

2 PROJECT EXPENDITURES

This section provides a brief description and summary of estimated expenditures, workforce demands and logistics requirements for the project components on the basis of information available at the time of writing.

2.1 Project Expenditures

The estimated project expenditures for planning, design, construction, operations, maintenance, decommissioning and abandonment are presented by project component.

Capital expenditures for each component are expected to be concentrated mainly during construction, from 2006–2007 to 2009–2010. However, there will be some capital expenditures before 2006–2007 and after 2009–2010. Expenditures occurring after 2009–2010 will pertain to ongoing drilling programs.

Operating expenditures for each component are expected to start in 2010 and continue until 2035. In addition, the life of the project could extend well beyond 25 years if additional natural gas reserves are discovered.

2.1.1 Expenditures – Anchor Fields

The project will be anchored by development of about 172 Gm³ of sweet natural gas from three natural gas fields, Niglintgak, Taglu and Parsons Lake. Each development will include production wells and a gas conditioning facility.

2.1.1.1 Niglintgak

Planning, Design and Construction

Shell Canada Limited (Shell) will develop Niglintgak, starting in 2006. The field is located near the southern end of Niglintgak Island in the Mackenzie Delta, within the Kendall Island Bird Sanctuary. The field is about 120 km northwest of Inuvik and 85 km west of Tuktoyaktuk.

The Niglintgak development plan is based on about 27 Gm³ of raw natural gas and natural gas liquid (NGL) production. The field will primarily produce lean dry natural gas. The field is expected to be in production for about 25 years.

Field development will include:

- three well pads (north, central and south)
- six to 12 production wells
- a gas conditioning facility
- a disposal well

SECTION 2: PROJECT EXPENDITURES

- flow lines
- a remote drilling sump
- supporting infrastructure

The initial field development will involve drilling four wells from the proposed north pad and one well from each of the proposed central and south pads. Up to six additional wells might be drilled from the proposed pads, depending on the production performance of the initial development wells. The wells will be drilled over three winter seasons. One rig will be used for the first season, and a second rig will be added for the second and third seasons. Well completion and testing is planned for winter and summer. Elevated steel pads will be installed at each well pad to support the drilling rig and its equipment.

Well pad facilities will collect production from the wells and direct it to the above-ground flow lines for delivery to the gas conditioning facility. The flow lines will rest on piled metal supports at least 2 m above the ground surface. Return lines providing utilities will run from the gas conditioning facility back to the wells on the same supports as the flow lines.

The gas conditioning facility will compress, dehydrate, chill and meter the production in preparation for delivery into the Niglintgak lateral.

Two options are currently being considered for the Niglintgak gas conditioning facility:

- placing it on a barge in a side channel of Kumak Channel adjacent to Kumak Island, referred to as Little Kumak Channel. This is referred to as the barge-based option.
- placing it on land east of Kumak Channel. This is referred to as the land-based option.

The barge-based option is currently preferred because it reduces the amount of land area disturbed, and has the lowest capital cost and cost risk.

In the barge-based option, a steel substructure and the gas conditioning facility will be fabricated at an off-site location, likely within the Pacific Rim. The facility will be transported around Point Barrow, Alaska, along the northern coast of Alaska to the Beaufort Sea. The facility will then be moved up the Mackenzie River to the installation site at Niglintgak. The facility will be a permanent installation for the life of the project, grounded on the riverbed and held in place by piles. Two bridges will connect the facility to shore.

In the land-based option, the gas conditioning facility foundation will be constructed of a combination of borrow material, steel decking and piles. All facility processes and equipment will be comparable to the barge-based option.

Initial capital expenditures for Niglintgak field development are expected to total \$369 million. Details of the Niglintgak capital expenditures are shown in Table 2-1.

Table 2-1: Capital Expenditures – Niglintgak, Barge-Based Option

Component	2002 (\$M)	2003 (\$M)	2004 (\$M)	2005 (\$M)	2006 (\$M)	2007 (\$M)	2008 (\$M)	2009 (\$M)	Total (\$M)
Engineering and project management ¹	1	4	4	6	18	18	14	7	72
Line pipe and piping materials	0	0	0	0	0	0	13	0	13
Major equipment and modularization ²	0	0	0	0	14	97	28	0	138
Logistics	0	0	0	0	0	0	3	0	3
Construction ³	0	0	0	0	0	0	7	9	16
Camp building set-up and catering	0	0	0	0	1	4	5	5	15
Drilling site preparation and site construction	0	0	0	0	4	6	2	2	14
Drilling and service wells	0	1	1	1	1	25	41	30	98
Total	1	4	4	7	37	149	113	54	369

NOTES:

1 Engineering and project management includes engineering and project management team (PMT) costs

2 Major equipment and modularization includes modularization, prefabricated modules and production

3 Construction includes workforce transportation, fuel, construction equipment rental, installation labour, granular delivery, granular royalty, facility site preparation and facility construction

Figures are in millions of constant \$2003

There are no capital expenditures for 2010 to 2023

Preliminary estimate for the land-based gas conditioning facility alternative is 10 to 15% higher than the barge-based gas conditioning facility

Numbers might not add up because of rounding

SOURCE: Shell (2004a)

Operations and Maintenance

The wells, flow lines and gas conditioning facility will be monitored, locally and remotely. Corrosion will be monitored and equipment inspected regularly. The wells will be serviced according to industry practice. Where practical, maintenance work will be done during winter when the site can be accessed by a winter road. Summer well maintenance will be done as required, using helicopter, aircraft and barge support. Inspection and maintenance programs will be planned and executed to ensure safe and reliable operations.

The estimated annual average operations and maintenance expenditures at Niglintgak over the life of the gas field are \$10 million.

Decommissioning and Abandonment

The Niglintgak facilities will be decommissioned at the end of their production life. Regulatory agencies will provide approvals to decommission and reclaim the surface components. The production and disposal wells will be abandoned according to National Energy Board requirements and the *Canada Oil and Gas Operations Act* (Government of Canada 1985).

Expenditures associated with decommissioning and abandonment are not available at this time.

2.1.1.2 Taglu

Planning, Design and Construction

Imperial Oil Resources Limited will develop Taglu starting in 2006. The field is located near the confluence of Kuluarpak and Harry channels of the Mackenzie River, and lies within the Kendall Island Bird Sanctuary. The field is about 120 km northwest of Inuvik and 70 km west of Tuktoyaktuk. The Taglu development plan is based on about 81 Gm³ of raw natural gas and NGL production. The field will be in production for about 30 years.

Field development will include:

- one well pad
- 10 to 15 production wells
- a gas conditioning facility
- flow lines
- one to two disposal wells
- supporting infrastructure, including an airstrip

Field development will involve drilling five to seven production wells from a single well pad. Full field development will require drilling an additional three to eight production wells from the same well pad within 10 years of start-up. The initial drilling program will occur uninterrupted for about 16 months. The well pad will consist of either gravel fill built up 3.5 m above grade or a steel deck.

