-	517	775	258	-	258	775
90.0000	Other value added	n.a.	592,849	59,285	59,285	474,279	-	118,570	474,279	59,285	-	59,285	474,279
88.0000	Compensation of Employees	n.a.	419,060	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			112,753	84,314	491,079	5,507	173,302	509,337	89,405	2,754	86,651	509,337

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 4. Operate Exploration Shore Base

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	4,722	3,306	944	472	944	2,833	944	1,889	472	1,417	944
70.0100	Banking	456	12,027	8,419	2,405	1,203	601	7,216	4,210	3,909	301	3,608	4,210
70.0400	Insurance carriers	459	2,398	1,679	480	240	120	1,439	839	779	60	719	839
71.0201	Real estate agents	462	11,825	8,277	2,365	1,182	591	7,095	4,139	3,843	296	3,547	4,139
72.0101	Hotels	463	5,608	3,365	1,122	1,122	280	2,804	2,524	1,542	140	1,402	2,524
73.0103	Personnel supply	474	3,284	1,970	657	657	164	1,642	1,478	903	82	821	1,478
73.0104	Computers & data processing	475	2,509	1,756	502	251	125	1,505	878	815	63	753	878
73.0111	Management & consulting	508	2,915	583	1,457	874	291	1,457	1,166	874	146	729	1,166
73.0200	Advertising	469	2,988	1,195	1,195	598	-	1,195	1,793	598	-	598	1,793
73.0301	Legal services	494	20,033	10,017	6,010	4,007	1,002	12,020	7,012	6,511	501	6,010	7,012
73.0302	Engineering, architectural & surveying	506	16,123	8,061	4,837	3,225	806	9,674	5,643	5,240	403	4,837	5,643
73.0303	Accounting, auditing & bookkeeping	507	885	443	266	177	44	531	310	288	22	266	310
74.0000	Eating & drinking places	454	6,641	3,320	1,992	1,328	332	3,985	2,324	2,158	166	1,992	2,324
75.0001	Automotive rental & leasing	477	2,048	819	410	819	205	819	1,024	512	102	410	1,024
77.0501	Associations & professional org.	503	1,291	258	387	646	-	517	775	258	-	258	775
90.0000	Other value added	n.a.	592,849	59,285	59,285	474,279	-	118,570	474,279	59,285	-	59,285	474,279
88.0000	Compensation of Employees	n.a.	419,060	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			112,753	84,314	491,079	5,507	173,302	509,337	89,405	2,754	86,651	509,337

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 5. Install Exploration Platform

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	6,363	4,454	1,273	636	1,273	3,818	1,273	2,545	636	1,909	1,273
70.0100	Banking	456	16,205	11,344	3,241	1,621	810	9,723	5,672	5,267	405	4,862	5,672
70.0400	Insurance carriers	459	3,231	2,262	646	323	162	1,939	1,131	1,050	81	969	1,131
71.0201	Real estate agents	462	15,932	11,152	3,186	1,593	797	9,559	5,576	5,178	398	4,780	5,576
72.0101	Hotels	463	7,556	4,534	1,511	1,511	378	3,778	3,400	2,078	189	1,889	3,400
73.0103	Personnel supply	474	4,424	2,655	885	885	221	2,212	1,991	1,217	111	1,106	1,991
73.0104	Computers & data processing	475	3,380	2,366	676	338	169	2,028	1,183	1,099	85	1,014	1,183
73.0111	Management & consulting	508	3,927	785	1,964	1,178	393	1,964	1,571	1,178	196	982	1,571
73.0200	Advertising	469	4,026	1,611	1,611	805	-	1,611	2,416	805	-	805	2,416
73.0301	Legal services	494	26,992	13,496	8,098	5,398	1,350	16,195	9,447	8,773	675	8,098	9,447
73.0302	Engineering, architectural & surveying	506	21,723	10,862	6,517	4,345	1,086	13,034	7,603	7,060	543	6,517	7,603
73.0303	Accounting, auditing & bookkeeping	507	1,193	597	358	239	60	716	418	388	30	358	418
74.0000	Eating & drinking places	454	8,948	4,474	2,684	1,790	447	5,369	3,132	2,908	224	2,684	3,132
75.0001	Automotive rental & leasing	477	2,759	1,104	552	1,104	276	1,104	1,379	690	138	552	1,379
77.0501	Associations & professional org.	503	1,740	348	522	870	-	696	1,044	348	-	348	1,044
90.0000	Other value added	n.a.	798,786	79,879	79,879	639,029	-	159,757	639,029	79,879	-	79,879	639,029
88.0000	Compensation of Employees	n.a.	564,628	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			151,921	113,602	661,664	7,420	233,502	686,265	120,461	3,710	116,751	686,265

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 6. Operate Exploration Platform

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	18,249	12,774	3,650	1,825	3,650	10,949	3,650	7,300	1,825	5,475	3,650
70.0100	Banking	456	46,478	32,535	9,296	4,648	2,324	27,887	16,267	15,105	1,162	13,943	16,267
70.0400	Insurance carriers	459	9,267	6,487	1,853	927	463	5,560	3,243	3,012	232	2,780	3,243
71.0201	Real estate agents	462	45,694	31,986	9,139	4,569	2,285	27,416	15,993	14,851	1,142	13,708	15,993
72.0101	Hotels	463	21,671	13,002	4,334	4,334	1,084	10,835	9,752	5,959	542	5,418	9,752
73.0103	Personnel supply	474	12,689	7,613	2,538	2,538	634	6,344	5,710	3,489	317	3,172	5,710
73.0104	Computers & data processing	475	9,695	6,786	1,939	969	485	5,817	3,393	3,151	242	2,908	3,393
73.0111	Management & consulting	508	11,263	2,253	5,632	3,379	1,126	5,632	4,505	3,379	563	2,816	4,505
73.0200	Advertising	469	11,548	4,619	4,619	2,310	-	4,619	6,929	2,310	-	2,310	6,929
73.0301	Legal services	494	77,416	38,708	23,225	15,483	3,871	46,450	27,096	25,160	1,935	23,225	27,096
73.0302	Engineering, architectural & surveying	506	62,304	31,152	18,691	12,461	3,115	37,382	21,806	20,249	1,558	18,691	21,806
73.0303	Accounting, auditing & bookkeeping	507	3,422	1,711	1,027	684	171	2,053	1,198	1,112	86	1,027	1,198
74.0000	Eating & drinking places	454	25,663	12,831	7,699	5,133	1,283	15,398	8,982	8,340	642	7,699	8,982
75.0001	Automotive rental & leasing	477	7,913	3,165	1,583	3,165	791	3,165	3,956	1,978	396	1,583	3,956
77.0501	Associations & professional org.	503	4,990	998	1,497	2,495	-	1,996	2,994	998	-	998	2,994
90.0000	Other value added	n.a.	2,290,975	229,098	229,098	1,832,780	-	458,195	1,832,780	229,098	-	229,098	1,832,780
88.0000	Compensation of Employees	n.a.	1,619,394	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			435,719	325,818	1,897,700	21,282	669,699	1,968,255	345,491	10,641	334,850	1,968,255

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 7. Drill Exploration Well

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	8,136	5,695	1,627	814	1,627	4,882	1,627	3,254	814	2,441	1,627
70.0100	Banking	456	20,722	14,505	4,144	2,072	1,036	12,433	7,253	6,735	518	6,217	7,253
70.0400	Insurance carriers	459	4,132	2,892	826	413	207	2,479	1,446	1,343	103	1,239	1,446
71.0201	Real estate agents	462	20,372	14,261	4,074	2,037	1,019	12,223	7,130	6,621	509	6,112	7,130
72.0101	Hotels	463	9,662	5,797	1,932	1,932	483	4,831	4,348	2,657	242	2,415	4,348
73.0103	Personnel supply	474	5,657	3,394	1,131	1,131	283	2,829	2,546	1,556	141	1,414	2,546
73.0104	Computers & data processing	475	4,322	3,026	864	432	216	2,593	1,513	1,405	108	1,297	1,513
73.0111	Management & consulting	508	5,022	1,004	2,511	1,506	502	2,511	2,009	1,506	251	1,256	2,009
73.0200	Advertising	469	5,149	2,059	2,059	1,030	-	2,059	3,089	1,030	-	1,030	3,089
73.0301	Legal services	494	34,515	17,258	10,355	6,903	1,726	20,709	12,080	11,217	863	10,355	12,080
73.0302	Engineering, architectural & surveying	506	27,777	13,889	8,333	5,555	1,389	16,666	9,722	9,028	694	8,333	9,722
73.0303	Accounting, auditing & bookkeeping	507	1,526	763	458	305	76	915	534	496	38	458	534
74.0000	Eating & drinking places	454	11,442	5,721	3,432	2,288	572	6,865	4,005	3,718	286	3,432	4,005
75.0001	Automotive rental & leasing	477	3,528	1,411	706	1,411	353	1,411	1,764	882	176	706	1,764
77.0501	Associations & professional org.	503	2,225	445	667	1,112	-	890	1,335	445	-	445	1,335
90.0000	Other value added	n.a.	1,021,411	102,141	102,141	817,129	-	204,282	817,129	102,141	-	102,141	817,129
88.0000	Compensation of Employees	n.a.	721,992	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			194,261	145,263	846,072	9,489	298,579	877,529	154,034	4,744	149,290	877,529

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 8. Construct Production Shore Base

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	10,322	7,225	2,064	1,032	2,064	6,193	2,064	4,129	1,032	3,097	2,064
70.0100	Banking	456	26,289	18,402	5,258	2,629	1,314	15,773	9,201	8,544	657	7,887	9,201
70.0400	Insurance carriers	459	5,242	3,669	1,048	524	262	3,145	1,835	1,704	131	1,573	1,835
71.0201	Real estate agents	462	25,846	18,092	5,169	2,585	1,292	15,507	9,046	8,400	646	7,754	9,046
72.0101	Hotels	463	12,258	7,355	2,452	2,452	613	6,129	5,516	3,371	306	3,064	5,516
73.0103	Personnel supply	474	7,177	4,306	1,435	1,435	359	3,589	3,230	1,974	179	1,794	3,230
73.0104	Computers & data processing	475	5,484	3,839	1,097	548	274	3,290	1,919	1,782	137	1,645	1,919
73.0111	Management & consulting	508	6,371	1,274	3,185	1,911	637	3,185	2,548	1,911	319	1,593	2,548
73.0200	Advertising	469	6,532	2,613	2,613	1,306	-	2,613	3,919	1,306	-	1,306	3,919
73.0301	Legal services	494	43,788	21,894	13,137	8,758	2,189	26,273	15,326	14,231	1,095	13,137	15,326
73.0302	Engineering, architectural & surveying	506	35,240	17,620	10,572	7,048	1,762	21,144	12,334	11,453	881	10,572	12,334
73.0303	Accounting, auditing & bookkeeping	507	1,935	968	581	387	97	1,161	677	629	48	581	677
74.0000	Eating & drinking places	454	14,515	7,258	4,355	2,903	726	8,709	5,080	4,718	363	4,355	5,080
75.0001	Automotive rental & leasing	477	4,476	1,790	895	1,790	448	1,790	2,238	1,119	224	895	2,238
77.0501	Associations & professional org.	503	2,822	564	847	1,411	-	1,129	1,693	564	-	564	1,693
90.0000	Other value added	n.a.	1,295,829	129,583	129,583	1,036,663	-	259,166	1,036,663	129,583	-	129,583	1,036,663
88.0000	Compensation of Employees	n.a.	915,967	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			246,453	184,290	1,073,383	12,038	378,798	1,113,291	195,418	6,019	189,399	1,113,291

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 9. Operate Production Shore Base

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	10,322	7,225	2,064	1,032	2,064	6,193	2,064	4,129	1,032	3,097	2,064
70.0100	Banking	456	26,289	18,402	5,258	2,629	1,314	15,773	9,201	8,544	657	7,887	9,201
70.0400	Insurance carriers	459	5,242	3,669	1,048	524	262	3,145	1,835	1,704	131	1,573	1,835
71.0201	Real estate agents	462	25,846	18,092	5,169	2,585	1,292	15,507	9,046	8,400	646	7,754	9,046
72.0101	Hotels	463	12,258	7,355	2,452	2,452	613	6,129	5,516	3,371	306	3,064	5,516
73.0103	Personnel supply	474	7,177	4,306	1,435	1,435	359	3,589	3,230	1,974	179	1,794	3,230
73.0104	Computers & data processing	475	5,484	3,839	1,097	548	274	3,290	1,919	1,782	137	1,645	1,919
73.0111	Management & consulting	508	6,371	1,274	3,185	1,911	637	3,185	2,548	1,911	319	1,593	2,548
73.0200	Advertising	469	6,532	2,613	2,613	1,306	-	2,613	3,919	1,306	-	1,306	3,919
73.0301	Legal services	494	43,788	21,894	13,137	8,758	2,189	26,273	15,326	14,231	1,095	13,137	15,326
73.0302	Engineering, architectural & surveying	506	35,240	17,620	10,572	7,048	1,762	21,144	12,334	11,453	881	10,572	12,334
73.0303	Accounting, auditing & bookkeeping	507	1,935	968	581	387	97	1,161	677	629	48	581	677
74.0000	Eating & drinking places	454	14,515	7,258	4,355	2,903	726	8,709	5,080	4,718	363	4,355	5,080
75.0001	Automotive rental & leasing	477	4,476	1,790	895	1,790	448	1,790	2,238	1,119	224	895	2,238
77.0501	Associations & professional org.	503	2,822	564	847	1,411	-	1,129	1,693	564	-	564	1,693
90.0000	Other value added	n.a.	1,295,829	129,583	129,583	1,036,663	-	259,166	1,036,663	129,583	-	129,583	1,036,663
88.0000	Compensation of Employees	n.a.	915,967	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			246,453	184,290	1,073,383	12,038	378,798	1,113,291	195,418	6,019	189,399	1,113,291

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 10. Install Production Platform

