INTRODUCTION

This section supports an application for land use activities and operations associated with the Norman Wells compressor station. It contains:

- an overview map showing the facility location
- an estimate of personnel requirements
- a summary of the operations
- a description of potential environmental and resource effects
- construction equipment estimates

The location of the Norman Wells compressor station is shown in an overview map in Figure 7-1 and a site-specific map in Figure 7-2. A site photograph is shown in Figure 7-3.

PERSONNEL (PART 3)

The construction of the Norman Wells compressor station will involve three major steps. The first step is preparing the site and installing the site pad. This will require a crew size of about 60. The second step is the piling activity, which will require a crew size of about 60. The third step is installing the prefabricated processing facility modules followed by pre-commissioning activities. This step requires about 120 personnel, including camp staff.

Construction plans require the installation of a 120-person camp within the footprint of the Norman Wells compressor station for the construction period. A description of this activity is contained in Section 4.

Commissioning of the Norman Wells compressor station will require a relatively high level of on-site operations and maintenance activity. A workforce of up to eight personnel might be required for about three months. When the facility is commissioned and operations have reached steady state, the main control centre will remotely monitor, control and diagnose compressor station functions, including starting and stopping compressor units and changing control set point.

Routine operations and maintenance activities will likely require two to four personnel to be on site intermittently, depending on the level of activity. Periodically, major maintenance or repair activities, or scheduled maintenance will be required. This type of activity might normally require about 8 to 12 personnel on site for a short period.

Maintenance personnel at the Norman Wells compressor station might also support pipeline operations, as required.

SUMMARY OF OPERATION (PART 5)

The land use activities and operations associated with this site include:

- developing and maintaining a 9.5 ha site
- developing and maintaining a 20 m wide, 900 m long all-weather access road from the Enbridge interconnect facility (see Section 4) to the Norman Wells compressor station site
- abandoning and reclaiming the site at the end of the operational life of the facility

Preconstruction Activities

Before facility development begins:

- a preconstruction survey will be conducted to finalize the location and site-specific layout
- geotechnical evaluations might be conducted, as required, to support engineering of the various aspects of the facility, as required

Development Activities

Construction of the Norman Wells compressor station site is scheduled to start in the winter of 2006-2007. The facilities are scheduled for start-up in 2009. Construction activities will take place year-round and are scheduled to be complete in the summer of 2010.

Site Development

Terrain, soil type and the extent of permafrost will influence development at the Norman Wells compressor station site. Site preparation activities might include:

- fencing or flagging to define site boundaries and areas to be avoided
- clearing vegetation and storing merchantable timber
- grading and placing fill to provide a supporting surface for installing, operating and maintaining the facilities
- sloping the surface to direct runoff away from the facility site

The degree of grading will depend on the amount of permafrost at the site and on soil conditions.

Borrow material will be placed in varying thickness around the site. The thickness will depend on soil conditions, soil temperatures, and the intended use within the site.

Pad materials will be excavated from approved borrow site locations as close as deemed practical to the Norman Wells compressor station. These materials will be transported to the facility on the new 900 m all-weather access road and various all-weather access roads. They might be hauled and placed while frozen, and allowed to thaw during the following summer season. This might require compacting at a later date.

Pile foundations will generally be used to support permanent buildings, modules, equipment supports, and pipe racks. The type of pile selected will depend on soil conditions and the amount of permafrost at the site.

The Norman Wells compressor station site is located in an extensive discontinuous permafrost zone. As a result, the buildings and equipment at these sites will be constructed mainly on piles that will be driven steel, or on cast-in-place concrete with pile caps. Slab-on-grade foundations might be considered for some buildings. Site-specific geotechnical studies will be used to complete the design at each location.

Module Transportation

To reduce installation personnel requirements and length of time on site, most of the facility components will be fabricated into transportable modules in off-site shops. To the extent practical, pre-testing of the modules will be performed at these fabrication shops.

The modules will be transported by truck or rail to a staging area in Hay River where additional assembly and testing might be performed. The modules might be as large as 350 t for the Norman Wells compressor station.

Modules and other components will be barged from Hay River to Norman Wells. After unloading the modules and components from the barge, they will be staged at the nearby barge landing or equipment storage location and then transported to the Norman Wells compressor station site. Transport trailers will be used to transport modules.