The well pad facilities will collect production from the wells and direct it to the above-ground flow lines for delivery to the gas conditioning facility. The flow lines will rest on pipe racks in a utilidor below the well pad surface. Return lines will run from the gas conditioning facility back to the wells on the same pipe racks as the flow lines.

The gas conditioning facility will separate, dehydrate, cool, meter and, in future years, compress the production in preparation for delivery into the Taglu lateral.

Capital costs for Taglu development are estimated to be about \$935 million. Details are shown in Table 2-2.

Table 2-2: Capital Expenditures – Taglu

Component	2002 (\$M)	2003 (\$M)	2004 (\$M)	2005 (\$M)	2006 (\$M)	2007 (\$M)	2008 (\$M)	2009 (\$M)	2012 (\$M)	2014 (\$M)	2020 (\$M)	2023 (\$M)	Total (\$M)
Engineering and project management ¹	0	7	18	25	24	21	17	8	0	18	17	3	159
Line pipe and piping materials	0	0	0	0	0	0	0	0	0	0	0	0	0
Major equipment and modularization ²	0	0	0	9	67	10	1	1	0	42	40	9	179
Logistics	0	0	0	0	0	2	4	2	0	1	1	0	9
Construction ³	0	0	0	0	0	37	39	19	0	16	16	2	129
Camp building set-up and catering	0	0	0	0	0	4	7	3	3	2	5	0	24
Drilling site preparation and site construction	0	0	0	0	0	17	6	0	1	0	1	0	25
Drilling and service wells	0	0	2	2	2	16	145	42	100	0	100	0	408
Total	0	7	19	36	92	106	218	76	105	79	180	15	935

NOTES:

- 1 Engineering and project management includes engineering and PMT costs
 - 2 Major equipment and modularization includes modularization, prefabricated modules and production
 - 3 Construction includes workforce transportation, fuel, construction equipment rental, installation labour, granular delivery, granular royalty, facility site preparation and facility construction
- Figures are in millions of constant \$2003
There are no capital expenditures for 2010–2011, 2013, 2015–2019 and 2021–2022
Numbers might not add up because of rounding

SOURCE: Imperial Oil (2004a)

Operations and Maintenance

The wells, flow lines and gas conditioning facility will be continuously monitored. Internal corrosion will be monitored as required. Inspection and maintenance programs will be planned and executed to ensure safe and reliable operations. The wells will be serviced according to industry practice. Where practical, maintenance work will be done during winter when the site can be accessed by winter road. Summer well maintenance will be done as required using aircraft, including helicopters, and barge support.

The estimated annual average for operations and maintenance expenditures at Taglu over the life of the field are \$19 million.

Decommissioning and Abandonment

An abandonment and reclamation plan will be developed in accordance with regulatory requirements in effect during abandonment. The plan will include public consultation and consideration of alternative uses of the sites being abandoned.

Expenditures associated with decommissioning and abandonment are not available at this time.

2.1.1.3 Parsons Lake

Planning, Design and Construction

ConocoPhillips Canada (North) Limited (ConocoPhillips) and ExxonMobil Canada Properties (ExxonMobil) will develop the Parsons Lake field, starting in 2006. The development area of the field is about 70 km north of Inuvik and 55 km southwest of Tuktoyaktuk. The Parsons Lake development plan is based on about 64 Gm³ of raw natural gas and NGL production. The field will be in production for about 25 years.

Field development will include:

- a north pad consisting of:
 - nine to 19 production wells
 - two disposal wells
 - a gas conditioning facility
- a south pad consisting of:
 - three to seven production wells
 - flow lines on the north pad, and from the south pad to the north pad
 - supporting infrastructure, including an airstrip

Initial field development will involve drilling nine wells from the proposed north pad. Up to 10 contingent wells might be drilled at the north pad. Three wells will be drilled at the south pad, seven to 10 years after the initial phase. Up to four contingent wells might be drilled at the south pad. Drilling the initial five wells of the nine-well drilling program will occur uninterrupted over about 18 months using a single rig before start-up. Thereafter, drilling will likely continue to complete the original nine-well program over the following 12 months. The south pad wells will be drilled using one rig, after north pad drilling is complete. The facility foundation will include steel piles and gravel.

The well pad facilities will collect production from the wells and direct it to above-ground flow lines for delivery to the gas conditioning facility. The flow lines at the north pad will rest on pipe racks 1 to 3 m above the gravel surface. Return lines will run from the gas conditioning facility back to the wells on the same pipe racks or metal supports as the flow lines.

The gas conditioning facility will be on the north pad. The facility will dehydrate, cool and meter the production in preparation for delivery into the Parsons Lake lateral.

Initial capital expenditures for Parsons Lake are estimated to total about \$938 million. Details regarding capital expenditures are shown in Table 2-3.

Operations and Maintenance

The wells, flow lines and gas conditioning facility will be continuously monitored. Internal corrosion will be monitored as required. Inspection and maintenance programs will be planned and executed to ensure safe and reliable operations. The wells will be serviced according to regulatory requirements and standard industry practice. Where practical, maintenance work will be done during winter when the site can be accessed by winter road. Summer well maintenance will be done as required, using fixed-wing aircraft or helicopter support.

The estimated annual average operations and maintenance expenditures at Parsons Lake over the life of the field are \$11 million.

Decommissioning and Abandonment

An abandonment and reclamation plan will be developed in accordance with regulatory requirements in effect during abandonment. Development of the plan will include public consultation and consideration of alternative uses of the sites being abandoned.

Expenditures associated with decommissioning and abandonment are not available at this time.

SECTION 2: PROJECT EXPENDITURES

Table 2-3: Capital Expenditures – Parsons Lake

Component	2002 (\$M)	2003 (\$M)	2004 (\$M)	2005 (\$M)	2006 (\$M)	2007 (\$M)	2008 (\$M)	2009 (\$M)	2010 (\$M)	2011 (\$M)	2012 (\$M)	2013 (\$M)	2014 (\$M)	2015 (\$M)	2016 (\$M)	2017 (\$M)	2018 (\$M)	2019 (\$M)	2020 (\$M)	2021 (\$M)	Total (\$M)
Engineering and project management ¹	38	5	13	18	21	16	16	23	6	0	0	3	1	0	7	3	2	1	1	0	173
Line pipe and piping materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major equipment and modularization ²	0	0	0	0	12	72	33	0	0	0	0	3	15	0	0	15	2	15	10	6	183
Logistics	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	2	0	2	0	2	21
Construction ³	0	0	0	0	0	18	10	38	0	0	0	0	2	28	0	8	8	0	0	10	122
Camp building set-up and catering	0	0	0	0	0	0	9	10	3	0	0	0	2	2	2	2	2	0	0	0	31
Drilling site preparation and site construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drilling and service wells	0	0	0	0	0	0	123	113	67	0	0	0	0	34	34	36	0	0	0	0	407
Total	38	5	13	18	33	106	191	199	76	0	0	6	20	64	43	66	14	18	11	18	938

NOTES:

1 Engineering and project management includes engineering and PMT costs

2 Major equipment and modularization includes modularization, prefabricated modules and production

3 Construction includes workforce transportation, fuel, construction equipment rental, installation labour, granular delivery, granular royalty, facility site preparation and facility construction

Figures are in millions of constant \$2003

There are no capital expenditures for 2022 and 2023

Numbers might not add up because of rounding

SOURCE: ConocoPhillips (2004a)

2.1.2 Expenditures – Gathering System

2.1.2.1 Planning, Design and Construction

For this socio-economic impact assessment, the gathering system includes the Niglintgak, Taglu, Parsons Lake and Storm Hills laterals, and the Storm Hills pigging facility, Inuvik area facility, NGL pipeline and block valves. The gathering system pipelines will connect the three anchor fields to the Inuvik area facility.