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	67,566	47,296	13,513	6,757	13,513	40,539	13,513	27,026	6,757	20,270	13,513
70.0100	Banking	456	172,081	120,457	34,416	17,208	8,604	103,249	60,228	55,926	4,302	51,624	60,228
70.0400	Insurance carriers	459	34,311	24,017	6,862	3,431	1,716	20,586	12,009	11,151	858	10,293	12,009
71.0201	Real estate agents	462	169,178	118,425	33,836	16,918	8,459	101,507	59,212	54,983	4,229	50,753	59,212
72.0101	Hotels	463	80,234	48,140	16,047	16,047	4,012	40,117	36,105	22,064	2,006	20,059	36,105
73.0103	Personnel supply	474	46,979	28,188	9,396	9,396	2,349	23,490	21,141	12,919	1,174	11,745	21,141
73.0104	Computers & data processing	475	35,894	25,126	7,179	3,589	1,795	21,537	12,563	11,666	897	10,768	12,563
73.0111	Management & consulting	508	41,701	8,340	20,850	12,510	4,170	20,850	16,680	12,510	2,085	10,425	16,680
73.0200	Advertising	469	42,756	17,103	17,103	8,551	-	17,103	25,654	8,551	-	8,551	25,654
73.0301	Legal services	494	286,626	143,313	85,988	57,325	14,331	171,976	100,319	93,153	7,166	85,988	100,319
73.0302	Engineering, architectural & surveying	506	230,673	115,337	69,202	46,135	11,534	138,404	80,736	74,969	5,767	69,202	80,736
73.0303	Accounting, auditing & bookkeeping	507	12,669	6,334	3,801	2,534	633	7,601	4,434	4,117	317	3,801	4,434
74.0000	Eating & drinking places	454	95,014	47,507	28,504	19,003	4,751	57,008	33,255	30,880	2,375	28,504	33,255
75.0001	Automotive rental & leasing	477	29,296	11,718	5,859	11,718	2,930	11,718	14,648	7,324	1,465	5,859	14,648
77.0501	Associations & professional org.	503	18,475	3,695	5,542	9,237	-	7,390	11,085	3,695	-	3,695	11,085
90.0000	Other value added	n.a.	8,482,123	848,212	848,212	6,785,698	-	1,696,425	6,785,698	848,212	-	848,212	6,785,698
88.0000	Compensation of Employees	n.a.	5,995,656	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			1,613,208	1,206,310	7,026,057	78,796	2,479,499	7,287,280	1,279,148	39,398	1,239,750	7,287,280

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 11. Operate Production Platform

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	17,547	12,283	3,509	1,755	3,509	10,528	3,509	7,019	1,755	5,264	3,509
70.0100	Banking	456	44,891	31,283	8,938	4,469	2,235	26,814	15,642	14,524	1,117	13,407	15,642
70.0400	Insurance carriers	459	8,911	6,237	1,782	891	446	5,346	3,119	2,896	223	2,673	3,119
71.0201	Real estate agents	462	43,937	30,756	8,787	4,394	2,197	26,362	15,378	14,279	1,098	13,181	15,378
72.0101	Hotels	463	20,837	12,502	4,167	4,167	1,042	10,419	9,377	5,730	521	5,209	9,377
73.0103	Personnel supply	474	12,201	7,320	2,440	2,440	610	6,100	5,490	3,355	305	3,050	5,490
73.0104	Computers & data processing	475	9,322	6,525	1,864	932	466	5,593	3,263	3,030	233	2,797	3,263
73.0111	Management & consulting	508	10,830	2,166	5,415	3,249	1,083	5,415	4,332	3,249	541	2,707	4,332
73.0200	Advertising	469	11,104	4,442	4,442	2,221	-	4,442	6,662	2,221	-	2,221	6,662
73.0301	Legal services	494	74,439	37,219	22,332	14,888	3,722	44,663	26,054	24,193	1,861	22,332	26,054
73.0302	Engineering, architectural & surveying	506	59,907	29,954	17,972	11,981	2,995	35,944	20,968	19,470	1,498	17,972	20,968
73.0303	Accounting, auditing & bookkeeping	507	3,290	1,645	987	658	165	1,974	1,152	1,069	82	987	1,152
74.0000	Eating & drinking places	454	24,676	12,338	7,403	4,935	1,234	14,805	8,637	8,020	617	7,403	8,637
75.0001	Automotive rental & leasing	477	7,608	3,043	1,522	3,043	761	3,043	3,804	1,902	380	1,522	3,804
77.0501	Associations & professional org.	503	4,798	960	1,439	2,399	-	1,919	2,879	960	-	960	2,879
90.0000	Other value added	n.a.	2,202,861	220,286	220,286	1,762,289	-	440,572	1,762,289	220,286	-	220,286	1,762,289
88.0000	Compensation of Employees	n.a.	1,557,110	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			418,960	313,286	1,824,712	20,464	643,942	1,892,553	332,203	10,232	321,971	1,892,553

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 12. Drill Production Well

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply				
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.	
66.0100	Telephone communications	441	3,770	2,639	754	377	754	2,282	754	1,508	377	1,131	754	
70.0100	Banking	456	9,601	6,721	1,920	960	480	5,761	3,360	3,120	240	2,880	3,360	
70.0400	Insurance carriers	459	1,914	1,340	383	191	96	1,149	670	622	48	574	670	
71.0201	Real estate agents	462	9,439	6,607	1,888	944	472	5,664	3,304	3,068	236	2,832	3,304	
72.0101	Hotels	463	4,477	2,686	895	895	224	2,238	2,014	1,231	112	1,119	2,014	
73.0103	Personnel supply	474	2,621	1,573	524	524	131	1,311	1,180	721	66	655	1,180	
73.0104	Computers & data processing	475	2,003	1,402	401	200	100	1,202	701	651	50	601	701	
73.0111	Management & consulting	508	2,327	465	1,163	698	233	1,163	931	698	116	582	931	
73.0200	Advertising	469	2,386	954	954	477	-	954	1,431	477	-	477	1,431	
73.0301	Legal services	494	15,992	7,996	4,798	3,198	800	9,595	5,597	5,197	400	4,798	5,597	
73.0302	Engineering, architectural & surveying	506	12,870	6,435	3,861	2,574	644	7,722	4,505	4,183	322	3,861	4,505	
73.0303	Accounting, auditing & bookkeeping	507	707	353	212	141	35	424	247	230	18	212	247	
74.0000	Eating & drinking places	454	5,301	2,651	1,590	1,060	265	3,181	1,855	1,723	133	1,590	1,855	
75.0001	Automotive rental & leasing	477	1,635	654	327	654	163	654	817	409	82	327	817	
77.0501	Associations & professional org.	503	1,031	206	309	515	-	412	618	206	-	206	618	
90.0000	Other value added	n.a.	473,255	47,326	47,326	378,604	-	94,651	378,604	47,326	-	47,326	378,604	
88.0000	Compensation of Employees	n.a.	334,524	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
	Total			90,008	67,305	392,015		4,396	138,342	406,590	71,369	2,198	69,171	406,590

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 13. Lay Offshore Pipeline

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply				
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.	
66.0100	Telephone communications	441	560	392	112	56	112	336	112	224	56	168	112	
70.0100	Banking	456	1,426	999	285	143	71	856	499	464	36	428	499	
70.0400	Insurance carriers	459	284	199	57	28	14	171	100	92	7	85	100	
71.0201	Real estate agents	462	1,402	982	280	140	70	841	491	456	35	421	491	
72.0101	Hotels	463	665	399	133	133	33	333	299	183	17	166	299	
73.0103	Personnel supply	474	389	234	78	78	19	195	175	107	10	97	175	
73.0104	Computers & data processing	475	298	208	60	30	15	179	104	97	7	89	104	
73.0111	Management & consulting	508	346	69	173	104	35	173	138	104	17	86	138	
73.0200	Advertising	469	354	142	142	71	-	142	213	71	-	71	213	
73.0301	Legal services	494	2,376	1,188	713	475	119	1,426	832	772	59	713	832	
73.0302	Engineering, architectural & surveying	506	1,912	956	574	382	96	1,147	669	621	48	574	669	
73.0303	Accounting, auditing & bookkeeping	507	105	53	32	21	5	63	37	34	3	32	37	
74.0000	Eating & drinking places	454	788	394	236	158	39	473	276	256	20	236	276	
75.0001	Automotive rental & leasing	477	243	97	49	97	24	97	121	61	12	49	121	
77.0501	Associations & professional org.	503	153	31	46	77	-	61	92	31	-	31	92	
90.0000	Other value added	n.a.	70,313	7,031	7,031	56,250	-	14,063	56,250	7,031	-	7,031	56,250	
88.0000	Compensation of Employees	n.a.	49,701	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
	Total			13,373	10,000	58,242		653	20,554	60,408	10,603	327	10,277	60,408

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 14. Lay Onshore Pipeline

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply				
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.	
66.0100	Telephone communications	441	156	109	31	16	31	93	31	62	16	47	31	
70.0100	Banking	456	396	277	79	40	20	238	139	129	10	119	139	
70.0400	Insurance carriers	459	79	55	16	8	4	47	28	26	2	24	28	
71.0201	Real estate agents	462	390	273	78	39	19	234	136	127	10	117	136	
72.0101	Hotels	463	185	111	37	37	9	92	83	51	5	46	83	
73.0103	Personnel supply	474	108	65	22	22	5	54	49	30	3	27	49	
73.0104	Computers & data processing	475	83	58	17	8	4	50	29	27	2	25	29	
73.0111	Management & consulting	508	96	19	48	29	10	48	38	29	5	24	38	
73.0200	Advertising	469	98	39	39	20	-	39	59	20	-	20	59	
73.0301	Legal services	494	660	330	198	132	33	396	231	214	16	198	231	
73.0302	Engineering, architectural & surveying	506	531	266	159	106	27	319	186	173	13	159	186	
73.0303	Accounting, auditing & bookkeeping	507	29	15	9	6	1	18	10	9	1	9	10	
74.0000	Eating & drinking places	454	219	109	66	44	11	131	77	71	5	66	77	
75.0001	Automotive rental & leasing	477	67	27	13	27	7	27	34	17	3	13	34	
77.0501	Associations & professional org.	503	43	9	13	21	-	17	26	9	-	9	26	
90.0000	Other value added	n.a.	19,531	1,953	1,953	15,625	-	3,906	15,625	1,953	-	1,953	15,625	
88.0000	Compensation of Employees	n.a.	13,806	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
	Total			3,715	2,778	16,179		181	5,709	16,780	2,945	91	2,855	16,780

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 15. Construct Onshore Production Facility

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)			
										Kenai	Anchorage	Other U.S.	
66.0100	Telephone communications	441	354,399	248,079	70,880	35,440	70,880	212,839	70,880	141,760	35,440	106,320	70,880
70.0100	Banking	456	902,610	631,827	180,522	90,261	45,130	541,566	315,913	293,348	22,565	270,783	315,913
70.0400	Insurance carriers	459	179,968	125,978	35,994	17,997	8,998	107,981	62,989	58,490	4,499	53,990	62,989
71.0201	Real estate agents	462	887,382	621,167	177,476	88,738	44,369	532,429	310,584	288,399	22,185	266,215	310,584
72.0101	Hotels	463	420,849	252,509	84,170	84,170	21,042	210,424	189,382	115,733	10,521	105,212	189,382
73.0103	Personnel supply	474	246,418	147,851	49,284	49,284	12,321	123,209	110,888	67,765	6,160	61,605	110,888
73.0104	Computers & data processing	475	188,274	131,792	37,655	18,827	9,414	112,965	65,896	61,189	4,707	56,482	65,896
73.0111	Management & consulting	508	218,731	43,746	109,365	65,619	21,873	109,365	87,492	65,619	10,937	54,683	87,492
73.0200	Advertising	469	224,268	89,707	89,707	44,854	-	89,707	134,561	44,854	-	44,854	134,561
73.0301	Legal services	494	1,503,427	751,714	451,028	300,685	75,171	902,056	526,199	488,614	37,586	451,028	526,199
73.0302	Engineering, architectural & surveying	506	1,209,940	604,970	362,982	241,988	60,497	725,964	423,479	393,231	30,249	362,982	423,479
73.0303	Accounting, auditing & bookkeeping	507	66,450	33,225	19,935	13,290	3,322	39,870	23,257	21,596	1,661	19,935	23,257
74.0000	Eating & drinking places	454	498,374	249,187	149,512	99,675	24,919	299,024	174,431	161,971	12,459	149,512	174,431
75.0001	Automotive rental & leasing	477	153,665	61,466	30,733	61,466	15,367	61,466	76,833	38,416	7,683	30,733	76,833
77.0501	Associations & professional org.	503	96,906	19,381	29,072	48,453	-	38,762	58,144	19,381	-	19,381	58,144
90.0000	Other value added	n.a.	44,490,919	4,449,092	4,449,092	35,592,735	-	8,898,184	35,592,735	4,449,092	-	4,449,092	35,592,735
88.0000	Compensation of Employees	n.a.	31,448,759	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			4,861,692	6,327,407	36,853,482	413,304	13,005,613	38,223,663	6,709,458	206,652	6,502,806	38,223,663

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 16. Operate Production Facility

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)			
										Kenai	Anchorage	Other U.S.	
66.0100	Telephone communications	441	37,602	26,322	7,520	3,760	7,520	22,561	7,520	15,041	3,760	11,281	7,520
70.0100	Banking	456	95,768	67,038	19,154	9,577	4,788	57,461	33,519	31,125	2,394	28,731	33,519
70.0400	Insurance carriers	459	19,095	13,386	3,819	1,909	955	11,457	6,683	6,206	477	5,728	6,683
71.0201	Real estate agents	462	94,153	65,907	18,631	9,415	4,708	56,492	32,953	30,600	2,354	28,246	32,953
72.0101	Hotels	463	44,653	26,792	8,931	8,931	2,233	22,326	20,094	12,280	1,116	11,163	20,094
73.0103	Personnel supply	474	26,145	15,687	5,229	5,229	1,307	13,073	11,765	7,190	654	6,536	11,765
73.0104	Computers & data processing	475	19,976	13,983	3,995	1,998	999	11,986	6,992	6,492	499	5,993	6,992
73.0111	Management & consulting	508	23,208	4,642	11,604	6,962	2,321	11,604	9,283	6,962	1,160	5,802	9,283
73.0200	Advertising	469	23,795	9,518	9,518	4,759	-	9,518	14,277	4,759	-	4,759	14,277
73.0301	Legal services	494	159,516	79,758	47,855	31,903	7,976	95,710	55,831	51,843	3,988	47,855	55,831
73.0302	Engineering, architectural & surveying	506	128,377	64,188	38,513	25,675	6,419	77,026	44,932	41,722	3,209	38,513	44,932
73.0303	Accounting, auditing & bookkeeping	507	7,050	3,525	2,115	1,410	353	4,230	2,468	2,291	176	2,115	2,468
74.0000	Eating & drinking places	454	52,878	26,439	15,863	10,576	2,644	31,727	18,507	17,185	1,322	15,863	18,507
75.0001	Automotive rental & leasing	477	16,304	6,522	3,261	6,522	1,630	6,522	8,152	4,076	815	3,261	8,152
77.0501	Associations & professional org.	503	10,282	2,056	3,085	5,141	-	4,113	6,169	2,056	-	2,056	6,169
90.0000	Other value added	n.a.	4,720,561	472,056	472,056	3,776,449	-	944,112	3,776,449	472,056	-	472,056	3,776,449
88.0000	Compensation of Employees	n.a.	3,336,766	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			897,800	671,348	3,910,216	43,852	1,379,917	4,055,594	711,885	21,926	689,959	4,055,594

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 17. Construct Marine Terminal