Figure 7.1 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Module Installation

When the modules are received at the site, they will either be stored at the infrastructure site or cranes will be used to set the modules onto previously installed pile foundations. Structural, piping, mechanical, electrical and instrumentation interconnections will be completed. Other facility components, such as yard piping and vessels, will be installed.

Equipment and Buildings

The equipment and buildings at the Norman Wells compressor station site might be modular to facilitate construction. The gas compression facilities will include:

- an inlet scrubber
- a gas turbine compressor package
- aerial coolers
- gas compression equipment
- gas-to-gas heat exchangers
- safety and control systems
- utility systems, including:
    - fuel gas equipment, including metering equipment
    - electrical power generation
    - controls and communications equipment
    - safety equipment

Pipeline facilities and appurtenances will also be situated on the site, including:

- block valves
- pig launcher and receiver facilities for the gas pipeline

High-pressure sodium lights will be used for process buildings and external yard lighting. External lighting will be controlled to reduce light pollution, while providing enough light for safety and maintenance purposes. White lighting will be installed in the control and maintenance buildings.

Safety and Control Systems

The safety and control systems will include gas and smoke detection units, overpressure protection equipment, and an emergency shutdown system.

Site Testing and Commissioning

Commissioning and start up activities are scheduled to begin in 2009 and be completed by year-end. Commissioning activities verify that equipment and systems are functioning according to the design and that the system is ready for operation. This includes energizing selected equipment and systems.

Testing will include pressure-testing facilities to ensure that they are free of leaks. Testing media being considered for the Norman Wells compressor station include heated water, water and freeze depressant mixture, air, and nitrogen.

Disturbed parts of the site that are not required during operations will be reclaimed.

Operations and Maintenance Activities

SCADA (Supervisory Control and Data Acquisition) will provide surveillance, management and maintenance of automated compressor station operational controls of the Norman Wells compressor station and pipelines from the main control centre in Calgary.

Every one to two years, major scheduled routine maintenance and repair activities might be required. This activity will cause a short-term increase in personnel, material and vehicular traffic.

Non-routine activities might also occur from time to time. This might involve the mobilization of crews and heavy equipment to the site, depending on the situation (see Section 3).

Access

An all-weather access road about 900 m long will be built to the site from the Enbridge interconnect facility in Norman Wells. There is an existing municipal road running from the Imperial Oil Dock barge landing to the Enbridge interconnect facility. Table 7-1 contains access road details.

The access road will be constructed to accommodate the transportation of large facility modules, construction equipment and materials. See Section 3, for a cross-section of an all-weather access road. See the site-specific map in Figure 7-3 for access road alignment.

Table 7-1: Access Road to Norman Wells Compressor Station

Access Road Name	Kilometre Post (KP)	Land Use			Estimated Length (km)
		Municipal Length (km)	Private Length (km)	Crown Length (km)	
TD-F-A-476.3	476.3	0.9			0.9
Total length of facility access roads on land in Norman Wells:					0.9

ENVIRONMENT

The following section provides specific biophysical and human environment setting, effects and mitigation information for Norman Wells compressor station. This information includes data collected during the 2004 field programs.

Biophysical Environment

The Norman Wells compressor station will consist of a natural gas compression facility that will be installed on a 9.5 ha site, together with a 900 m long, all-weather access road in a 20 m wide road allowance running from the Enbridge interconnect facility to the site.

Air Quality Setting

Air quality monitoring has been conducted in the vicinity of the Norman Wells compressor station. Climate was characterized based on available data from existing Meteorological Service of Canada (MSC) stations. Results of the monitoring programs indicated higher levels of VOCs, which may be due to existing oil and gas facilities.

The air quality setting for this site is expected to be similar to the regional setting described Section 8.

Air Quality Potential Effects and Mitigation

One of the primary sources of project emissions in the SSA will be the continuous operation of emissions producing equipment at the Norman Wells compressor station. Emissions from the Norman Wells compressor station predicted during peak operations are summarized in Table 7-2.

Ground level concentrations were predicted using air dispersion models. Dispersion models consider various site-specific meteorological and topographical conditions to predict ground level concentrations, based on facility configuration and emission rates.

These figures represent the likely emissions following the implementation of mitigation measures. During the life of the project, there might be brief periods when it will be necessary to release gas into the atmosphere as a result of facility upsets or routine maintenance. There is also the potential for small volumes of gases, known as fugitive emissions, to be released from valves and fittings during project operations. As such fugitive emissions are usually restricted to older operations and are expected to be very small given the modern design and configuration of this project. Therefore, fugitive emissions were not quantified in the air assessment.