The Niglintgak lateral will be about 16 km long. The buried nominal pipe size (NPS) 16 pipe will carry gas and associated NGLs from Niglintgak to a connection point on the Taglu lateral.

The Taglu lateral will be about 81 km long. The buried NPS 26 pipe will carry gas and associated NGLs from Taglu and the Niglintgak lateral to the Storm Hills pigging facility.

The Parsons Lake lateral will be about 27 km long. The buried NPS 18 pipe will carry gas and associated NGLs from Parsons Lake to the Storm Hills pigging facility.

The Storm Hills lateral will be about 52 km long. The buried NPS 30 pipe will carry product from the Storm Hills pigging facility to a connection point at the Inuvik area facility.

The Storm Hills pigging facility will be located at the junction of the Taglu, Parsons Lake and Storm Hills laterals. The pigging facility will be designed to receive a pig from the Taglu and Parsons Lake laterals, and to remotely send a pig down the Storm Hills lateral to the Inuvik area facility. The facility will be accessible by helicopter.

The Inuvik area facility will be located in the Gwich'in Settlement Area (GSA), near the boundary with the Inuvialuit Settlement Region (ISR), about 20 km east of Inuvik. The facility will be accessible from the Dempster Highway via a new 19-km all-weather road and by helicopter. The facility will separate and process dehydrated, sweet natural gas and NGLs received from the gathering system, to meet the inlet specifications of the natural gas and NGL pipelines.

The NGL pipeline will connect the Inuvik area facility with the existing Enbridge pipeline at Norman Wells. The NGL pipeline will be about 476 km long. The NPS 10 pipe will carry NGLs from the Inuvik area facility to Norman Wells, where it will connect with the existing Enbridge pipeline. The pipeline will generally be buried, although certain sections might be above ground. The gas and NGL pipelines will be constructed in a common right-of-way, with the pipelines in separate trenches, about 20 to 25 m apart. If required, the pipes might be placed in a common trench.

SECTION 2: PROJECT EXPENDITURES

The interconnection to Enbridge will be located near the existing Enbridge pump station at Norman Wells. The facility will measure the volume of NGL flow into the Enbridge system. The facility will use the infrastructure available at Norman Wells.

Block valve assemblies will be installed along the gathering pipelines at the same time the pipelines are installed. The block valves will allow pipeline segments to be isolated for operations and maintenance.

Total estimated capital construction expenditures for the gathering system are \$1,652 million. A breakdown of capital expenditures for the gathering system is shown in Table 2-4.

Table 2-4: Capital Expenditures – Gathering System

Component	2002 (\$M)	2003 (\$M)	2004 (\$M)	2005 (\$M)	2006 (\$M)	2007 (\$M)	2008 (\$M)	2009 (\$M)	2010 (\$M)	Total (\$M)
Engineering and project management ¹	12	28	46	58	57	53	48	38	18	358
Line pipe and piping materials	0	0	0	0	0	47	47	5	0	100
Major equipment and modularization ²	0	0	0	0	22	100	54	7	0	184
Logistics	0	0	0	5	8	27	45	44	0	129
Construction ³	0	0	0	0	38	105	332	294	17	786
Camp building set-up and catering	0	0	0	0	23	42	24	6	0	95
Drilling site preparation and site construction	0	0	0	0	0	0	0	0	0	0
Drilling and service wells	0	0	0	0	0	0	0	0	0	0
Total	12	28	46	63	149	374	551	395	35	1,652

NOTES:
 1 Engineering and project management includes engineering and PMT costs
 2 Major equipment and modularization includes modularization, prefabricated modules and production
 3 Construction includes workforce transportation, fuel, construction equipment rental, installation labour, granular delivery, granular royalty, facility site preparation and facility construction
 Figures are in millions of \$2003
 There are no capital expenditures for 2011 to 2023
 Numbers might not add up because of rounding

SOURCE: Imperial Oil (2004a)

2.1.2.2 Operations and Maintenance

The project will be operated according to all corporate standards, regulatory requirements, permit conditions and licences. The pipelines will be remotely monitored and operated from a main control centre in Calgary, and supported by the supervisory control and data acquisition system (SCADA). Data will be made available, as needed, to technical support locations, maintenance bases and third-party locations.

Lateral and NGL pipeline operations and maintenance activities will include:

- pipeline pigging
- monitoring and surveillance, including aerial and ground surveys
- scheduled and unscheduled maintenance and repairs
- vegetation management
- postconstruction monitoring

The Storm Hills pigging facility will be remotely monitored and operated from the main control centre in Calgary. The Inuvik area facility will be monitored and operated from an on-site control centre. Data will be made available, as needed, to technical support locations, maintenance bases and third-party locations.

Helicopters will be used to access the pigging facility during operations.

Maintenance activities requiring heavy equipment and material will be restricted to winter. The Inuvik area facility will be accessible by all-weather road and by helicopter.

The estimated annual average operations and maintenance expenditures for the gathering system during the life of the pipelines and facilities are \$47 million.

2.1.2.3 Decommissioning and Abandonment

When the gas resource has been produced, options for decommissioning the pipelines will be assessed. The options might include:

- evaluating other uses for the system and possibly selling the property to others interested in using the pipelines
- removing any remaining NGLs by purging the lateral and NGL pipelines, and subsequently filling them with an inert substance at specific sites
- removing discrete segments of the pipelines
- leaving most of the pipelines in place in the ground

An abandonment and reclamation plan will be developed for the lateral and NGL pipelines and facilities according to regulatory requirements in effect during abandonment. Development of the plan will include public consultation and consideration of alternative uses of the sites being abandoned.

Expenditures associated with gathering system decommissioning and abandonment are unavailable at this time.

2.1.3 Expenditures – Gas Pipeline and Facilities

2.1.3.1 Planning, Design and Construction

For this socio-economic impact assessment, the pipeline consists of the gas pipeline, four compressor stations, an interconnection with Enbridge, a heater station, a pig receiver adjacent to the NOVA Gas Transmission Ltd. (NGTL) interconnect facility and block valves.

The gas pipeline will be about 1,220 km long. The nominal pipe size (NPS) 30 pipe will carry gas from the Inuvik area facility to a tie-in with the NGTL system just south of the Northwest Territories–Alberta boundary. The pipeline will generally be buried, although certain sections might be above ground.