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)			
										Kenai	Anchorage	Other U.S.	
66.0100	Telephone communications	441	221,013	154,709	44,203	22,101	44,203	132,608	44,203	88,405	22,101	66,304	44,203
70.0100	Banking	456	562,893	394,025	112,579	56,289	28,145	337,736	197,013	182,940	14,072	168,868	197,013
70.0400	Insurance carriers	459	112,233	78,563	22,447	11,223	5,612	67,340	39,282	36,476	2,806	33,670	39,282
71.0201	Real estate agents	462	553,397	387,378	110,679	55,340	27,670	332,038	193,689	179,854	13,835	166,019	193,689
72.0101	Hotels	463	262,453	157,472	52,491	52,491	13,123	131,227	118,104	72,175	6,561	65,613	118,104
73.0103	Personnel supply	474	153,673	92,204	30,735	30,735	7,684	76,837	69,153	42,260	3,842	38,418	69,153
73.0104	Computers & data processing	475	117,413	82,189	23,483	11,741	5,871	70,448	41,095	38,159	2,935	35,224	41,095
73.0111	Management & consulting	508	136,407	27,281	68,203	40,922	13,641	68,203	54,563	40,922	6,820	34,102	54,563
73.0200	Advertising	469	139,860	55,944	55,944	27,972	-	55,944	83,916	27,972	-	27,972	83,916
73.0301	Legal services	494	937,580	468,790	281,274	187,516	46,879	562,548	328,153	304,713	23,439	281,274	328,153
73.0302	Engineering, architectural & surveying	506	754,553	377,277	226,366	150,911	37,728	452,732	264,094	245,230	18,864	226,366	264,094
73.0303	Accounting, auditing & bookkeeping	507	41,440	20,720	12,432	8,288	2,072	24,864	14,504	13,468	1,036	12,432	14,504
74.0000	Eating & drinking places	454	310,800	155,400	93,240	62,160	15,540	186,480	108,780	101,010	7,770	93,240	108,780
75.0001	Automotive rental & leasing	477	95,830	38,332	19,166	38,332	9,583	38,332	47,915	23,957	4,791	19,166	47,915
77.0501	Associations & professional org.	503	60,433	12,087	18,130	30,217	-	24,173	36,260	12,087	-	12,087	36,260
90.0000	Other value added	n.a.	27,745,799	2,774,580	2,774,580	22,196,639	-	5,549,160	22,196,639	2,774,580	-	2,774,580	22,196,639
88.0000	Compensation of Employees	n.a.	19,612,338	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			5,276,951	3,945,950	22,982,877	257,748	8,110,669	23,837,361	4,184,209	128,874	4,055,335	23,837,361

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 18. Operate Marine Terminal

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	58,210	40,747	11,642	5,821	11,642	34,926	11,642	23,284	5,821	17,463	11,642
70.0100	Banking	456	148,254	103,778	29,651	14,825	7,413	88,953	51,889	48,183	3,706	44,476	51,889
70.0400	Insurance carriers	459	29,560	20,692	5,912	2,956	1,478	17,736	10,346	9,607	739	8,868	10,346
71.0201	Real estate agents	462	145,753	102,027	29,151	14,575	7,288	87,452	51,014	47,370	3,644	43,726	51,014
72.0101	Hotels	463	69,125	41,475	13,825	13,825	3,456	34,562	31,106	19,009	1,728	17,281	31,106
73.0103	Personnel supply	474	40,474	24,285	8,095	8,095	2,024	20,237	18,213	11,130	1,012	10,119	18,213
73.0104	Computers & data processing	475	30,924	21,647	6,185	3,092	1,546	18,555	10,823	10,050	773	9,277	10,823
73.0111	Management & consulting	508	35,927	7,185	17,963	10,778	3,593	17,963	14,371	10,778	1,796	8,982	14,371
73.0200	Advertising	469	38,836	14,734	14,734	7,367	-	14,734	22,102	7,367	-	7,367	22,102
73.0301	Legal services	494	246,939	123,469	74,082	49,388	12,347	148,163	86,429	80,255	6,173	74,082	86,429
73.0302	Engineering, architectural & surveying	506	198,733	99,367	59,620	39,747	9,937	119,240	69,557	64,588	4,968	59,620	69,557
73.0303	Accounting, auditing & bookkeeping	507	10,914	5,457	3,274	2,183	546	6,549	3,820	3,547	273	3,274	3,820
74.0000	Eating & drinking places	454	81,858	40,929	24,557	16,372	4,093	49,115	28,650	26,604	2,046	24,557	28,650
75.0001	Automotive rental & leasing	477	25,240	10,096	5,048	10,096	2,524	10,096	12,620	6,310	1,262	5,048	12,620
77.0501	Associations & professional org.	503	15,917	3,183	4,775	7,958	-	6,367	9,550	3,183	-	3,183	9,550
90.0000	Other value added	n.a.	7,307,657	730,766	730,766	5,846,126	-	1,461,531	5,846,126	730,766	-	730,766	5,846,126
88.0000	Compensation of Employees	n.a.	5,165,475	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			1,389,837	1,039,280	6,053,204	67,885	2,136,179	6,278,257	1,102,032	33,943	1,068,089	6,278,257

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 19. Major Platform Maintenance

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	6,042	4,229	1,208	604	1,208	3,625	1,208	2,417	604	1,813	1,208
70.0100	Banking	456	15,388	10,772	3,078	1,539	769	9,233	5,386	5,001	385	4,616	5,386
70.0400	Insurance carriers	459	3,068	2,148	614	307	153	1,841	1,074	997	77	920	1,074
71.0201	Real estate agents	462	15,128	10,590	3,026	1,513	756	9,077	5,295	4,917	378	4,539	5,295
72.0101	Hotels	463	7,175	4,305	1,435	1,435	359	3,587	3,229	1,973	179	1,794	3,229
73.0103	Personnel supply	474	4,201	2,521	840	840	210	2,101	1,890	1,155	105	1,050	1,890
73.0104	Computers & data processing	475	3,210	2,247	642	321	160	1,926	1,123	1,043	80	963	1,123
73.0111	Management & consulting	508	3,729	746	1,864	1,119	373	1,864	1,492	1,119	186	932	1,492
73.0200	Advertising	469	3,823	1,529	1,529	765	-	1,529	2,294	765	-	765	2,294
73.0301	Legal services	494	25,631	12,815	7,689	5,126	1,282	15,379	8,971	8,330	641	7,689	8,971
73.0302	Engineering, architectural & surveying	506	20,627	10,314	6,188	4,125	1,031	12,376	7,220	6,704	516	6,188	7,220
73.0303	Accounting, auditing & bookkeeping	507	1,133	566	340	227	57	680	397	368	28	340	397
74.0000	Eating & drinking places	454	8,496	4,248	2,549	1,699	425	5,098	2,974	2,761	212	2,549	2,974
75.0001	Automotive rental & leasing	477	2,620	1,048	524	1,048	262	1,048	1,310	655	131	524	1,310
77.0501	Associations & professional org.	503	1,652	330	496	826	-	661	991	330	-	330	991
90.0000	Other value added	n.a.	758,495	75,850	75,850	606,796	-	151,699	606,796	75,850	-	75,850	606,796
88.0000	Compensation of Employees	n.a.	536,148	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			144,258	107,872	628,290	7,046	221,724	651,649	114,385	3,523	110,862	651,649

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 20. Well Workover

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	1,395	976	279	139	279	837	279	558	139	418	279
70.0100	Banking	456	3,552	2,486	710	355	178	2,131	1,243	1,154	89	1,066	1,243
70.0400	Insurance carriers	459	708	496	142	71	35	425	248	230	18	212	248
71.0201	Real estate agents	462	3,492	2,444	698	349	175	2,095	1,222	1,135	87	1,048	1,222
72.0101	Hotels	463	1,656	994	331	331	83	828	745	455	41	414	745
73.0103	Personnel supply	474	970	582	194	194	48	485	436	267	24	242	436
73.0104	Computers & data processing	475	741	519	148	74	37	445	259	241	19	222	259
73.0111	Management & consulting	508	861	172	430	258	86	430	344	258	43	215	344
73.0200	Advertising	469	883	353	353	177	-	353	530	177	-	177	530
73.0301	Legal services	494	5,916	2,958	1,775	1,183	296	3,550	2,071	1,923	148	1,775	2,071
73.0302	Engineering, architectural & surveying	506	4,761	2,381	1,428	952	238	2,857	1,666	1,547	119	1,428	1,666
73.0303	Accounting, auditing & bookkeeping	507	261	131	78	52	13	157	92	85	7	78	92
74.0000	Eating & drinking places	454	1,961	981	588	392	98	1,177	686	637	49	588	686
75.0001	Automotive rental & leasing	477	605	242	121	242	60	242	302	151	30	121	302
77.0501	Associations & professional org.	503	381	76	114	191	-	153	229	76	-	76	229
90.0000	Other value added	n.a.	175,074	17,507	17,507	140,059	-	35,015	140,059	17,507	-	17,507	140,059
88.0000	Compensation of Employees	n.a.	123,752	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Total			33,297	24,899	145,020	1,626	51,178	150,412	26,402	813	25,589	150,412

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 21. Helicopter Support

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	3.61	2.53	0.72	0.36	0.72	2.17	0.72	1.44	0.36	1.08	0.72
66.0200	Cable TV	441	-	-	-	-	-	-	-	-	-	-	-
70.0100	Banking	456	1.80	1.26	0.36	0.18	0.09	1.08	0.63	0.59	0.05	0.54	0.63
70.0200	Credit agencies	457	2.35	1.65	0.47	0.24	0.12	1.41	0.82	0.76	0.06	0.71	0.82
70.0400	Insurance carriers	459	-	-	-	-	-	-	-	-	-	-	-
71.0201	Real estate agents	462	4.27	2.99	0.85	0.43	0.21	2.56	1.50	1.39	0.11	1.28	1.50
73.0102	Services to dwellings/buildings	472	-	-	-	-	-	-	-	-	-	-	-
73.0103	Personnel supply	474	-	-	-	-	-	-	-	-	-	-	-
73.0104	Computers & data processing	475	6.67	4.67	1.33	0.67	0.33	4.00	2.33	2.17	0.17	2.00	2.33
73.0106	Detective services	476	-	-	-	-	-	-	-	-	-	-	-
73.0107	Equipment rental & leasing	473	2.02	1.01	0.61	0.40	0.10	0.91	1.01	0.51	0.05	0.46	1.01
73.0109	Other business services	470	-	-	-	-	-	-	-	-	-	-	-
73.0111	Management & consulting	508	-	-	-	-	-	-	-	-	-	-	-
73.0112	Testing and research labs	509	-	-	-	-	-	-	-	-	-	-	-
73.0200	Advertising	469	4.16	1.67	1.67	0.83	-	1.67	2.50	0.83	-	0.83	2.50
73.0301	Legal services	494	2.83	1.42	0.85	0.57	0.14	1.70	0.99	0.92	0.07	0.85	0.99
73.0302	Engineering, architectural & surveying	506	-	-	-	-	-	-	-	-	-	-	-
73.0303	Accounting, auditing & bookkeeping	507	-	-	-	-	-	-	-	-	-	-	-
74.0000	Eating & drinking places	454	5.49	2.75	1.65	1.10	0.27	3.30	1.92	1.79	0.14	1.65	1.92
75.0001	Automotive rental & leasing	477	-	-	-	-	-	-	-	-	-	-	-
78.0100	U.S. Postal Service	513	-	-	-	-	-	-	-	-	-	-	-
90.0000	Other value added	n.a.	11.12	-	2.22	8.90	-	2.22	8.90	1.11	-	1.11	8.90
88.0000	Compensation of Employees	n.a.	98.22	-	-	-	-	-	-	-	-	-	-
	Total			11.51	8.33	12.47	0.85	13.79	17.65	7.32	0.43	6.90	17.65

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 22. Large Workboat

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	-	-	-	-	-	-	-	-	-	-	-
66.0200	Cable TV	441	-	-	-	-	-	-	-	-	-	-	-
70.0100	Banking	456	17	12.1	3.5	1.7	0.9	10.4	6.1	5.6	0.4	5.2	6.1
70.0200	Credit agencies	457	19	13.6	3.9	1.9	1.0	11.6	6.8	6.3	0.5	5.8	6.8
70.0400	Insurance carriers	459	-	-	-	-	-	-	-	-	-	-	-
71.0201	Real estate agents	462	32	22.7	6.5	3.2	1.6	19.4	11.3	10.5	0.8	9.7	11.3
73.0102	Services to dwellings/buildings	472	-	-	-	-	-	-	-	-	-	-	-
73.0103	Personnel supply	474	-	-	-	-	-	-	-	-	-	-	-
73.0104	Computers & data processing	475	10	7.2	2.1	1.0	0.5	6.2	3.6	3.4	0.3	3.1	3.6
73.0106	Detective services	476	-	-	-	-	-	-	-	-	-	-	-
73.0107	Equipment rental & leasing	473	7	3.4	2.1	1.4	0.3	3.1	3.4	1.7	0.2	1.5	3.4
73.0109	Other business services	470	7	-	-	-	-	-	-	-	-	-	-
73.0111	Management & consulting	508	34	6.7	16.8	10.1	3.4	16.8	13.4	10.1	1.7	8.4	13.4
73.0112	Testing and research labs	509	27	11.0	5.5	11.0	1.4	6.9	19.2	4.1	0.7	3.4	19.2
73.0200	Advertising	469	46	18.4	18.4	9.2	-	18.4	27.5	9.2	-	9.2	27.5
73.0301	Legal services	494	6	3.0	1.8	1.2	0.3	3.6	2.1	2.0	0.2	1.8	2.1
73.0302	Engineering, architectural & surveying	506	11	5.6	3.3	2.2	0.6	6.7	3.9	3.6	0.3	3.3	3.9
73.0303	Accounting, auditing & bookkeeping	507	8	4.0	2.4	1.6	0.4	4.8	2.8	2.6	0.2	2.4	2.8
74.0000	Eating & drinking places	454	-	-	-	-	-	-	-	-	-	-	-
75.0001	Automotive rental & leasing	477	-	-	-	-	-	-	-	-	-	-	-
78.0100	U.S. Postal Service	513	-	-	-	-	-	-	-	-	-	-	-
90.0000	Other value added	n.a.	187	-	37.4	149.8	-	37.4	149.8	18.7	-	18.7	149.8
88.0000	Compensation of Employees	n.a.	264	-	-	-	-	-	-	-	-	-	-
	Total			59.33	89.79	187.46	6.85	103.89	225.84	55.37	3.43	51.94	225.84

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 23. Small Workboat

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	4	2.9	0.8	0.4	0.8	2.5	0.8	1.7	0.4	1.2	0.8
66.0200	Cable TV	441	4	0.6	0.6	3.0	0.4	0.8	3.0	0.6	0.2	0.4	3.0
70.0100	Banking	456	19	13.4	3.8	1.9	1.0	11.5	6.7	6.2	0.5	5.7	6.7
70.0200	Credit agencies	457	15	10.7	3.1	1.5	0.8	9.2	5.3	5.0	0.4	4.6	5.3
70.0400	Insurance carriers	459	-	-	-	-	-	-	-	-	-	-	-
71.0201	Real estate agents	462	15	10.8	3.1	1.5	0.8	9.3	5.4	5.0	0.4	4.6	5.4
73.0102	Services to dwellings/buildings	472	7	4.2	1.4	1.4	0.4	3.5	3.2	1.9	0.2	1.8	3.2
73.0103	Personnel supply	474	6	3.5	1.2	1.2	0.3	2.9	2.6	1.6	0.1	1.4	2.6
73.0104	Computers & data processing	475	4	2.7	0.8	0.4	0.2	2.3	1.4	1.3	0.1	1.2	1.4
73.0106	Detective services	476	5	2.3	1.4	0.9	0.2	2.8	1.6	1.5	0.1	1.4	1.6
73.0107	Equipment rental & leasing	473	-	-	-	-	-	-	-	-	-	-	-
73.0109	Other business services	470	11	-	-	-	-	-	-	-	-	-	-
73.0111	Management & consulting	508	11	2.2	5.5	3.3	1.1	5.5	4.4	3.3	0.6	2.8	4.4
73.0112	Testing and research labs	509	-	-	-	-	-	-	-	-	-	-	-
73.0200	Advertising	469	11	4.5	4.5	2.2	-	4.5	6.7	2.2	-	2.2	6.7
73.0301	Legal services	494	3	1.7	1.0	0.7	0.2	2.0	1.2	1.1	0.1	1.0	1.2
73.0302	Engineering, architectural & surveying	506	-	-	-	-	-	-	-	-	-	-	-
73.0303	Accounting, auditing & bookkeeping	507	-	-	-	-	-	-	-	-	-	-	-
74.0000	Eating & drinking places	454	3	1.7	1.0	0.7	0.2	2.0	1.2	1.1	0.1	1.0	1.2
75.0001	Automotive rental & leasing	477	-	-	-	-	-	-	-	-	-	-	-
78.0100	U.S. Postal Service	513	3	1.8	0.6	0.6	0.3	1.8	0.9	1.1	0.2	0.9	0.9
90.0000	Other value added	n.a.	70	-	14.1	56.3	-	14.1	56.3	7.0	-	7.0	56.3
88.0000	Compensation of Employees	n.a.	228	-	-	-	-	-	-	-	-	-	-
	Total			24.59	31.44	67.70	2.82	41.46	79.45	22.14	1.41	20.73	79.45

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 24. Landing Craft

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	6	4.5	1.3	0.6	1.3	3.9	1.3	2.6	0.6	1.9	1.3
66.0200	Cable TV	441	-	-	-	-	-	-	-	-	-	-	-
70.0100	Banking	456	3	2.3	0.6	0.3	0.2	1.9	1.1	1.0	0.1	1.0	1.1
70.0200	Credit agencies	457	4	2.9	0.8	0.4	0.2	2.5	1.5	1.4	0.1	1.3	1.5
70.0400	Insurance carriers	459	-	-	-	-	-	-	-	-	-	-	-
71.0201	Real estate agents	462	8	5.3	1.5	0.8	0.4	4.6	2.7	2.5	0.2	2.3	2.7
73.0102	Services to dwellings/buildings	472	-	-	-	-	-	-	-	-	-	-	-
73.0103	Personnel supply	474	-	-	-	-	-	-	-	-	-	-	-
73.0104	Computers & data processing	475	12	8.3	2.4	1.2	0.6	7.2	4.2	3.9	0.3	3.6	4.2
73.0106	Detective services	476	-	-	-	-	-	-	-	-	-	-	-
73.0107	Equipment rental & leasing	473	4	1.8	1.1	0.7	0.2	1.6	1.8	0.9	0.1	0.8	1.8
73.0109	Other business services	470	-	-	-	-	-	-	-	-	-	-	-
73.0111	Management & consulting	508	-	-	-	-	-	-	-	-	-	-	-
73.0112	Testing and research labs	509	-	-	-	-	-	-	-	-	-	-	-
73.0200	Advertising	469	7	3.0	3.0	1.5	-	3.0	4.5	1.5	-	1.5	4.5
73.0301	Legal services	494	5	2.5	1.5	1.0	0.3	3.0	1.8	1.6	0.1	1.5	1.8
73.0302	Engineering, architectural & surveying	506	-	-	-	-	-	-	-	-	-	-	-
73.0303	Accounting, auditing & bookkeeping	507	-	-	-	-	-	-	-	-	-	-	-
74.0000	Eating & drinking places	454	10	4.9	2.9	2.0	0.5	5.9	3.4	3.2	0.2	2.9	3.4
75.0001	Automotive rental & leasing	477	-	-	-	-	-	-	-	-	-	-	-
78.0100	U.S. Postal Service	513	-	-	-	-	-	-	-	-	-	-	-
90.0000	Other value added	n.a.	20	-	4.0	15.9	-	4.0	15.9	2.0	-	2.0	15.9
88.0000	Compensation of Employees	n.a.	176	-	-	-	-	-	-	-	-	-	-
	Total			20.6	14.9	22.3	1.5	24.7	31.6	13.1	0.8	12.3	31.6

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 25. Dive Boat

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	-	-	-	-	-	-	-	-	-	-	-
66.0200	Cable TV	441	-	-	-	-	-	-	-	-	-	-	-
70.0100	Banking	456	16	10.9	3.1	1.6	0.8	9.4	5.5	5.1	0.4	4.7	5.5
70.0200	Credit agencies	457	18	12.3	3.5	1.8	0.9	10.5	6.1	5.7	0.4	5.3	6.1
70.0400	Insurance carriers	459	-	-	-	-	-	-	-	-	-	-	-
71.0201	Real estate agents	462	29	20.4	5.8	2.9	1.5	17.5	10.2	9.5	0.7	8.8	10.2
73.0102	Services to dwellings/buildings	472	-	-	-	-	-	-	-	-	-	-	-
73.0103	Personnel supply	474	-	-	-	-	-	-	-	-	-	-	-
73.0104	Computers & data processing	475	9	6.5	1.9	0.9	0.5	5.6	3.3	3.0	0.2	2.8	3.3
73.0106	Detective services	476	-	-	-	-	-	-	-	-	-	-	-
73.0107	Equipment rental & leasing	473	6	3.1	1.9	1.2	0.3	2.8	3.1	1.5	0.2	1.4	3.1
73.0109	Other business services	470	7	-	-	-	-	-	-	-	-	-	-
73.0111	Management & consulting	508	30	6.1	15.2	9.1	3.0	15.2	12.1	9.1	1.5	7.6	12.1
73.0112	Testing and research labs	509	25	9.9	4.9	9.9	1.2	6.2	17.3	3.7	0.6	3.1	17.3
73.0200	Advertising	469	41	16.6	16.6	8.3	-	16.6	24.8	8.3	-	8.3	24.8
73.0301	Legal services	494	5	2.7	1.6	1.1	0.3	3.3	1.9	1.8	0.1	1.6	1.9
73.0302	Engineering, architectural & surveying	506	10	5.0	3.0	2.0	0.5	6.0	3.5	3.3	0.3	3.0	3.5
73.0303	Accounting, auditing & bookkeeping	507	7	3.6	2.2	1.4	0.4	4.3	2.5	2.3	0.2	2.2	2.5
74.0000	Eating & drinking places	454	-	-	-	-	-	-	-	-	-	-	-
75.0001	Automotive rental & leasing	477	-	-	-	-	-	-	-	-	-	-	-
78.0100	U.S. Postal Service	513	-	-	-	-	-	-	-	-	-	-	-
90.0000	Other value added	n.a.	169	-	33.8	135.0	-	33.8	135.0	16.9	-	16.9	135.0
88.0000	Compensation of Employees	n.a.	238	-	-	-	-	-	-	-	-	-	-
	Total			53.5	81.0	169.0	6.2	93.7	203.6	49.9	3.1	46.8	203.6

Exhibit 4-5: Estimates of Purchased Services by Sector and Geographic Area for E&D Activities
Activity # 26. Camp Support

BEA I-O Sector	Sector Name	IMPLAN Sector	Service Purchases	Cook Inlet Projects			Remote Projects			Remote Projects Near Labor Supply			
				Kenai	Anchorage	Other U.S.	Kenai	Anchorage	Other U.S.	Local (If Near Labor Supply)	Kenai	Anchorage	Other U.S.
66.0100	Telephone communications	441	7,435	5,205	1,487	744	1,487	4,461	1,487	2,974	744	2,231	1,487
66.0200	Cable TV	441	7,558	1,134	1,134	5,291	756	1,512	5,291	1,134	378	756	5,291
70.0100	Banking	456	34,205	23,944	6,841	3,421	1,710	20,523	11,972	11,117	855	10,262	11,972
70.0200	Credit agencies	457	27,344	19,141	5,469	2,734	1,367	16,406	9,570	8,887	684	8,203	9,570
70.0400	Insurance carriers	459	-	-	-	-	-	-	-	-	-	-	-
71.0201	Real estate agents	462	27,712	19,399	5,542	2,771	1,386	16,627	9,699	9,007	693	8,314	9,699
73.0102	Services to dwellings/buildings	472	12,678	7,607	2,536	2,536	634	6,339	5,705	3,487	317	3,170	5,705
73.0103	Personnel supply	474	10,323	6,194	2,065	2,065	516	5,161	4,645	2,639	258	2,581	4,645
73.0104	Computers & data processing	475	6,984	4,889	1,397	698	349	4,191	2,445	2,270	175	2,095	2,445
73.0106	Detective services	476	8,316	4,158	2,495	1,663	416	4,989	2,911	2,703	208	2,495	2,911
73.0107	Equipment rental & leasing	473	-	-	-	-	-	-	-	-	-	-	-
73.0109	Other business services	470	19,274	-	-	-	-	-	-	-	-	-	-
73.0111	Management & consulting	508	19,888	3,978	9,944	5,966	1,989	9,944	7,955	5,966	994	4,972	7,955
73.0112	Testing and research labs	509	-	-	-	-	-	-	-	-	-	-	-
73.0200	Advertising	469	19,950	7,980	7,980	3,990	-	7,980	11,970	3,990	-	3,990	11,970
73.0301	Legal services	494	5,919	2,960	1,776	1,184	296	3,552	2,072	1,924	148	1,776	2,072
73.0302	Engineering, architectural & surveying	506	-	-	-	-	-	-	-	-	-	-	-
73.0303	Accounting, auditing & bookkeeping	507	-	-	-	-	-	-	-	-	-	-	-
74.0000	Eating & drinking places	454	6,104	3,052	1,831	1,221	305	3,662	2,136	1,984	153	1,831	2,136
75.0001	Automotive rental & leasing	477	-	-	-	-	-	-	-	-	-	-	-
78.0100	U.S. Postal Service	513	5,407	3,244	1,081	1,081	541	3,244	1,622	1,893	270	1,622	1,622
90.0000	Other value added	n.a.	126,149	-	25,230	100,920	-	25,230	100,920	12,615	-	12,615	100,920
88.0000	Compensation of Employees	n.a.	408,291	-	-	-	-	-	-	-	-	-	-
	Total			44,061	56,334	121,324	5,046	74,293	142,381	39,669	2,523	37,146	142,381

5 CAPITAL AND MATERIAL INPUTS

The purpose of this chapter is to provide an overview of the methods used to develop estimates of the capital and material inputs to the production process. The starting points for the estimates are the lists of equipment and purchases for each of the activities that were collected by the project engineering staff. These purchases are described for each activity in Chapter 2.

In many cases, the assignment of these various purchases as capital or materials is counter intuitive. From an accountant's viewpoint a large piece of equipment such as a production platform would be a capital purchase that would be depreciated over many years. In this study, however, the production platform is treated as a material. This is because this piece of equipment is put in place in one year and never moved or used in another activity or project. The economic impact of producing, wholesaling and transporting this piece of equipment is, therefore, all realized within that year. Only equipment that is used over multiple activities or projects is treated as capital with an annualized cost. This allows their impact to be assigned to the correct activity or year.

The two sections that follow provide an overview of the techniques and sources of data used to develop estimates of capital and material inputs.

5.1 CAPITAL INPUTS

Unlike most labor and material inputs which are entirely and immediately consumed in the production process, capital inputs are used up gradually over time. This defining aspect of capital requires special attention when utilizing an input-output (I-O) framework to estimate economic impacts. Capital expenditures are not included in the use coefficients of an industry, which only account for inputs that are immediately consumed for current production. In an I-O model, annualized capital expenditures are included with value added. Unfortunately, these expenses are frequently aggregated and, without a capital flow matrix, it is not possible to isolate specific types of investments or trace the secondary impacts associated with such investments. For this reason, exogenous estimates of capital investment are often developed outside of the I-O model, and then used as model catalysts along with other direct expenditures.

Capital investments represent a substantial portion of mineral exploration and development (E&D) expenditures. Due to the harsh environment, this is especially true in Alaska. E&D activities require transportation and earth moving equipment, drilling equipment, et cetera.

This section provides an overview of how expenditures for these items are developed and used to stimulate the IMPLAN input-output model.

Overview of the Capital Component

Estimates of annual capital expenditures were developed for each activity by IMPLAN sector and geographic region. The numbers are based upon estimated expenditures for the different

assets needed to carry out each activity. Each capital expenditure is based upon the total delivered price of the asset. This cost is annualized (based upon the average life of the machine), converted into a "per unit" basis, and then divided into its various cost components: i.e., manufacturing, transportation and wholesale trade, and retrofitting. Each cost category is assigned to an associated IMPLAN sector.

Finally, regional purchase coefficients (RPC) were used to allocate expenditures to impacted geographic regions. This allocation is performed for each cost component. For example, the manufacturing cost of a particular asset may have been assigned to the contiguous 48-states whereas part of the cost of delivering it to Alaska may have been assigned to Anchorage.

Identification of Assets Used in Each E&D Activity

The first step in the process was to identify the capital assets used in each E&D activity. It should be noted that much of the equipment has to be retrofitted with special accessories before it can be used in the harsh conditions found in Alaska. These accessories include insulation, special engine lubricants, and hardware attachments. The accessories associated with each primary piece of capital were also identified in this first step.

The numbers of assets required to carry out one unit of the activity were then estimated. This information was compiled through surveys of construction and mining contractors and supplemented with engineering and economic judgment.

Annual Cost Estimates by Asset

This step entailed developing an annual cost estimate for each asset per activity unit.

To develop the annual cost estimates, it was necessary to make some assumptions regarding the average life of the machine and the amount of time that it was devoted to the particular activity in question. Average life was used to capitalize the investment in the machine. Dedication to task was needed since some machinery can be used on multiple projects simultaneously during a given time period. Both of these numbers are based on professional engineering judgments.

Total delivery cost was the final information needed to develop the annual cost estimates. This information was gathered primarily in contractor surveys. Some of the information had to be supplemented with additional estimates based upon professional judgment.

For each activity and asset, an annual cost estimate was developed using the above information. The total delivery cost was multiplied by the number of assets needed, adjusted for the amount of time it was devoted to the activity, and then divided by the average life of the machine. For each asset type, this last step implies an assumption that the age distribution of the current population is uniform. In the judgment of project staff it would be too difficult and too costly to compute this distribution through survey work. It was also assumed that each asset adheres to a straight-line depreciation schedule. Again, in the judgment of project staff it would be too costly and would make the model unnecessarily complicated to develop different depreciation schedules by

asset type. The option of using established depreciation schedules at the national level was rejected given Alaska's harsh environment.