The compressor stations are required to increase the pressure of the gas in the pipeline to offset pressure loss caused by friction. Four compressor stations will be spaced at intervals of about 225 km along the gas pipeline, and will be located near Little Chicago, Norman Wells, the Blackwater River and the Trail River. The stations will be designed for remote operation and will be accessible by helicopter. The Norman Wells and Trail River facilities will also be accessible by all-weather roads.

The Trout River heater station is required to maintain gas pipeline operating temperatures within design requirements. The facility will be located about 100 km north of the Northwest Territories–Alberta boundary. The facility will be designed for remote operation and will be accessible by helicopter.

Block valves will be installed along the gas pipelines at the same time as the pipelines are installed. The block valves will allow pipeline segments to be isolated for operations and maintenance.

The gas pipeline will terminate at a pig receiver located adjacent to the NGTL interconnect facility. NGTL will construct, under separate regulatory authorities, the NGTL interconnect facility and a 66-km NPS 36 pipeline from the NGTL interconnect facility to a tie-in on the NGTL system.

The pipeline construction plan assumes that pipeline construction will be segmented into five construction zones. As the pipeline will be constructed over two winter seasons, the zones have been divided into two spreads, one for each season of construction. The spreads vary in length from about 120 to 160 km. An additional spread will be used to build the northwestern Alberta portion of the pipeline. Details are shown in Table 2-5.

Capital construction expenditure data for pipelines and facilities along the pipeline corridor are shown in Table 2-6. The estimated total capital expenditures for the pipelines and related facilities are \$3,838 million.

Table 2-5: Location and Length of Pipeline Construction Spreads

Construction Zone	Spread	Year of Construction	From	To	Route Length (km)
E	E1 ^a	1	Inuvik area facility	Travaillant Lake	127 (two pipes)
	E2 ^b	2	Niglintgak	Inuvik area facility	124
D	D1	1	Travaillant Lake	Little Chicago	126 (two pipes)
	D2	2	Little Chicago	Fort Good Hope	124 (two pipes)
C	C1	1	Fort Good Hope	Norman Wells	147 (two pipes)
	C2	2	Norman Wells	Little Smith Creek	147
B	B1	1	Little Smith Creek	Ochre River	137
	B2	2	Ochre River	Camsell Bend	150
A	A1	1	Camsell Bend	McGill station	157
	A2	2	McGill station	NGTL interconnect facility	157
Northwestern Alberta	N/A	2	NGTL interconnect facility	Connection point with existing NGTL system	66

NOTES:
N/A = not applicable
a Spread E1 includes the Storm Hills lateral
b Spread E2 includes three gathering pipeline laterals (Niglintgak, Taglu and Parsons Lake)

Table 2-6: Capital Expenditures – Gas Pipeline and Facilities

Component	2002 (\$M)	2003 (\$M)	2004 (\$M)	2005 (\$M)	2006 (\$M)	2007 (\$M)	2008 (\$M)	2009 (\$M)	2010 (\$M)	Total (\$M)
Engineering and project management ¹	28	64	107	128	127	119	109	86	43	811
Line pipe and piping materials	0	0	0	0	0	291	291	28	0	610
Major equipment and modularization ²	0	0	0	0	38	89	66	9	0	202
Logistics	0	0	0	18	30	97	153	155	0	453
Construction ³	0	0	0	0	69	129	586	622	37	1,444
Camp building set-up and catering	0	0	0	0	82	144	75	17	0	318
Drilling site preparation and site construction	0	0	0	0	0	0	0	0	0	0
Drilling and service wells	0	0	0	0	0	0	0	0	0	0
Total	28	64	107	147	345	869	1,280	917	80	3,838

NOTES:

- 1 Engineering and project management includes engineering and PMT costs
- 2 Major equipment and modularization includes modularization, prefabricated modules and production
- 3 Construction includes workforce transportation, fuel, construction equipment rental, installation labour, granular delivery, granular royalty, facility site preparation and facility construction

Figures in millions of constant \$2003

There are no capital expenditures for 2011 to 2023

Numbers might not add up because of rounding

SOURCE: Imperial Oil (2004a)

2.1.3.2 Operations and Maintenance

The project will be operated according to all corporate standards, regulatory requirements, permit conditions and licences. The pipelines will be remotely monitored and operated from a main control centre in Calgary, and supported by SCADA. Data will be made available, as needed, to technical support locations, maintenance bases and third-party locations.

Pipeline operations and maintenance activities will include:

- pipeline pigging
- monitoring and surveillance, including aerial and ground surveys
- scheduled and unscheduled maintenance and repairs
- vegetation management
- postconstruction monitoring

Helicopters and small aircraft will be used to access remote sites during operations, and maintenance activities requiring heavy equipment and material will be restricted to winter. Several of the facilities will be accessible by all-weather road and by helicopter.

The estimated annual average operations and maintenance expenditures throughout the operating life of the gas pipeline and facilities are \$58 million.

2.1.3.3 Decommissioning and Abandonment

When the gas resource has been produced, options for decommissioning the gas pipeline will be assessed. The options might include:

- evaluating other uses for the system and possibly selling the property to others interested in using the pipelines
- removing any remaining gas by purging the gas pipeline and subsequently filling it with an inert substance at specific sites
- removing discrete segments of the gas pipeline
- leaving most of the pipeline in place in the ground

An abandonment and reclamation plan will be developed for the gas pipeline and facilities according to regulatory requirements in effect during abandonment. Plan development will include public consultation and consideration of alternative uses of the sites being abandoned.

2.1.4 Expenditures – Infrastructure

Project infrastructure for construction and operations includes:

- barge landing sites
- pipe and material stockpile sites
- fuel storage sites
- camps
- potable water supply
- access roads
- air strips and helipads
- communication centres

For descriptions of the infrastructure sites required to support project activities, see Volume 2, Project Description.

Capital and operating infrastructure expenditures are included in the capital and operations expenditure totals for all project components.

2.1.4.1 Operations and Maintenance

Most project infrastructure will be temporary and will be removed at the end of construction.

The cost of infrastructure that will remain in place during operations is included in the operations and maintenance expenditures for the various project components.

2.1.5 Summary of Project Expenditures

Planning, design and construction expenditures for all project components will total about \$7,731 million. The capital expenditures for all project components are shown in Table 2-7.

The annual average for operations and maintenance expenditures for all project components are estimated to be \$145 million per year over the assumed 25-year life of the anchor fields, gathering system, pipelines and facilities. In reality, the life of the project could extend well beyond 25 years if additional natural gas reserves are discovered.

Table 2-7: Capital Expenditures – All Project Components

Component	Niglintgak ¹ (Barge-Based Option)	Taglu	Parsons Lake	Gathering System ²	Gas Pipeline and Facilities	Total
Engineering and project management ³	72	159	173	358	811	1,574
Line pipe and piping materials	13	0	0	100	610	723
Major equipment and modularization ⁴	138	179	183	184	202	886
Logistics	3	9	21	129	453	617
Construction ⁵	16	129	122	786	1,444	2,496
Camp building set-up and catering	15	24	31	95	318	483
Drilling site preparation and site construction	14	25	0	0	0	40
Drilling and service wells	98	408	407	0	0	913
Total	369	935	938	1,652	3,838	7,731

NOTES:

- 1 Preliminary estimate for the land-based option is 10 to 15% higher than the barge-based option
 - 2 Gathering system includes the gathering pipelines, Inuvik area facility and the NGL pipelines
 - 3 Engineering and project management includes engineering and PMT costs
 - 4 Major equipment and modularization includes modularization, prefabricated modules and production
 - 5 Construction includes workforce transportation, fuel, construction equipment rental, installation labour, granular delivery, granular royalty, facility site preparation and facility construction
- Numbers might not add up because of rounding

SOURCES: Imperial Oil (2004a), ConocoPhillips (2004a), Shell (2004a)

2.2 Project Employment

Preliminary estimates of direct employment for planning, design, construction, operations and maintenance are presented by project component. The demand for qualified labour will be highest during construction. Project employment estimates for decommissioning and abandonment have not yet been determined.

To the extent practical, qualified Aboriginal and other northern residents and contractors will be provided with employment or contracting opportunities.

Where circumstances dictate, residents and contractors from outside the Northwest Territories could be brought in to fill specific roles.

The project will result in indirect and induced employment because of project procurement of supplies and materials, and because people employed directly and indirectly by the project will be spending their disposable income. Indirect and induced employment is described in Section 3.1.3.4, Employment and Income – Construction.

2.2.1 Employment – Anchor Fields

2.2.1.1 Niglintgak

Construction

Field development at Niglintgak was described previously in Section 2.1.1, Expenditures – Anchor Fields. Direct on-site construction labour at Niglintgak will include crews involved in:

- site preparation and installation of the gas conditioning facility, well pads, flow lines and site infrastructure
- well drilling and completions

Table 2-8 provides an estimate of labour force requirements for construction at Niglintgak with the barge-based option, excluding drilling. It is estimated that this work would generate about 170 jobs, including camp staff, over a four-year period beginning in 2006–2007, with a peak of 102 jobs in 2008–2009.

Table 2-8: Construction Employment – Niglintgak, Barge-Based Option

Position	2006–2007	2007–2008	2008–2009	2009–2010	Total
Supervisors	3	7	12	4	26
Welders	2	7	28	1	38
Teamsters	0	2	3	1	6
Operators	1	4	12	1	18
Labourers	2	8	24	3	37
Other	2	4	11	4	21
Inspectors	0	1	4	1	6
Construction reclamation and demobilization personnel	0	0	0	0	0
Camp and catering personnel	2	3	6	2	13
Camp infrastructure personnel	0	0	1	0	1
Camp logistics personnel	1	1	1	1	4
Total	13	37	102	18	170

NOTE:

Data supplied was based on calendar years, but has been recalculated for July to June for this table

SOURCE: Shell (2004b)

Table 2-9 provides an estimate of labour force requirements for construction at Niglintgak using the land-based option, excluding drilling. It is estimated that this work would generate about 249 jobs, including camp staff, over a four-year period beginning in 2006–2007, with a peak of 150 jobs in 2008–2009.

Table 2-9: Construction Employment – Niglintgak, Land-Based Option

Position	2006–2007	2007–2008	2008–2009	2009–2010	Total
Supervisors	2	6	11	4	23
Welders	2	7	44	1	54
Teamsters	0	2	3	0	5
Operators	15	11	11	1	38
Labourers	2	7	16	3	28
Other	2	10	48	10	70
Inspectors	0	1	5	1	7
Construction reclamation and demobilization personnel	0	0	0	0	0
Camp and catering personnel	2	4	10	3	19
Camp infrastructure personnel	0	0	1	0	1
Camp logistics personnel	1	1	1	1	4
Total	26	49	150	24	249
NOTE: Data supplied was based on calendar years, but has been recalculated for July to June for this table					
SOURCE: Shell (2004b)					

Table 2-10 shows employment estimates for drilling activities at Niglintgak. The drilling activity will begin in 2006–2007 and will be repeated over two successive winter drilling seasons. Well completions will be scheduled during the winter and summer months. These activities will create on-site employment for an estimated workforce of 341 people over the course of the drilling program, and a peak of 122 workers during 2007–2008 and 2008–2009, including camp staff.

Operations and Maintenance

After construction activities are complete, well production and conditioning of the NGLs and natural gas will begin. There will be an initial five- to six-month start-up period when experienced teams of professionals, technical and trades people will be on-site to bring the gas field and processing online. On-site camp accommodation will be provided. Once fully operational in 2009–2010, Niglintgak operations will be turned over to permanent operations staff. Niglintgak field operations will require 13 full-time equivalent (FTE) employees, including two trainees, and two FTE contract maintenance personnel. See Table 2-11 for details.

Table 2-10: Drilling, Completions and Related Employment – Niglintgak

Position	2006–2007	2007–2008	2008–2009	Total
Supervisors, technical, administrative	11	13	13	37
Surveyors, monitors, safety personnel	12	13	13	38
Equipment operators	30	28	28	86
Construction labourers	6	4	4	14
Welders	1	1	1	3
Electricians	1	1	1	3
Mechanics	1	1	1	3
Camp staff	12	12	12	36
Drilling crew personnel	12	24	24	60
Specialty drilling services	11	25	25	61
Total	97	122	122	341
SOURCE: Shell (2004b)				

Table 2-11: Ongoing Estimated Operations Employment – Niglintgak

Position	No. of Personnel
Manager	1
Administrative support	1
Professional staff	0
Driver	0
Labourer	0
Millwright	2
Pipefitter	0
Electrician	2
Control room operator	1
Field operator	4
Subtotal	11
Maintenance contractor	2
Total	13
SOURCE: Shell (2004b)	

Decommissioning and Abandonment

Employment estimates for decommissioning and abandonment of the Niglintgak field have not yet been determined.

2.2.1.2 Taglu**Construction**

Field development at Taglu was described previously in Section 2.1.1, Expenditures – Anchor Fields. Direct on-site construction labour at Taglu will include crews involved in:

- site preparation and installation of the gas conditioning facility, well pad, flow lines and site infrastructure
- well drilling and completions

Table 2-12 shows an estimate of labour force requirements for construction at Taglu, excluding drilling. It is estimated that this work would generate about 255 jobs over two years, with a peak of 135 jobs occurring in 2008–2009, including camp staff.

Table 2-12: Construction Employment – Taglu

Position	2006–2007	2007–2008	2008–2009	Total
Supervisors	8	8	19	35
Welders	0	2	35	37
Teamsters	50	0	4	54
Operators	12	14	6	32
Labourers	0	0	7	7
Other	2	8	47	57
Inspectors	2	3	7	12
Construction reclamation and demobilization personnel	0	0	0	0
Camp and catering personnel	6	5	10	21
Camp infrastructure personnel	0	0	0	0
Camp logistics personnel	0	0	0	0
Total	80	40	135	255
NOTE: Data supplied was based on calendar years, but has been recalculated for July to June for this table				
Source: Imperial Oil (2004b)				

Table 2-13 shows employment estimates for drilling activities at Taglu. Drilling activity will begin in 2007–2008 and continue uninterrupted for about 18 months. These activities will create on-site employment for an estimated workforce of 209 people, including camp staff.