Finally, the annual cost estimates were converted into a per unit basis by dividing them by the number of activity units per year.

Margins

The annual cost estimates developed above are based on the total delivered price of the asset. This price includes, in addition to the manufacturing price, trade and transportation margins as well as additional labor for retrofitting. To be used in the I-O model, it was necessary to break out these expenditures from the total delivery price. This was accomplished by developing a margin matrix. For each asset, the margin matrix shows the percentage of the delivery price that can be attributed to the following categories:

- Production
- Transportation to Alaska
 - Rail
 - Water
 - Truck
 - Air
- Transportation within Alaska
 - Rail
 - Water
 - Truck
 - Air
- Wholesale Trade
- Retrofitting

During the contractor interviews conducted for the study, data was gathered on production costs, transportation costs to Alaska, transportation costs within Alaska, wholesale trade, and retrofitting. Secondary data sources were used to develop the modal detail for the transportation cost categories; these include the 1993 Commodity Flow Survey and other sources available from the U.S. Department of Commerce (e.g., the economic censuses, County Business Patterns, etc.). Data are extremely sparse in this area and in some instances IMPLAN data or professional judgment was relied upon.

Regional Purchase Coefficients

After each asset's total delivered price had been split into the above expenditure categories, it was necessary to assign the expenditures to geographic locales. This was accomplished through a regional purchase matrix, which allocates each expenditure to up to five geographic areas: the local area of Alaska where the project takes place, the Kenai Peninsula, Anchorage, Other US, and Foreign. The geographic definitions were determined in part by MMS's need for equitable sharing analysis.

By associating the expenditures with the areas in which they take place, this step helps to ensure that both the direct and indirect regional impacts of an investment are accurately gauged. For example, most of the heavy equipment utilized in Alaska is manufactured in the contiguous 48-states or overseas. Therefore, there won't be any direct manufacturing employment generated in a remote area as a result of a firm investing in one of these assets. Those impacts will occur where the product is manufactured. On the other hand, employment in the local area may be generated as a result of transportation and wholesale activities associated with a heavy equipment purchase. Once these direct impacts have been estimated, they can be used in an I-O model to estimate the secondary impacts.

The regional purchase coefficients are based upon information gathered during the contractor interviews, internet searches to identify production locations for brand name equipment and secondary data sources such as the Survey of Manufactures, and professional judgment.

Assignment of Expenditures to IMPLAN Sectors

At this point, annual capital expenditure estimates by asset and activity unit have been divided into production and margin categories and allocated to geographic regions. Each asset and margin was then assigned to an IMPLAN sector. Annual expenditures were then summed across IMPLAN sectors.

In some cases, the cost of a larger asset was distributed to multiple IMPLAN sectors. In these cases, the distribution among sectors was based on data in the national capital flow matrix or data from IMPLAN vectors for construction.

5.2 MATERIAL INPUTS

Most major material inputs such as fuel were estimated based on information on cost and quantity gathered in the industry interviews or based on the expert engineering knowledge of project staff. However, in order to determine what materials and purchased services are utilized in quantities that are significant enough to warrant estimation, data from the latest national-level input-output table of the U.S. economy was tabulated and analyzed. The latest table available is for the year 1992, as developed by the U.S. Bureau of Economic Analysis, and published in September 1998. This tabulation was presented earlier in Exhibit 4-1.

As shown in Exhibit 4-1 and discussed in Chapter 4, the various activities that comprise the oil and gas industry are subsumed within four sectors in the national I-O table. The largest of these sectors is Mining Sector 8.0001, Crude Petroleum and Natural Gas. The three smaller sectors are all construction industries. These include Sector 11.0601 (Petroleum and Natural Gas Well Drilling), Sector 11.0602 (Petroleum, Natural Gas, and Solid Mineral Exploration), and Sector 12.0215 (Maintenance and Repair of Petroleum and Natural Gas Wells).

Of these four sectors, the mining sector, Crude Petroleum and Natural Gas, is far larger than the others with output of over \$100 billion compared to just over \$10 billion for Petroleum and Natural Gas Well Drilling and between \$1 and \$2 billion for the other two sectors.

Exhibit 4-1 provides the dollars of purchases for all input sectors that accounted for at least one half of one percent of industry output for any of the four sectors. In total, there were 53 sectors that met this criterion. Note that as shown at the bottom of Exhibit 4-1, the purchases from these 53 sectors account for 96 to 99 percent of the total purchases of the four oil and gas sectors.

Many of these sectors were not of interest in the analysis of material goods or purchased services and were therefore dropped from the analysis. A discussion of these sectors is provided in Chapter 4.

Of the remaining sectors, nine, which happen to be the first nine sectors listed in Exhibit 4-1, were considered to be material inputs. These include the following sectors:

- 27.0100 Industrial inorganic and organic chemicals
- 27.0406 Chemicals and chemical preparations, not elsewhere classified
- 29.0203 Polishes and sanitation goods
- 31.0101 Petroleum refining
- 31.0102 Lubricating oils and greases
- 31.0200 Asphalt paving mixtures and blocks
- 36.0100 Cement, hydraulic
- 36.1100 Concrete products, except block and brick
- 36.1900 Minerals, ground or treated

In summary, material inputs to the oil and gas production process are made up of four main types of commodities. The first, represented by the first three sectors on the list, are chemicals. The second, corresponding to the fourth and fifth sectors on the list are the products of petroleum refining such as gasoline as well as lubricating oils and greases. The third, corresponding to the sixth through eighth sectors on the list, are the various paving and building compounds, asphalt, concrete and cement. The fourth and final group of major material inputs, corresponding to the final sector on the list, is specialty minerals used in well drilling operations.

The type of products for each of these sectors and their associated SIC codes were useful input to the interviewing process. Estimates were solicited on the usage of these various inputs for the particular activity under consideration. These estimates were often based on usage rates for particular pieces of equipment that were then multiplied by the number of units in use, the hours or days of use per piece of equipment and the cost per unit of the input. An example would be the gallons of fuel used per day for a pickup truck. This estimate would then be multiplied by the product of the number of pickup trucks and the number of days they were employed in the task. Total usage would then be multiplied by the cost of fuel. Since the products were already defined by SIC code and input-output sector it was a simple matter to code them to IMPLAN sector. As the estimates were in purchasers prices, rough estimates of shipping costs by mode and wholesale and retail margins (if applicable) had to be made prior to assignment to sectors. Finally, the area of production for each of the inputs was specified, so that the resulting values could be divided among the local community, the KPB, Anchorage, and the 49 States.

6. GOVERNMENT VECTORS AND REAL ESTATE COSTS

This Chapter provides information on the data development methodologies for the vectors of government spending and for costs for purchasing real estate for buildings or pipeline easements.

6.1 GOVERNMENT VECTORS

In addition to the E&D activities listed in Exhibit 2-4, IMPAK estimates direct economic impacts associated with government related expenditures. The methods used to estimate these impacts are somewhat different than the overall approach that was used to develop the other vectors in the model. Government revenues, as described below in Section 7.3.1 are distributed to a number of IMPLAN sectors. To carry out the allocation, separate input-output vectors were developed for local, state and federal governments. Each cell in the vectors represents a percentage of the respective total government expenditures. For the most part, it is assumed that all expenditures will take place in the region in which the government is located.

Vectors for state and local government expenditures were developed using data provided by MMS. The MMS data was developed using location-specific State and local budget data from the U.S. Census Bureau's Census of Governments and data from the national input-output accounts published by the U.S. Bureau of Economic Analysis. Table C in the national input-output accounts provides the commodity composition of Federal Government consumption and investment expenditures. To minimize the number of industries added to the model, we recalibrated the commodity expenditure shares using 95% of the value of commodity purchases. Expenditures in National Income and Products Accounts (NIPA) industry 82, reflecting government value added, were adjusted for taxes and savings and assigned to PCE. The proportion of the expenditures assigned to PCE was based on data from the Census of Governments and from published budgets of the relevant State and local governments.

6.2 REAL ESTATE COSTS

The costs to purchase real estate, other than the revenue flowing to real state agents, are typically not included in input-output models as they are assumed to be merely transfers between two parties creating no net economic impact. In the case of this model, however, where there are multiple geographic areas under consideration, one area can see a positive economic impact as money flows into the area. As this is an important source of revenue and economic impact in remote areas, an estimate of the value of the real estate is made and assigned to personal income. Note that the offsetting value of economic funds which may be thought of as the opportunity costs of the purchases, are not included.

Real estate costs are extremely variable, especially in remote costal areas, and therefore the values selected are an attempt to select a median value. Data were collected on both the value per acre and the number of acres required for the activities. Data were provided by both the project engineering staff based on their extensive experience in facility development and the many interviews conducted for this study and from the Manager of the Drift River Terminal who

provided specific experience on acreage requirements and land costs for petroleum production facilities and marine terminals. The estimates of values per acre, acreage requirements and total real estate or easement costs are provided in Exhibit 6-1. For projects in the Cook Inlet, these estimates were then allocated to total personal income by assuming that half of the value accrued to owners in the Kenai and half to owners in Anchorage. For remote projects, the Kenai percentage was reduced to 10 percent and the balance was assigned to the local area. Personal income was then converted personal consumption expenditures by area of spending using the same techniques as discussed above for labor income.

Exhibit 6-1: Estimates of Real Estate and Easement Costs (\$, 1,000)

Facility Type	Acreage	Cost Per Acre		Total Cost	
		Cook Inlet	Remote	Cook Inlet	Remote
Construct Exploration Shore Base	10.0	7,500	4,000	75,000	40,000
Construct Production Shore Base	5.0	7,500	4,000	37,500	20,000
Construct Onshore Production Facility	40.0	4,000	2,000	160,000	80,000
Construct Marine Terminal	160.0	4,000	2,000	640,000	320,000
Construct Onshore Pipeline	25.3	4,000	2,000	101,200	50,600
Construct Offshore Pipeline	25.3	4,000	2,000	101,200	50,600

7. DESCRIPTION OF THE MODEL

This chapter provides an overview of the model and describes how to use it to forecast manpower and expenditures needed to carry out oil exploration and development (E&D) operations in Sub-Arctic Alaska.

The main purpose of the model is to forecast the direct manpower and expenditures needed to conduct oil exploration and development (E&D) operations in Sub-Arctic Alaska. The model can be adapted to Cook Inlet, semi-remote areas that are near population centers, and other remote Sub-Arctic planning areas. The first round estimates are categorized in such a way that the IMPLAN economic impact model can be used to estimate the secondary economic repercussions associated with these E&D activities.

Sub-Arctic IMPAK is organized around a comprehensive set of activities which characterize oil exploration and development in the Sub-Arctic areas of Alaska. These activities are shown in Exhibit 7-1. For each activity, the model houses a cost vector of labor and commodity input requirements on a per unit basis. The commodities are defined according to IMPLAN's 1995 commodity/industry sector scheme. Costs are provided in 1999 dollars.

Beginning with the 2001 IMPLAN data (expected to be available near the end of the 2003), IMPLAN's sectors will be based on the new North American Industry Classification System (NAICs), a new sectoring scheme to be used for all Federal economic statistics. After that time, the Sub-Arctic IMPAK: First-Step model described in this documentation will remain a valid stand alone model. However, some adjustments may be necessary to use it to provide inputs to the IMPAK: Second-Step model files that MMS has developed to estimate employment, personal income, total value added etc.

The user is required to input some general data that describe a particular E&D scenario being evaluated. To make things easy for the user, most of these data can be obtained from MMS' E&D reports. These reports are prepared by MMS staff and describe any given proposed lease sale.

The model translates these user inputs into IMPAK activity levels and then multiplies the results by the cost vectors described above. The product and primary output of the model is a vector of the estimated expenditures by IMPLAN sector. The model produces separate vectors for each year in the forecast horizon. The model can handle up to 50 years in the forecast horizon.

As noted above, Sub-Arctic IMPAK allows the user to distinguish between three different types of geographic areas where E&D activity takes place. The three areas include Cook Inlet, semi-remote areas that are near population centers, and other remote Sub-Arctic planning areas.

The model also breaks down and assigns the cost estimates to geographic regions where the associated economic impacts accrue. Four regions are utilized: local, Kenai Peninsula Borough, the rest of Alaska, and the continental United States. The output is organized according to these geographic definitions and is presented on separate worksheet tabs accordingly. A generalized schematic of the model is presented in Exhibit 7-2.

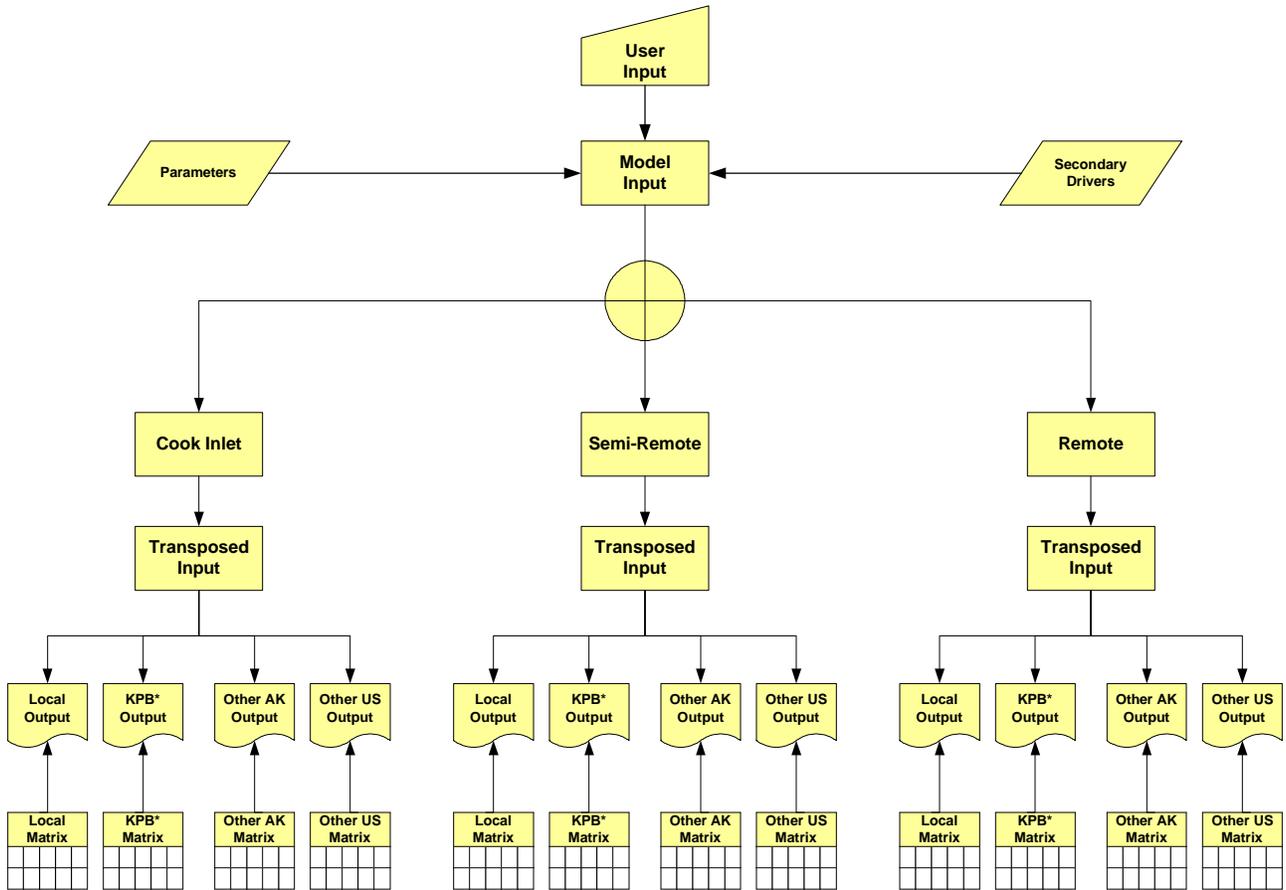
Exhibit 7-1: IMPAK Activities and Respective Units