Table 2-13: Drilling, Completions, and Related Employment – Taglu

Position	2007–2008	2008–2009	Total
Supervisors, technical, administrative	15	15	30
Surveyors, monitors, safety personnel	8	8	16
Equipment operators	23	23	46
Construction labourers	0	0	0
Welders	4	4	8
Electricians	2	2	4
Mechanics	4	4	8
Camp staff	28	28	56
Drilling crew personnel	46	46	92
Specialty drilling services	79	79	158
Total	209	209	418
NOTES: Program estimated to start in February 2008 and run continuously for 14 to 18 months			
SOURCE: Imperial Oil (2004b)			

Operations and Maintenance

After construction activities are complete, well production and conditioning of the NGLs and natural gas will begin. There will be an initial five- to six-month start-up period when an experienced team of professionals, technical and trades people will be on-site to bring the gas field and processing online. Once operational in 2009–2010, Taglu field operations will be turned over to permanent operations staff. Taglu field operations will require 14 FTE employees, including three trainees, and nine FTE contract maintenance personnel. Operating positions will be rotational. Maintenance contract personnel will come to Taglu periodically as required. See Table 2-14 for details.

Decommissioning and Abandonment

Employment estimates for decommissioning and abandonment of Taglu have not yet been determined.

Table 2-14: Ongoing Estimated Operations Employment – Taglu

Position	No. of Personnel
Manager	0
Administrative support	0
Professional staff	0
Equipment operator	0
Driver	0
Labourer	0
Millwright	2
Pipefitter	0
Electrician	2
Control room operator	2
Field operator	8
Subtotal	14
Maintenance contractor	9
Total	23
SOURCE: Imperial Oil (2004b)	

2.2.1.3 Parsons Lake

Construction

Field development at Parsons Lake was described previously in Section 2.1.1, Expenditures – Anchor Fields. Direct construction labour at Parsons Lake will include crews involved in:

- site preparation and installation of the gas conditioning facility, well pads, flow lines and site infrastructure
- well drilling and completions

Table 2-15 shows an estimate of labour force requirements for construction at the Parsons Lake north pad, excluding drilling. It is estimated that this work would generate about 224 jobs, including camp staff, over a four-year period beginning in 2006–2007. The construction workforce will peak at 120 workers in 2008–2009.

Table 2-16 shows employment estimates for drilling and completions activities. The initial drilling activity will begin in winter of 2007–2008 and continue uninterrupted through 2008–2009 and 2009–2010 until the original nine-well program is complete. These activities will create on-site employment for an estimated workforce of 260 people for 2007–2008, and 220 for each of 2008–2009 and 2009–2010, including camp staff.

Table 2-15: Construction Employment – Parsons Lake North Pad

Position	2006–2007	2007–2008	2008–2009	2009–2010	Total
Supervisors	8	8	15	2	33
Welders	0	2	32	3	37
Teamsters	20	0	3	1	24
Operators	12	14	7	1	34
Labourers	0	0	6	1	7
Other	2	8	42	5	57
Inspectors	2	3	6	1	12
Construction, reclamation and demobilization personnel	0	0	0	0	0
Camp and catering personnel	5	5	9	1	20
Camp infrastructure personnel	0	0	0	0	0
Camp logistics personnel	0	0	0	0	0
Total	49	40	120	15	224

SOURCE: ConocoPhillips (2004b)

Table 2-16: Drilling, Completions and Related Employment – Parsons Lake

Position	2007–2008	2008–2009	2009–2010	Total
Supervisors, technical, administrative	31	25	25	81
Surveyors, monitors, safety personnel	20	20	20	60
Equipment operators	50	38	38	126
Construction labourers	0	0	0	0
Welders	2	2	2	6
Electricians, instrumentation and mechanical	4	4	4	12
Mechanics	4	4	4	12
Camp staff	28	14	14	56
Drilling crew personnel	47	39	39	115
Specialty drilling services	74	74	74	222
Total	260	220	220	700

SOURCE: ConocoPhillips (2004b)

Drilling at the south pad will take place during the winter seasons of 2014–2015, 2015–2016 and 2016–2017, with one drill rig and a workforce of 220, including camp staff. During that period, development of the south pad and module installation is expected to take place with a workforce of about 21 people.

Operations and Maintenance

After construction activities at the north pad are complete, well production and conditioning of the NGLs and natural gas will begin in 2009. There will be an initial five- to six-month start-up period when an experienced team of professionals, technical and trades people will be on-site to bring the gas field and processing online. On-site camp accommodation will be provided. Once fully operational, Parsons Lake operations will be turned over to permanent operations staff. Parsons Lake field operations will require 19 FTE operations employees, including three trainees, and three FTE contract maintenance personnel. These positions will be rotational. See Table 2-17 for details.

Table 2-17: Ongoing Estimated Operations Employment – Parsons Lake

Position	No. of Personnel
Manager	1
Administrative support	1
Professional staff	0
Driver	0
Labourer	0
Millwright	3
Pipefitter	0
Electrician	4
Field and control room operator	7
Subtotal	16
Maintenance contractor	3
Total	19
SOURCE: ConocoPhillips (2004b)	

Decommissioning and Abandonment

Employment estimates for decommissioning and abandonment of Parsons Lake have not yet been determined.

2.2.2 Employment – Gathering System

2.2.2.1 Construction

The gathering system components were described previously in Section 2.1.2, Expenditures – Gathering System. Gathering system construction will begin in 2006 and will involve a number of activities that are undertaken sequentially and in some cases concurrently. Pipelines construction activities will include:

- site preparation, which involves right-of-way configuration, clearing and surface preparation
- pipeline installation, which involves stringing and bending, coating and welding, trenching, lowering and backfilling
- watercourse crossings
- road and pipeline crossings
- pressure testing
- cleanup and reclamation

Pipeline facility construction activities will include:

- site preparation, which involves clearing, salvaging loose surface material, levelling, and placing fill
- foundation installation
- module installation
- site testing and commissioning

Table 2-18 provides an estimate and breakdown for gathering system construction employment by worker classification. It is estimated that gathering system construction activities will generate employment for 4,137 qualified workers over a four-year period beginning in 2006–2007. The construction workforce will peak at 2,355 workers in 2008–2009.

2.2.2.2 Operations and Maintenance

After construction activities are complete, the facilities and pipelines will be commissioned and transmission of the product will begin. Activities associated with operation and maintenance of the gathering system were described in Section 2.1.2, Expenditures – Gathering System.

Table 2-18: Construction Employment – Gathering System

Position	Gathering Pipelines (Laterals)					Inuvik Area Facility					NGL Pipeline					Totals				
	2006- 2007	2007- 2008	2008- 2009	2009- 2010	2009- 2010	2006- 2007	2007- 2008	2008- 2009	2009- 2010	2009- 2010	2006- 2007	2007- 2008	2008- 2009	2009- 2010	2009- 2010	2006- 2007	2007- 2008	2008- 2009	2009- 2010	Total
Supervisors	0	10	75	3	3	11	4	32	1	20	67	41	4	4	31	81	148	9	268	
Operators	0	38	385	0	0	25	9	8	0	50	321	205	0	0	75	368	597	1	1,041	
Teamsters	0	39	214	1	1	15	1	8	0	56	181	118	1	1	70	221	339	1	633	
Labourers	0	42	338	0	0	11	19	31	0	55	283	170	0	0	66	343	539	1	949	
Welders, pipefitters	0	13	183	0	0	0	0	62	0	1	203	134	0	0	1	217	379	0	598	
Other trades	0	1	6	0	0	0	0	89	0	1	5	3	0	0	1	5	98	0	104	
Inspectors	0	3	25	2	2	2	1	2	0	5	18	14	1	1	7	22	41	3	73	
Construction, reclamation and demobilization personnel	0	0	0	34	0	0	0	0	7	0	0	0	44	0	0	0	0	85	85	
Camp and catering staff	0	12	102	5	5	2	3	19	1	7	87	57	7	9	102	178	13	302	302	
Camp infrastructure personnel	0	9	12	1	1	2	3	3	0	7	7	6	1	9	19	21	2	51	51	
Camp logistics personnel	0	2	8	1	1	2	0	2	0	6	9	4	1	8	11	14	2	35	35	
Total	0	169	1,348	48	48	69	40	255	9	207	1,180	752	60	277	1,389	2,355	117	4,137	4,137	

NOTE:
Numbers might not add up because of rounding

SOURCE: ColtKBR (2004)

The Storm Hills pigging facility will have remote monitoring and control functions and is expected to be unstaffed, except during pigging operations when maintenance personnel might be needed on site. Operations staff from the control centre at the Inuvik area facility and contract maintenance personnel based in Inuvik will make periodic visits to the facility.

The Inuvik area facility will be monitored and operated from an on-site control centre. On-site personnel will manage surveillance and maintenance of the facility. Operations staff will be rotational, whereas maintenance, management, administrative and some technical personnel will likely reside in Inuvik.

During initial project start-up, operations and maintenance of the gathering pipelines, the Storm Hills pigging facility, the Inuvik area facility and the NGL pipeline will require a total workforce of 49 people.

The gathering pipelines and the Inuvik area facility will include 26 employees and northern trainees (Pipeline Operations Training Committee [POTC] and nonPOTC), and 13 maintenance contract personnel. The NGL pipeline will require 10 workers, which includes seven employees and northern trainees (POTC and nonPOTC), and three maintenance contract personnel. The workers in rotational jobs will work out of Inuvik.

After the initial three or four years of operations, the size of the gathering system workforce is expected to decline from 49 to 38, including contract personnel.

Operation of the gathering pipelines will be continuously monitored and controlled from the Inuvik area facility. Operation of the NGL pipelines will be continuously monitored and controlled from the main control centre in Calgary. The NGL pumps will be started up and shut down remotely from this location. Emergency shutdown of the pipelines or pumping stations will be initiated from the control room, if required, or locally when personnel are on site.

The Calgary control centre will provide support to both the gathering system and the gas pipeline. The control centre will require positions for such activities as communications, line repair supervision, frost and heave repair supervision, and instrument work in the field.

2.2.2.3 Decommissioning and Abandonment

Employment estimates for decommissioning and abandonment of the gathering system have not yet been determined.

2.2.3 Employment – Gas Pipeline and Facilities

2.2.3.1 Construction

The gas pipeline components were described previously in Section 2.1.2, Expenditures – Gathering System. Gas pipeline and associated facility construction will begin in 2006–2007, and will involve a number of activities that will be undertaken sequentially, or in some cases, concurrently. Pipeline construction activities will include:

- site preparation, which involves right-of-way configuration, clearing and surface preparation
- pipeline installation, which involves stringing and bending, coating and welding, trenching, lowering, and backfilling
- watercourse crossings
- highway, road and pipeline crossings
- pressure testing
- cleanup and reclamation

Pipeline facility construction activities will include:

- site preparation, which involves clearing, salvaging loose surface material, levelling and placing fill
- foundation installation
- module installation
- on-site testing and commissioning

Table 2-19 shows an estimate and breakdown for pipeline and facilities construction employment by worker classification. Qualified labour for the pipeline spread will be required in 2006–2007. An estimated 13,788 workers will be required over the four-year period. The construction workforce will peak at 7,220 workers in 2007–2008.

2.2.3.2 Operations and Maintenance

After construction activities are complete, the facilities and pipeline will be commissioned and product transmission will begin. Activities associated with pipeline operations and maintenance were described previously in Section 2.1.2, Expenditures – Gathering System.

Table 2-19: Construction Employment – Gas Pipeline and Facilities

Position	Gas Pipeline and Related Facilities				Compressor, Heater and Meter Stations				Totals				
	2006–2007	2007–2008	2008–2009	2009–2010	2006–2007	2007–2008	2008–2009	2009–2010	2006–2007	2007–2008	2008–2009	2009–2010	Total
Supervisors	116	378	231	26	33	57	59	3	149	435	289	29	903
Operators	284	1,821	1,160	2	79	55	42	0	363	1,876	1,202	2	3,443
Teamsters	318	1,024	667	4	46	21	17	0	363	1,045	684	4	2,098
Labourers	314	1,603	967	3	34	118	64	0	348	1,720	1,030	3	3,101
Welders, pipefitters	6	1,152	761	0	1	88	116	0	7	1,240	877	0	2,123
Other trades	3	26	17	0	1	118	182	0	4	144	200	0	347
Inspectors	26	99	81	7	6	12	10	0	32	111	91	7	241
Construction reclamation and demobilization personnel	0	0	0	240	0	0	0	23	0	0	0	263	263
Camp and catering staff	38	492	324	41	7	38	41	4	45	530	365	45	985
Camp infrastructure personnel	36	36	41	6	7	28	5	2	43	64	46	8	161
Camp logistics personnel	31	49	23	5	6	4	3	1	37	53	26	6	122
Total	1,171	6,681	4,272	334	219	539	539	34	1,390	7,220	4,811	368	13,788

NOTE:
Numbers might not add up because of rounding
SOURCE: ColtKBR (2004)

Operations and maintenance bases to support pipeline and facilities operations will include warehousing for equipment, spare parts and emergency response equipment. A base will be established in Norman Wells. Live-in management, administration and some technical staff, and rotational operators and contract maintenance personnel will work largely work from these bases.

The four compressor stations and the heater station will have remote monitoring and control functions. Initial operation of the four compressor stations will begin with a fully staffed environment (two persons working days at each compressor station). After a year of operation, the compressor stations will be unstaffed, and operations and maintenance personnel will visit by air every two weeks. Unplanned and emergency visits to facilities will be carried out using helicopters. Facilities personnel will include both rotational and live-in operators and contract maintenance personnel from the maintenance bases.

The gas pipeline and facilities operations and maintenance labour force requirements will total 49 workers. This includes 33 employees and northern trainees (POTC and nonPOTC), and 16 maintenance contract personnel. After the initial three or four years of operations, the total number of workers is expected to decline to about 38, including contract personnel.