<i>Activity</i>	<i>Unit</i>	<i>Unit Cost</i>
Seismic Survey	One Month	Cost Per Month
Spill Contingency Operations	Support for 3 Platforms	Annual Operating Cost [†]
Construct Exploration Base	One 3000 Sq. Ft. Facility	Construction Cost
Operate Exploration Base	One 3000 Sq. Ft. Facility	Annual Operating Cost [†]
Install Exploration Platform	One Exploration Platform	Installation Cost
Operate Exploration Platform	One Exploration Platform	Annual Operating Cost [†]
Drill Exploration Well	One Exploration Well	Cost to Drill 1 Well
Construct Production Base	One 7200 Sq. Ft. Facility	Construction Cost
Operate Production Base	One 7200 Sq. Ft. Facility	Annual Operating Cost [†]
Install Production Platform	One Production Platform	Installation Cost
Operate Production Platform	One Production Platform	Annual Operating Cost [†]
Drill Production Well	One Production Well	Cost to Drill 1 Well
Lay Offshore Pipeline	One Mile of Offshore Pipeline	Installation Cost
Lay Onshore Pipeline	One Mile of Onshore Pipeline	Installation Cost
Construct Production Facility	One 50 Million Barrel Facility	Construction Cost
Operate Production Facility	One 50 Million Barrel Facility	Annual Operating Cost [†]
Construct Marine Terminal	One 40,000 Gallon Capacity Terminal	Construction Cost
Operate Marine Terminal	One 40,000 Gallon Capacity Terminal	Annual Operating Cost [†]
Major Platform Maintenance	One Production Platform	Cost to Conduct 1 Maintenance
Well Workover	One Production Well	Cost to Conduct 1 Workover
Helicopter Support	One Hour	Operating Cost Per Hour*
Large Workboat	One Hour	Operating Cost Per Hour*
Small Workboat	One Hour	Operating Cost Per Hour*
Landing Craft	One Hour	Operating Cost Per Hour*
Dive Boat	One Hour	Operating Cost Per Hour*
Camp Support	One Year	Annual Operating Cost [†]
Abandonment	One Production Platform	Cost to Abandon 1 Platform

*Includes annualized capital costs.

[†]Takes into account the fact that some operations are not carried out over the entire year.

Exhibit 7-2: Model Flowchart



* Kenai Peninsula Borough

7.1 INSTALLATION

The application consists of an Excel spreadsheet file with supporting documentation activated through hyperlinks to PDF files. In order for the hyperlinks to work properly, the documentation and spreadsheet files should be copied to the same directory. The links will not work with shortcuts. The files that should be copied include:

Sub-Arctic_IMPAK.xls (MS Excel spreadsheet application)

Sub-Arctic_IMPAK Model Description.pdf (model documentation)

Sub-Arctic IMPAK Final Report.pdf (final report)

To maintain the documentation in a different directory, use Excel's Properties option to set the default address for hyperlinks in the file:

- 1.) On the File menu, click Properties.
- 2.) Click the Summary tab.
- 3.) In the Hyperlink base box, type the path you want to use.

When opening the file, the user may be prompted with a caution and a choice about enabling the macros contained in the file. The application will not work properly if the macros are disabled.

Whether or not the user sees the message will depend upon the security level set for macros in the user's version of Excel (see the Security Level tab in the Security dialog box (Tools menu, Macro submenu). Under all settings, if antivirus software that works with Microsoft Office XP is installed and the file contains macros, the file is scanned for known viruses before it is opened. For information on how to change the security settings and/or verify trusted file sources using digital signatures, see Excel's help files on the topic.

7.2 USER INTERFACE

IMPAK is a Microsoft Excel workbook consisting of numerous worksheets or pages. Most of these pages are designated by labeled tabs at the bottom of the screen and which the user can select with the mouse. The main screens are described in more detail below.

7.2.1 Documentation Screen

This screen contains hyperlinks to this help file and the final report. These files are in PDF file format so the user must have a version of Adobe's Acrobat Reader in order to view the files.

7.2.2 Model Setup Screen

This screen provides an avenue for altering some of the default settings used in the model.

Calculation

Under this option the user can choose how formulas in the model are updated when the user input data and/or parameters are changed.

- *Automatic* calculation: each time a cell's value changes, all other cells linked to it through formulas are immediately updated to reflect the new value. With large spreadsheets, the updating process can be somewhat slow, especially if the user's computer has limited memory and/or a relatively slow processor.
- *Manual* calculation: even though linked cell values change, formulas are not updated until the user presses F9. When the updating process is slow due to limited computer resources, this option allows the user to minimize the amount of time spent waiting for formulas to update.

Study Area

These selections specify where the E&D scenario takes place in Sub-Arctic Alaska and the user must choose one. The three choices include (1) Cook Inlet, (2) semi-remote regions that are near population centers and (3) remote regions that are not close to a population center. Based upon the circumstances and location of the E&D scenario, the analyst will need to use his/her own judgment to determine which choice best applies to the scenario under consideration. The choice determines which matrices, manpower vectors, PCE vectors and TPI drivers are used in the model. It should be noted that only one type of scenario can be modeled at one time.

Use of Existing Infrastructure

These options determine whether certain types of existing infrastructure will be used in the scenario or whether new infrastructure will have to be constructed to support the E&D operations. The potential types of existing infrastructure that are addressed include marine terminals, production facilities and shore bases. If an option is not selected, it is assumed that new infrastructure of the respective type will have to be constructed. See Section 7.3.1 for information on how the construction expenditure levels are estimated and when construction activities are assumed to occur.

- *Use Existing Marine Terminal*: If this box is not selected, the model assumes that a new marine terminal will have to be constructed and estimates the required resources to do so.
- *Use Existing Production Facility*: If this box is not selected, the model assumes that a new production facility will have to be constructed and estimates the required resources to do so.

- *Use Existing Shore Base:* If this box is not selected, the model assumes that a new shore base will have to be constructed and estimates the required resources to do so.

Initialize Forecast Horizon

Here the user specifies the first year in the forecast horizon. Since the Model Setup worksheet does not utilize a blinking cursor at the insertion point, it might be difficult to see that the initial year is already selected. Simply select the cell to the right of Initialize Forecast horizon (Average Water Depth) and enter the first year of the forecast. Subsequent years that are printed on the data entry screen, the output screens, and the manpower graph are determined by this initial year.

Average Water Depth

Average water depth is used to determine whether platforms are situated in deep water or shallow water. The value is compared to the parameter that specifies the criteria for deep water versus shallow water. If the scenario takes place in deep water, installation and operating costs are increased. See Sections 7.2.3 and 7.3.1 for more details.

7.2.3 Parameters Screen

This screen allows the user to modify the parameters used in model equations to estimate the activity levels for a given scenario. Unlike the variable inputs entered by the user on the Data Entry screen, parameters remain constant throughout the forecasts horizon.

- *Platform Related:* These parameters are used to relate the number of platforms to other activity levels.

Parameter	Description
Number of Platforms Supported by Each Spill Operation	The number of production and exploration platforms is divided by this parameter to estimate the size of the spill contingency operation needed for the scenario.
Number of Exploration Platforms Supported by a 3000 sq. ft. Shore Base	The number of exploration platforms is divided by this parameter to estimate the size of the exploration shore base needed for the scenario.
Number of Production Platforms Supported by a 7200 sq. ft. Shore Base	The number of production platforms is divided by this parameter to estimate the size of the exploration shore base needed for the scenario.

- *Water Depth:* These parameters allow the model to differentiate between different cost factors that apply to deep water versus shallow water scenarios.

Parameter	Description
Water Depth Determining Deep Water from Normal (feet)	This parameter is used to determine whether platforms are situated in deep water or shallow water.
Deep Water Operating Cost Factor	This factor is multiplied by the production platform operating cost vector to account for increased operating costs for platforms situated in deep water.
Deep Water Installation Cost Factor	This factor is multiplied by the production platform installation cost vector to account for the increased costs of installing deep water platforms.

- *Production Facility:* These parameters are used to estimate the size and operating levels of the production facility needed to support production levels in the scenario.

Parameter	Description
Construction Cost Per Annual Volume of Crude Processed (Dollars)	This parameter is multiplied by the maximum barrels of annual oil production to estimate the total resources needed to construct a production facility.
Annual Operating Cost Per Barrel of Oil Treated (Dollars)	This parameter is multiplied by annual oil production to estimate annual operating cost to treat the volume of oil produced in the scenario.
Cost to Build Model Production Facility	This parameter reflects the total construction cost of the facility upon which the production facility construction cost vector is based. It is used to calibrate the estimated construction costs in each scenario.
Annual Cost to Operate Model Production Facility	This parameter reflects the total operating cost of the facility upon which the production facility operating cost vector is based. It is used to calibrate the estimated operating costs in each scenario.

- *Marine Terminal:* These parameters are used to estimate the size and operating levels of the marine terminals needed to support production levels in the scenario.

Parameter	Description
Storage Capacity at Marine Terminal Given Daily Production Volume (Days)	This parameter reflects the average number of days that oil is stored at a marine terminal. The parameter is multiplied by average daily production to estimate the total number of days of storage needed for the scenario. This figure is then used to calculate construction cost of the terminal as well as annual operating cost.
Construction Cost Per Storage Capacity (Dollars Per Day of Storage Capacity)	This parameter reflects the average construction cost per day of storage capacity. It is multiplied by the maximum amount of daily storage capacity needed in the scenario to estimate the total construction cost of the marine terminal.
Annual Operating Cost Per Day of Storage Capacity	This parameter reflects the average annual operating cost per day of storage capacity. It is multiplied by the average daily storage capacity needed each year to estimate the annual operating cost of

	the marine terminal.
Cost to Build Model Marine Terminal	This parameter reflects the total construction cost of the facility upon which the marine terminal construction cost vector is based. It is used to calibrate the estimated construction costs in each scenario.
Annual Cost to Operate Model Marine Terminal	This parameter reflects the total operating cost of the facility upon which the marine terminal operating cost vector is based. It is used to calibrate the estimated operating costs in each scenario.

- **Boat Support:** These parameters are used to estimate the total hours of boat support required under the given scenario.

Parameter	Description
Adjustment in Miles Added to Straight-line Distance (miles)	A figure added to the distance from base user input to take into account the fact that most trips are not "as the crow flies".
Average Boat Speed (mph)	The average distance per trip is divided by this parameter to estimate the average hours of transit time per trip.
Hours Small Workboat Support Needed to Conduct 1 Month of Seismic Survey	This parameter is multiplied by the months of seismic survey work conducted to estimate the hours of small workboat related support.
Hours Dive Boat Support Needed to Conduct 1 Month of Seismic Survey	This parameter is multiplied by the months of seismic survey work conducted to estimate the hours of dive boat related support.
Number of Large Workboat Trips to Install 1 Exploration Platform	This parameter is multiplied by the number of exploration platforms installed each year to estimate the number of large workboat related support trips.
Number of Small Workboat Trips to Install 1 Exploration Platform	This parameter is multiplied by the number of exploration platforms installed each year to estimate the number of small workboat related support trips.
Number of Large Workboat Trips to Install 1 Production Platform	This parameter is multiplied by the number of production platforms installed each year to estimate the number of large workboat related support trips.
Number of Small Workboat Trips to Install 1 Production Platform	This parameter is multiplied by the number of production platforms installed each year to estimate the number of small workboat related support trips.
Annual Number of Large Workboat Trips to Operate 1 Production Platform	This parameter is multiplied by the number of operating production platforms each year to estimate the number of large workboat related support trips.
Annual Number of Small Workboat Trips to Operate 1 Production Platform	This parameter is multiplied by the number of operating production platforms each year to estimate the number of small workboat related support trips.
Annual Number of Large Workboat Trips to Operate 1 Exploration Platform	This parameter is multiplied by the number of operating exploration platforms each year to estimate the number of large workboat related support trips.
Annual Number of Small Workboat Trips to Operate 1 Exploration Platform	This parameter is multiplied by the number of operating exploration platforms each year to estimate the number of small workboat related support trips.

Number of Large Workboat Trips to Abandon 1 Production Platform	This parameter is multiplied by the number of production platforms abandoned each year to estimate the number of large workboat related support trips.
Number of Small Workboat Trips to Abandon 1 Production Platform	This parameter is multiplied by the number of production platforms abandoned each year to estimate the number of small workboat related support trips.
Number of Large Workboat Trips to Drill 1 Production Well	This parameter is multiplied by the number of production wells drilled each year to estimate the number of large workboat related support trips.
Number of Large Workboat Trips to Drill 1 Exploration Well	This parameter is multiplied by the number of exploration wells drilled each year to estimate the number of large workboat related support trips.
Number of Large Workboats to Lay 1 Mile of Offshore Pipe.	This parameter is used to estimate the hours of large workboat support needed to lay the offshore pipe in the scenario. It is multiplied by the miles of pipeline, number of days to install 1 mile of pipe, and the average daily hours of support provided.
Number of Dive Boats to Lay 1 Mile of Offshore Pipe.	This parameter is used to estimate the hours of Dive Boat support needed to lay the offshore pipe in the scenario. It is multiplied by the miles of pipeline, number of days to install 1 mile of pipe, and the average daily hours of support provided.
Annual Number of Landing Craft Trips to Construct 1 Marine Terminal	This parameter is used to estimate the hours of landing craft support needed to construct a marine terminal. During years which construction takes place, the parameter is multiplied by the average number of hours required to complete each trip.
Annual Number of Landing Craft Trips to Construct 1 Marine Terminal	This parameter is used to estimate the hours of landing craft support needed to construct a marine terminal. During years which construction takes place, the parameter is multiplied by the average number of hours required to complete each trip.
Annual Number of Landing Craft Trips to Operate 1 Marine Terminal	This parameter is used to estimate the hours of landing craft support needed to operate a marine terminal for one year. During years of operation, the parameter is multiplied by the average number of hours required to complete each trip.
Annual Number of Large Workboat Trips Needed to Support Major Platform Maintenance	During years of oil production, this parameter is multiplied by the number of operating production platforms to estimate the number of large workboat related support trips.
Annual Number of Small Workboat Trips Needed to Support Major Platform Maintenance	During years of oil production, this parameter is multiplied by the number of operating production platforms to estimate the number of small workboat related support trips.
Number of Large Workboat Trips to Support 1 Well Workover	This parameter is multiplied by the number of well workovers each year to estimate the number of large workboat related support trips.