It is assumed that 40% of the maintenance contract personnel will live in Fort Simpson and 60% will be based in Norman Wells. All positions, including trainees, will be filled to the extent practical by qualified Aboriginal people and other northern residents.

Gas pipeline operations will be continuously monitored and controlled from a main control centre in Calgary. The compressors will be started up and shut down remotely from this location.

2.2.3.3 Decommissioning and Abandonment

Employment estimates for decommissioning and abandonment of the pipelines and facilities have not yet been determined.

2.2.4 Other Project Employment

In addition to the employment associated with the previously described project components, the project will generate employment in the Northwest Territories and Alberta to complete the following activities:

- borrow site development
- infrastructure development
- construction camp operations
- logistics and transportation
- module assembly
- project management

2.2.4.1 Borrow Site Development

Borrow sites are required to provide the materials needed to construct the anchor fields, facility and infrastructure sites, and pipelines. The project will require 5 Mm³ of borrow material. About 70 sites have been identified as primary sites for development and 50 additional sites have been identified as secondary sites.

Construction, including infrastructure development, will have the highest demand for borrow material. Most of the selected borrow sites will be in full operation during construction. Project activities will stabilize at a much lower level during operations. The need for borrow materials will be determined on a site-specific basis.

The workforce requirements, including camp staff, for borrow site development have not been calculated because the volumes and qualities of borrow materials at the individual borrow sites have not been determined. However, if there were about 20 to 30 borrow site development crews ranging in size from 12 to 24 people, accompanied by a small mobile camp staff of four to five, there could be 245 to 725 people involved in borrow site development. Each crew, including camp staff, would likely include:

- a foreman
- surveyors
- heavy equipment operators
- dump truck drivers
- one or two mechanics
- a few labourers
- a camp manager
- a cook
- a kitchen assistant
- a camp attendant
- a multi-skilled maintenance person

Qualified Aboriginal residents, northern contractors and skilled labourers will have an opportunity to participate in borrow site development as subcontractors within a large borrow site development contract, or as employees of the successful contractors.

2.2.4.2 Infrastructure Development

The infrastructure components required by the project were described previously in Section 2.1.4, Expenditures – Infrastructure.

The workforce required to support infrastructure site development will range from about 680 in 2006–2007, to a peak of 977 in 2007–2008, to 785 in 2008–2009 (ColtKBR 2004). It will be composed of supervisors, operators, truck drivers, welders, pipefitters, and other trades, labourers and camp staff.

Crew sizes will vary according to the nature and size of infrastructure sites. A typical crew involved in developing a barge landing, access road and pad for a camp, and pipe, fuel and construction equipment storage would total about 20 to 30 workers.

When the infrastructure sites are no longer required for the project, they will be reclaimed according to regulatory standards and subject to community consultation. Some components, such as camp facilities, might be available for after-project use by the communities.

2.2.4.3 Construction Camp Operations

In addition to the mobile camps associated with borrow sites and infrastructure site development, stationary camps will be required to support construction of the anchor fields (including drilling), gathering system, pipelines and facilities, and for module assembly at Hay River. Camps will vary in size to accommodate 10 to 1,350 people. Consequently, camp staffing will vary with the size of the camp and will range from five to 126 people per camp (see Table 2-20). Further, it is likely that the camps will remain in place throughout construction, even if they are not in use all the time.

Table 2-21 shows a breakdown of staff requirements for a 950-person construction camp.

Additional employment will be generated during camp set-up and dismantling. The sizes of the crews involved in these activities and the duration of the work will vary with the size of the camps.

The following skill sets are required for camp mobilization and demobilization:

- superintendent
- foremen
- plumbers
- electricians
- carpenters
- labourers

This type of work will be available to qualified Aboriginal and other northern contractors and residents, and qualified construction and trades people residing outside the Northwest Territories.

Table 2-20: Size and Number of Construction Camps and Camp Staff

Size of Camp (No. of People)	Number of Camps	Number of Camp Staff On-site per Camp	Camp Staff Totals
10	1	5	5
15	1	5	5
35	1	6	6
40	4	6	24
100	2	8–9	16–18
120	4	10	40
130	1	10	10
150	3	11	33
250	1	21	21
300	1	25	25
300–400	1	25–35	25–35
900	1	80	80
950	5	86	430
1,350	4	126	504
Total	30		1,224–1,236
NOTE: Includes the two camps in northwestern Alberta (Weibe and Wildboy Trail)			
SOURCE: Imperial Oil (2004c)			

Table 2-21: Staff Requirements for a 950-Person Camp

Position	Number of Jobs
Manager, assistant manager	2
Chefs	3
First cooks	2
Second cooks	6
Bakers	2
Kitchen staff	30
Camp attendants, utility	25
Pipefitters, plumbers, gasfitters	3
Electricians	3
Carpenters	2
Maintenance labourers	4
First aid personnel	2
Security personnel	2
Total	86
SOURCES: ColtKBR (2003), Travis Food Services (2004)	

2.2.4.4 Logistics and Transportation

Logistics and transportation planning, resources and employment needs will increase during 2006 as the pipeline construction equipment and supplies, facility modules, camps and other large components are moved into the project area. The peak in activity will occur in 2007 and 2008, and decline as crews and equipment leave the project area. It is expected that activity will return to near baseline levels, with only minimal transportation needs through operations, decommissioning and abandonment.

It is estimated that the logistics and transportation workforce, consisting of supervisory staff, various operators, truck drivers and labourers, will total about 590 in 2006–2007, 710 in 2007–2008, 480 in 2008–2009 and 65 in 2009–2010.

The primary transportation methods for project construction activities will be:

- barge
- rail
- aircraft
- vehicle, i.e., trucks, buses and low-ground-pressure vehicles

Details regarding these methods of transportation, and the use of existing marine, rail, air and road infrastructure are provided in Section 4, Infrastructure and Community Services.

2.2.4.5 Module Assembly – Hay River

Modules for the Taglu and Parsons Lake gas conditioning facilities, gathering system and pipeline facilities will be fabricated in southern Canada. The modules will be transported by rail and tractor-trailer to Hay River, where they will be partially assembled for transport by barge and truck to the sites, where module assembly and installation will be completed. As shown Table 2-22, the module assembly work in Hay River will require a skilled crew of about 283 people.

2.2.4.6 Project Management

Project management team staff working on the project during construction will range from 170 to 200, as shown in Table 2-23. Almost all these jobs will be located in Calgary.

Table 2-22: Employment – Hay River Module Assembly

Position	2007–2008
Supervisors	29
Operators	10
Teamsters	0
Labourers	12
Welders and pipefitters	84
Other trades	116
Inspectors	6
Project proponents' representatives	0
Site abandonment personnel	0
Camp and catering staff	26
Total	283
SOURCE: ColtKBR (2004)	

Table 2-23: Construction Employment – Project Management

Year	PMT Jobs
2006	170
2007	200
2008	200
2009	175
NOTE: PMT = project management team	
SOURCE: Imperial Oil (2004b)	