- *Helicopter Support:* These parameters are used to estimate the total number of days of helicopter support required under the given scenario.

Parameter	Description
Number of Helicopter Trips Per Month of Seismic Survey	This parameter is multiplied by the number of months of seismic survey work each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Support a Spill Contingency Operation for 3 Platforms	This parameter is multiplied by the number of spill contingency operations each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Install a Platform in Shallow Water	This parameter is multiplied by the number of platforms installed in shallow water each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Install a Production Platform in Deep Water	This parameter is multiplied by the number of production platforms installed in deep water each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Operate 1 Production Platform	This parameter is multiplied by the number of operating production platforms each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Operate 1 Exploration Platform	This parameter is multiplied by the number of operating exploration platforms each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Abandon 1 Production Island	This parameter is multiplied by the number of production islands abandoned each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Drill 1 Well	This parameter is multiplied by the number of wells drilled each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Lay 1 Mile of Offshore Pipe	This parameter is multiplied by the miles of offshore pipe laid to estimate the number of helicopter related support trips. It was assumed that it would take 6.6 days on average to lay 1 mile of pipe.
Number of Helicopter Trips to Operate 1 Marine Terminal	This parameter is multiplied by the number of operating marine terminals each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Conduct Major Platform Maintenance	This parameter is multiplied by the number of operating production platforms each year to estimate the number of helicopter-related support trips.
Number of Helicopter Trips to Conduct 1 Well Workover	This parameter is multiplied by the number of well workovers each year to estimate the number of helicopter-related support trips.
Average Helicopter Speed (mph)	This parameter is used to convert the total number of helicopter trips into an hourly basis. Distance from base is divided by the parameter and the result is then multiplied by the number of trips.
Average Time to Load/Unload Cargo Personnel (hours)	This parameter is multiplied by 2 (to account for each trip end) and then added to the time it takes to complete each trip.

- *Government Revenue and Taxes:* These parameters are used to estimate government revenues for the local government, the State of Alaska, and the Federal government.

Parameter	Description
Royalty Paid for Oil Production	This parameter is multiplied by the value of oil production to estimate royalty revenues to the Federal government.
Fee Paid to Lease Land During E&D	This parameter is multiplied by leased acreage to estimate acreage rental payments to the Federal government.
Percent of 8(g) Revenues Returned to Alaska	This parameter is multiplied by total 8(g) revenues to estimate the amounts that contribute to Federal government revenues and state government revenues.
Percent of 8(g) Revenues Allocated to General Fund	This parameter is used to estimate the amount of the state's 8(g) revenues that are allocated to the state's general fund.
Percent of 8(g) Revenues Allocated to Permanent Fund	This parameter is used to estimate the amount of the state's 8(g) revenues that are allocated to the Alaska Permanent Fund.
Percent of AK Tax and 8(g) Revenues Distributed to each local government	This parameter is used to estimate the amount of state government revenues that are distributed to the local government.
Percent of Permanent Fund Balance Distributed to the Populace	This parameter is used to estimate Permanent Fund dividends that can be attributed to the oil industry activity in the given scenario.
Percent of Permanent Fund Dividend Allocated to the local residents	This parameter is used to distribute Permanent Fund dividends between local residents and Other Alaska residents.
Percent of local Permanent Fund Dividend Spent Locally	This parameter is used to determine where local residents spend their Permanent Fund dividends. The amounts are added to PCE estimates in the various regions.
Local Tax Revenues as a Percent of Total Income	This parameter is multiplied by the amount of personal income generated to estimate the amount of local government revenues generated from taxes.
State Tax Revenues as a Percent of Total Income	This parameter is multiplied by the amount of personal income generated to estimate the amount of state government revenues generated from taxes.
Federal Tax Revenues as a Percent of Total Income	This parameter is multiplied by the amount of personal income generated to estimate the amount of federal government revenues generated from taxes.

- *Miscellaneous*: These parameters are used to produce a variety of estimates used in the model.

Parameter	Description
Total Camp Expenditures for 1 Camp Operation	This parameter is used to determine the level of camp support operations required in the given scenario.
Gasoline Price (1999 Dollars Per Gallon)	This parameter is used to estimate fuel purchases and is multiplied by the gallons of fuel consumed in each activity. The parameter reflects the price of gasoline at the factor gate and does not include transportation or retail margins.
Number of Days to Lay 1 Mile of Offshore Pipe	This parameter converts mileage of pipe into days of activity. This is necessary in order to estimate the level of boat activity (calculated on a daily basis) needed to support the offshore pipe laying operation.
PCE as a Percent of Disposable Income	This parameter is used to determine the amount of Permanent Fund income that is spent on consumption and allocated to PCE.
Personal Savings as a Percent of Disposable Income	This parameter is multiplied by the amount of personal income generated to estimate personal savings.

7.2.4 Data Entry Screen

The Data Entry screen presents the user with a table organized by year and E&D activity. The analyst must enter the numbers of each activity that occur in a given year. For example, the analyst will enter the number of production platforms constructed in each year. Shown below in Exhibit 7-3, most of these activities can be obtained from MMS's E&D Scenario/Schedule. The one exception is "Distance from Base" which specifies the average straight-line distance between the shore base used and the platforms. This variable is used to calculate transit time for boat and helicopter operations.

Note that the activities in Exhibit 7-3 are somewhat different than the ones presented above in Exhibit 7-1. Through a number of formulas, the data entered by the user are converted into quantities that correspond to the activities defined in the Exhibit 7-1.

To develop an accurate analysis, the user should enter as much information as possible. The temporal profile of the data that is entered should also reflect the actual timeline that MMS expects to see for a given scenario: for example, aggregating the inputs and entering them into a single year may lead to anomalous results since many of the formulas have temporal components.

Since the matrices, PCE vectors and TPI vectors were developed in 1999 dollar values, data entry variables that are in dollar value units need to be stripped of inflation and computed in constant 1999 dollars.

Once the data has been entered, the user should be able to review the results almost immediately simply by clicking on the appropriate tab. If calculation is set to "manual", you will need to first press F9 so that the formulas are updated; otherwise the results will not correspond to the most recent data inputs.

As described in Section 7.3.1, these inputs are converted into IMPAK activity (Exhibit 7-1) levels and then used to estimate corresponding expenditures. The conversion takes place on the Data Entry screen in an area not visible to the user. To view these columns, please follow the steps below:

1. Unprotect the sheet. From the menus system, choose Tools|Protection|Unprotect Sheet and then enter the password.
2. Make sure that the column and row headers and vertical and horizontal scroll bars are visible. From the menu system, choose Tools|Options|View and then enter the appropriate selections.
3. Select and Display the hidden columns. Use your mouse to select column "T". Next, while pressing the "Shift" key, use your mouse to select column "T" again and then while continuing to hold down the left mouse button move the pointer right off of the page into the gray area. Release the shift key. From the menu system, choose Format|Columns|Unhide.

Exhibit 7-3: E&D Data Entry Requirements and Respective Units

<i>Variable</i>	<i>Unit</i>
Distance from Base	(Feet)
Seismic Survey	(Months)
Exploration Wells	(Number)
Delineation Wells	(Number)
Exploration Platforms	(Number)
Production Wells	(Number)
Production Platforms	(Number)
New Offshore Pipeline	(Miles)
New Onshore Pipeline	(Miles)
Total Oil Production	(Million Barrels)
8(g) Oil Production	(Million Barrels)
Oil Price	(1999 Constant Dollars per Barrel)
Total Gas Production	(Billion Cubic Feet)
8(g) Gas Production	(Billion Cubic Feet)
Gas Price	(1999 Constant Dollars Per Thousand Cubic Feet)
Total Lease Acreage	(Thousand Acres)
8(g) Lease Acreage	(Thousand Acres)
Total Bonus Bid	(Millions of 1999 Constant Dollars)
8(g) Bonus Bid	(Millions of 1999 Constant Dollars)

7.2.5 Output Screens

Output for a scenario is provided in tabular form on five different screens. The LocalOutput screen presents industry expenditures (by IMPLAN sector) and direct manpower that take place within and are provided by the local economy. Also included are expenditures and employment by the local government, personal consumption expenditures (PCE) that take place within the local economy, and total personal income (TPI) and savings that are generated for local residents.

Note that the production manpower estimates are provided in four different metrics: man-hours, man-days, man-weeks, and man-years. A separate graph for each series is provided. Conversion factors used to derive the different metrics are provided in Chapter 3 in the final report.

The KenaiOutput screen presents industry expenditures (by IMPLAN sector), personal consumption expenditures (PCE), total personal income (TPI), and savings that are generated within the Kenai Peninsula Borough (KPB). When the Study Area is Cook Inlet, please note that the local borough is KPB; for this reason, industry purchases, PCE and TPI values are set to zero on the LocalOutput screen when the Study Area is Cook Inlet.

The AKOutput screen presents industry expenditures (by IMPLAN sector), personal consumption expenditures (PCE), total personal income (TPI), and savings that are generated within Alaska areas other than the local borough and KPB.

The USOutput screen presents industry expenditures (by IMPLAN sector), personal consumption expenditures (PCE), total personal income, and savings that are generated within the continental US or Hawaii.

The TotalOutput screen presents the sum of the expenditures from the four previous screens. The analyst should exercise caution in using the sums to estimate the total cost of a project since foreign purchases are not included.

Please note that personal consumption expenditures reflect household purchases of commodities and services in an area and should be used to estimate the induced impacts in a region. The figures are derived from estimates of disposable income (total earnings minus taxes and savings) and take into account differences between where income is earned and where it is spent.

It is possible that some of the IMPLAN industry sectors, which show positive values, may not be present in a given IMPLAN model of a local Alaska economy. This is particularly true for economies that have not been specifically identified (i.e., remote or semi-remote economies) and which vary in terms of industry mix. There are a number of ways for an analyst to deal with this type of situation. For example, the impacts could be assigned to a neighboring region at the same geographic level (e.g., the Kenai Peninsula Borough) or a region at a higher geographic level (e.g., Other Alaska). A fair amount of subjectivity will be involved in making such an assignment and the analyst will need to rely upon the particular circumstances at hand for guidance. Another approach would involve using the IMPLAN software to construct a model of the specific economy in question. In this case, the analyst would first have to create a model of a similar economy that contained the missing industry. If this proves to be too difficult, a state-level model would probably suffice. After this first model has been constructed, the analyst should use IMPLAN's production function editing tools to save the missing industry's production function to IMPLAN's library. The next step is to construct an IMPLAN model of the actual local economy being addressed. During this process, the analyst should use IMPLAN's production function editing tool to import the production function of the missing industry and which was previously saved to IMPLAN's library. After this has been accomplished, it will be possible to retrieve the multipliers associated with the missing industry and needed to estimate the indirect and induced effects.

7.2.6 Graphs

Four screens graphically depict the amount of manpower needed to conduct the scenario under consideration. A different metric is used for each chart. The data used to populate the graphs are taken from the LocalOutput screen and refer to labor directly involved in oil exploration, development and production activities. Management and overhead personnel who are not directly involved in the activities are not included in the totals. The figures also do not include local government employment that is stimulated by the E&D activity; these data, however, are provided at the bottom of the LocalOutput screen.

Also provided are graphs for total personal income and total expenditures. In both cases, data by area are presented together.

7.3 MODEL PROCESSING ENGINE

7.3.1 Conversion of Data Entry Input into IMPAK Activity Levels

Since the activities listed in the E&D reports are not identical to those used in IMPAK, the model has to convert the E&D data into the corresponding IMPAK activity levels. The result of this translation takes place on the DataEntry Worksheet. The conversion is a function of model equations, the model parameters contained in the Parameters Worksheet, and the secondary activity drivers contained in the Secondary Drivers Worksheet. Details of the process are provided below.

Activity 1: Geological Survey

Currently, there are no E&D data that can be used to estimate this activity level and the user will have to enter the total number of months of geo-surveys required for all activities in the E&D scenario.

Activity 2: Spill Contingency Response

The number of spill contingency response operations required is based on the number of platforms in operation. The number of platforms needing spill containment support is equal to the number of production platforms established since the inception date. To be consistent with the expenditure vector, this figure is calibrated by dividing it by the average number of platforms supported by a spill containment operation. This parameter is currently set at five platforms per spill response operations, but can be changed by the analyst.

Activity 3: Construct Exploration Shore Base

This activity may not be required if existing underutilized exploration shore bases exist, such as in the Cook Inlet area. The analyst selects whether to use existing shore bases.

If existing exploration shore bases are not utilized the number needed is based on the number of exploration platforms in operation. The number of exploration platforms requiring shore base support is equal to the number of exploration platforms established since the inception date. To be consistent with the expenditure vector, this figure is calibrated by dividing it by the average number of exploration platforms supported by an exploration shore base operation. This parameter is currently set at three exploration platforms per exploration shore base, but can be changed by the analyst, if data are provided in the E&D report, for example.

Activity 4: Operate Exploration Shore Base

The number of exploration shore bases required to be operating is based on the number of exploration platforms in operation. The number of exploration platforms requiring shore base support is equal to the number of exploration platforms listed in the E&D report for that current year. Therefore, to estimate the required number of exploration shore bases, the model divides the number of exploration platforms by the average number of exploration platforms supported by an exploration shore base operation, a parameter which is specified on the Parameters Worksheet. The parameter is currently set at three exploration platforms per shore base, but can be changed by the analyst, if data are provided in the E&D report, for example.

Activity 5: Install Exploration Platform

The number of exploration platforms installed is equal to the number of exploration platforms listed in the E&D report for that current year. All explorations platforms are assumed to be installed in shallow water.

Activity 6: Operate Exploration Platform

The number of exploration platforms operated is equal to the number of exploration platforms listed in the E&D report for that current year. All explorations platforms are assumed to operate in shallow water.

Activity 7: Drill Exploration Well

The number of exploration wells drilled is equal to the number of exploration and delineation wells listed in the E&D report for that current year. All exploration wells are assumed to be drilled from platforms situated in shallow water.

Activity 8: Construct Production Shore Base

This activity may not be required if existing underutilized production shore bases exist, such as in the Cook Inlet area. On the Parameter Worksheet, the analyst selects whether to use existing shore bases.

The number of production shore bases that need to be constructed is based on the number of production platforms in operation. The number of production platforms requiring shore base support is equal to the number of production platforms established since the inception date. Therefore, to estimate the required number of production shore bases, the model divides the number of production platforms by the average number of production platforms supported by a production shore base operation, a parameter which is specified on the Parameters Worksheet. The parameter is currently set at three production platforms per production shore base, but can be changed by the analyst, if data are provided in the E&D report, for example.

Production shore bases are built the year before the production platforms are installed.

Activity 9: Operate Production Shore Base

The number of production shore bases required to be operating is based on the number of production platforms in operation. The number of production platforms requiring shore base support is equal to the number of production platforms established since the inception date. To be consistent with the expenditure vector, this figure is calibrated by dividing it by the average number of production platforms supported by a production shore base operation. This parameter is currently set at three production platforms per production shore base, but can be changed by the analyst, if data are provided in the E&D report, for example.

Activity 10: Install Production Platform

The number of production platforms installed is equal to the number of production platforms listed in the E&D report for that current year. The vector is calculated for a shallow water platform and is scaled by a factor of two for deep-water platforms. The analyst can change this factor on the Parameters Worksheet. In addition, please note that boat support and helicopter support are automatically increased to reflect the higher installation costs in deep water.

Activity 11: Operate Production Platform

The number of production platforms in operation is equal to the sum of production platforms listed in the E&D report since the inception date. The vector is calculated for a shallow water platform and is scaled by a factor of two for deep-water platforms. The analyst can change this factor on the Parameters Worksheet. In addition, please note that boat support and helicopter support are automatically increased to reflect the higher operating costs in deep water.

Activity 12: Drill Production Well

The number of production wells drilled is equal to the number of production wells listed in the E&D report for that current year. The vector is calculated for a well drilled from a shallow water platform. By altering a factor on the Parameters Worksheet, the analyst

can scale the costs for wells drilled from deep water platforms. The default value of the scalar was set to "1", implying no cost differential between shallow and deep water wells. Given the prevalence of non-vertical well drilling techniques, water depth in the Alaskan OCS is often only a small percentage of the total well depth (or length). High fixed costs for well set-up also mean that the difference between shallow and deep water depths will translate into relatively smaller cost increases. If the analyst does choose to increase the well drilling cost in deep water, please note that boat support and helicopter support will automatically increase to reflect the higher drilling costs in deep water.

Activity 13: Lay Offshore Pipeline

The number of pipeline miles is equal to offshore pipeline miles, specified in the E&D report, for that current year. Please note that although different approaches are used to lay pipe in shallow water versus deep water, the per-unit installation costs are the same. Therefore, no adjustment is made for installing pipeline in deep water.

Activity 14: Lay Onshore Pipeline

The number of pipeline miles is equal to onshore pipeline miles, specified in the E&D report, for that current year.

Activity 15: Construct Onshore Production Facility

This activity may not be required if existing underutilized production shore bases exist, such as in the Cook Inlet area. The analyst selects whether to use existing production facilities. Production facilities are built in the two years before production begins. Their size is based on the maximum yearly oil production.

Activity 16: Operate Production Facility

The vector for the cost of operating the production facility is developed on a per barrel basis. The number of barrels produced in each year, as specified in the E&D report, is then multiplied by the per barrel costs.

Activity 17: Construct Marine Terminal

This activity may not be required if existing underutilized marine terminals exist, such as in the Cook Inlet area. The analyst selects whether to use existing terminal facilities. Terminal facilities are built in the two years before production begins. Their size is based on the maximum yearly oil production.

Activity 18: Operate Marine Terminal

The vector for the cost of operating the terminal facility is developed on a per barrel basis. The number of barrels produced in each year, as specified in the E&D report, is then multiplied by the per barrel costs.

Activity 19: Major Platform Maintenance

The number of platform maintenance operations is based on the assumption that each production platform listed in the E&D report will need maintenance every year. It is assumed that all platforms continue operation until oil production ceases.

Activity 20: Well Workover

The number of well workovers is based on the assumption that each production well listed in the E&D report will need maintenance every six years. It is assumed that all wells continue operation until oil production ceases.

Activity 21: Helicopter Support

The amount of helicopter support is not directly entered by the user but is a function of the activity levels of the activities 1-20. These levels are multiplied by parameters which specify the amount of helicopter support per unit of each activity. The helicopter cost vector is based on an hourly rate, since this is the most accurate data available. The model, therefore, calculates the hours of support required. For each activity requiring helicopter support, the product of the number of helicopter trips per activity unit and the number of activity units is calculated. These results are then summed and converted into total trips of helicopter support. Helicopter trips are then converted into hours of operation. Hours are based on a formula that assumes a half-hour combined for take-off and landing and an average travel speed of 100 mph. Distance is an input that is specified by the analyst. In deep water scenarios, please note that helicopter support is indirectly elevated through cost increases for platform installation, platform operation, and well drilling.

Activities 22 - 25: Boat Support:

The amount of boat support is not directly entered by the user but is a function of the activity levels of the activities 1-20. These levels are multiplied by parameters which specify the amount of boat support per unit of each activity. The boat support cost vectors reflect hourly costs and are based on a daily rate and a ten-hour day, since daily rates are the most accurate data available. The model, therefore, calculates the hours of support required. For each activity requiring boat support, the product of the number of boat trips (by type of boat) per activity unit and the number of activity units is calculated. These results are then summed and converted into total trips of boat support by type of boat. Boat trips are then converted into hours of operation. Hours are based on a formula that assumes an average travel speed. Distance is an input that is specified by the analyst and augmented by a circuitry factor. In deep water scenarios, please note that boat support is indirectly elevated through cost increases for platform installation, platform operation, and well drilling.

Activity 26: Camp Support

The amount of camp support is not directly entered by the user but is a function of the activity levels of the activities 1-25. Expenditures for food and lodging were estimated for every activity except general personnel transportation. These expenditures, presented on the Secondary Drivers Worksheet, are normalized by the total cost of running a camp, multiplied by the corresponding activity levels, and then summed. When the sum is multiplied by the camp support input vector, the result will be the same as if the food and lodging expenditures had been allocated to input sectors based upon each commodity's share of the total cost of a camp operation.

Activity 27: Abandonment

Expenditures to abandon production platforms at the end of their useful lives are based on the number of production platforms installed during the scenario. The vector for the cost of abandonment was developed on a per platform basis. It is assumed that all abandonment activities take place the year after all other E&D activities have ceased. The total number of production platforms installed over the forecast horizon is then multiplied by the per platform costs.

Activities 28 - 30: Government

The amount of government related expenditures is not directly entered by the user but is a function of the amount of personal income generated by the other activities in the model. The model uses various government revenue functions to stimulate three government expenditure vectors: local government, the Alaska State government, and the US Federal government. In all three cases, government expenditures in the current period are assumed to be equal to revenues generated in the previous year.

The revenue function for a specific jurisdiction can be modeled by trying to imitate each revenue instrument or by using proxies. For many revenue sources, the former approach would be extremely time-consuming to implement, fraught with the potential of compounding errors in estimation, and difficult to adapt for changing fiscal regimes. In addition, the means by which State and local governments obtain revenues will vary over time and, certainly, from jurisdiction to jurisdiction. IMPAK instead uses a combination of the two approaches to estimate revenues resulting from new OCS activities. It directly estimates State (and local shares of) revenues from the Federal Government but uses proxies to estimate tax revenues.

State and Local Government

State and local government expenditures are a function of two primary revenue sources: (1) state and local tax revenues and (2) state revenues obtained from 8(g) funds.

Estimates of tax revenues by jurisdiction are based on ratios of total tax revenues to total personal income developed from data in the *Statistical Abstract of the United States*. To produce the revenue estimates, the ratios are multiplied by the amount of total personal income generated from the E&D activities in an IMPAK scenario. Total Personal Income is used as a proxy for the general level of economic activity, reflecting changes in infrastructure investment, production, property assessments, and government tax revenues. By using the relationship between Total Personal Income and government tax revenues, IMPAK can be adapted to changing fiscal regimes or for use with other local government entities, such as individual villages. However, given the small size of these jurisdictions, and the difficulty of obtaining good data, the user should be careful to seek independent confirmation of the revenue estimates.

Neither the State of Alaska nor local government has a broad-based income tax or a general sales tax, so state and local tax revenues are collected through property taxes, indirect business taxes (IBT), licenses (hunting, motor vehicle, etc.), and selective sales taxes (alcohol, insurance, motor fuel, and utility). The average ratio between total state tax revenues and total personal income in Alaska was calculated to be 1.6% between 1995 and 1997. The average ratio between total local tax revenues and total personal income in the state was calculated to be 5.17% over the same period. This average local tax ratio was applied to all Alaska residents. It should be noted that both the state and local tax parameters can be changed on the Parameters screen.

OCS oil activities provide income for Alaska residents through worker earnings and increases in the annual Permanent Fund dividends. Estimates of local earnings are obtained by summing, across activities, the product of earnings per unit and number of units. To estimate PF dividends, the model maintains a running PF balance based upon annual disbursements and additions generated by the level of E&D activities specified in the scenario. It should be emphasized that IMPAK's PF account only deals with funds related to the scenario under consideration; its balance and dividends, therefore, do not correspond to the actual values associated with the fund itself. Total dividends to Alaska residents are calculated by multiplying the dividend rate (a parameter) by the balance in the previous year. Parameters are then used to assign a portion of the total dividends to residents of the local community, the Kenai Peninsula Borough, and Other Alaska residents.

As noted above, revenues are also derived from 8(g) funds. Under section 8(g) of the OCS Lands Act, as amended, the Federal Government must pay to the State 27 percent of all revenues (bids to obtain leases, annual lease rental payments, and royalties on production) for leases within 3 miles of State waters. In IMPAK, 8(g) revenues are directly estimated based upon projected 8(g) bids, leases and oil production. Estimated royalties are the product of the royalty rate (a parameter,) 8(g) oil production, and price per barrel; production and price are both user inputs. Lease revenues are the product of 8(g) lease acreage (a user input) and the

acreage rental rate (a parameter). Bonus bids are input by the user. Twenty-seven percent of the total 8(g) revenue is then allocated to Alaska, where it is divided equally between the State budget and the Alaska Permanent Fund. Through the Parameters Worksheet, the user can change the default for any of the relevant rates: the Federal royalty rate, the 8(g) payment rate, the percentage of 8(g) revenues going into the Permanent Fund, etc.

Local governments receive none of these payments directly. However, a small portion of State funds is distributed to these governments as intergovernmental revenues. The proportion of the state revenues going to local governments can be changed on the Parameters Worksheet.

Federal Government

Federal government expenditures are a function of two primary revenue sources: (1) federal tax revenues generated from earnings, and (2) federal revenues obtained from royalties, lease revenues, and bonus bids. Government expenditures in the current period are assumed to be equal to revenues generated in the previous year.

Tax revenues are estimated by applying a federal tax rate to earnings that can be attributed to E&D activities (including government) in the scenario. Earnings are obtained by summing, across activities, the product of earnings per unit and number of units. These results are provided on the USOutput screen. The federal tax rate, a parameter, was estimated to be 11.7%. This was calculated as the average ratio between 1996 federal individual income tax returns of Alaska residents and personal income in the state in 1996 (The data were obtained from the Statistical Abstract of the United States.). Tax revenues were estimated for all US residents involved in the scenario. These include production workers directly involved in the E&D activities as well as overhead support personnel such as oil company employees serving engineering or administrative functions.

Other Federal revenues were estimated from total royalties, lease rental revenues, and bonus (auction) bids, less the portion of these amounts paid to Alaska under section 8(g) of the OCS Lands Act (see above). Royalties are the product of the royalty rate (a parameter,) total oil production, and price per barrel; production and price are both user inputs. Lease revenues are the product of total lease acreage (a user input) and the acreage rental rate (a parameter). Bonus bids are input by the user.

7.3.2 Secondary Drivers Worksheet

This worksheet is not displayed but is used in the model to estimate the amount of camp support needed for a given scenario. Camp support is the only secondary activity in the Sub-Arctic model and it is a function of the amount of activity generated by all of the other primary activities. The amount of camp support generated by one unit of each primary activity is

maintained on this page as a vector of secondary activity. For each year in the forecast horizon, the secondary activity vector is multiplied by the primary activity levels and the resulting products are then summed to estimate total camp support. Before the multiplication occurs, note that the secondary activity levels are first calibrated by the level of camp support (i.e., the size of the camp) that was used to develop the camp support expenditure vectors. The calibration is necessary to scale the activity and associated expenditures according to the size of the operation.

To view the page, select the following from Excel's menu system: Format | Sheet | Unhide | SecondaryDrivers.

7.3.3 TransposeInput Worksheet

This worksheet is not displayed but is used as an intermediary step to facilitate the multiplication of the matrices and arrays in the model. The sheet transposes the data on IMPAK activities (see Exhibit 7-1), which are calculated from the data entry inputs (See Exhibit 7-3 and Section 7.3.1) by year and activity. An Excel array function (transpose) is used to accomplish the task.

To view the page, select the following from Excel's menu system: Format | Sheet | Unhide | TransposeInput.

7.3.4 Activity Cost Vectors

These screens are not displayed but allow the user to view the input-output vectors and coefficients associated with each IMPAK activity and geographic region. Please note that only four out of the twelve matrices will be used for any model run, depending upon whether the scenario is in Cook Inlet, a semi-remote region near a population center, or in another remote Sub-Arctic region (See Section 7.2.2). The matrices show the commodities (IMPLAN sector) and associated values purchased by each activity. Values are in constant 1999 dollars and reflect the amounts needed to produce one unit of each respective activity. Included in the matrices are expenditures for labor (referred to as total personal income (TPI)), personal consumption expenditures generated from TPI, and manpower estimates.

Each column in a given matrix is multiplied by the corresponding activity level generated from the scenario data to produce an estimate of purchases by activity, commodity and year. For each year, these results are then summed across activities, resulting in an estimate of total purchases by year and commodity (See Section 7.3.5 below).

To view a matrix, select the following from Excel's menu system: Format | Sheet | Unhide | Name of WorkSheet. The worksheet names are self-explanatory and correspond to the respective matrices on the sheets.

7.3.5 Generation of Model Output

The model inputs are first transposed into a matrix compatible with the regional input-output matrices (See Section 7.3.3). The transposed input is then multiplied by each region's input-

output matrix to yield the total direct impacts by region and IMPLAN sector. Again, an Excel array function is used to accomplish the matrix multiplication (mmult). Note that each year in the forecast horizon requires a separate formula.

It should be noted that annual Permanent Fund (PF) disbursements arising from E&D activities in the scenario are converted and added to PCE at this time. As noted above, the dividends are estimated for both local and "Other Alaska" residents. The disbursements are adjusted for savings and taxes and then allocated to local spending areas. For example, after the tax and savings adjustment, PF disbursements to local residents are then divided between the local borough and Other Alaska. The adjustment for taxes is based upon the tax rate parameters found on the Parameters Worksheet. The PCERate parameter is used to adjust for savings and specify the percentage of disposable income assigned to personal consumption expenditures (PCE). The parameter is currently set at 98% with the remaining 2% going to savings. A location parameter (LocalPFExpenditurePercent) is used to divide the PCE into the areas where it is spent. The parameter is currently set at 10%, meaning that local residents spend 10% of their PF dividend, after adjustments for taxes and savings, in the local borough; the remainder is assumed to be spent in "Other Alaska". Estimated PF expenditures in "Other Alaska" are based upon the dividends to all Alaska residents. PF expenditures by "Other Alaska" residents are assumed to take place entirely in "Other Alaska". Added to these expenditures are purchases by local residents. As implied above, it is assumed that 90% of local PF expenditures are made in "Other Alaska".