Table 7-2: Predicted Emissions from Project Facilities at the Norman Wells Compressor Station

Activity	Emissions					
	SO_2[a] (t/d)	NO_X[b] (t/d)	CO[c] (t/d)	$PM_{2.5}$[d] (t/d)	Benzene (t/d)	BTEX (t/d)
Compression	<0.01	0.40	0.19	0.01	0.000	0.00
Power generation	<0.01	0.13	0.06	0.00	0.000	0.00
Ancillary equipment	<0.01	0.03	0.03	0.00	0.000	0.00
Totals[e]	<0.01	0.57	0.27	0.02	0.000	0.00

NOTES:
[a]SO_2 – sulphur dioxide
[b]NO_x – oxides of nitrogen
[c]CO – carbon monoxide
[d]$PM_{2.5}$ – fine particulate matter
[e]Numbers in this table have been rounded for presentation purposes. Therefore, the sum of the presented numbers might add up to values different than the totals.

Sulphur Dioxide

The natural gas that will be transported through the gas pipeline in the SSA is sweet gas that is effectively free of sulphur compounds. Therefore, project sulphur dioxide (SO_2) emissions will be small. The air quality assessment has included SO_2 as a parameter to ensure regulator and stakeholder concerns are addressed.

Table 7-3 summarizes ground–level SO_2 predictions for the Norman Wells compressor station, following implementation of mitigation measures. All of the predicted one–hour, 24–hour and annual SO_2 concentrations were below Northwest Territories standards.

Table 7-3: Sulphur Dioxide Ground-Level Predictions at the Norman Wells Compressor Station

Parameter	Averaging Period Predictions[a]		
	One–hour	24–hour	Annual
Maximum SO_2 concentration (µg/m³)	3.8	0.8	0.1
Distance to maximum[b] (km)	0.1	0.1	0.1
Direction to maximum[b]	W[c]	SE[d]	SE[d]
Expected occurrences exceeding standard[e]	0.0	0.0	0.0

Table 7-3: Sulphur Dioxide Ground-Level Predictions at the Norman Wells Compressor Station (cont'd)

Parameter	Averaging Period Predictions[a]		
	One–hour	24–hour	Annual
Area exceeding standard[f] (ha)	0	0	0
SO_2 standards[g] (µg/m³)	450	150	30

NOTES:
[a]The predictions in the table include the effects of combined emissions from project sources in the central airshed.
[b]Distance and direction are relative to the Norman Wells compressor station.
[c]W – west
[d]SE – southeast
[e]The expected occurrences exceeding standard is the number of hours, days or years with predicted concentrations exceeding the applicable standards. It is the average of five years of modelling data, so it might not be a whole number.
[f]The area exceeding standard is the total area over which the predicted one–hour, 24–hour or annual concentrations exceeded the applicable standards.
[g]Northwest Territories Ambient Air Standards (RWED 2002, now ENR)

Nitrogen Dioxide and Oxides of Nitrogen

Nitrogen dioxide (NO_2) and nitric oxide (NO) will be the primary oxides of nitrogen (NO_X) emitted from the combustion sources at the Norman Wells compressor station. The NO emissions can undergo chemical reactions in the atmosphere to form additional NO_2. Nitrogen dioxide is addressed because it is the only oxide of nitrogen that is regulated in Canada. However, the assessment does present predicted total NO_X concentrations, as these are required to determine NO_2 concentrations. There are no quality guideline values or objectives for NO_X.

Table 7-4 summarizes the NO_X and NO_2 concentrations predicted by dispersion models in area of the Norman Wells compressor station following implementation of mitigation measures. None of the maximum one–hour, 24–hour or annual NO_2 predictions exceeds objectives.

Table 7-4: Nitrogen Dioxide and Oxides of Nitrogen Ground-Level Concentration Predictions at the Norman Wells Compressor Station

Parameter	Maximum Average Period Predictions[a]		
	One–hour	24–hour	Annual
Maximum NO_X concentration (µg/m³)	1,478.8	406.1	53.2
Maximum NO_2 concentration (µg/m³)	151.9	47.3	6.2
Distance to maximum[b] (km)	0.1	1.3	0.1
Direction to maximum[b]	SE[c]	WNW[d]	SE[c]

Table 7-4: Nitrogen Dioxide and Oxides of Nitrogen Ground-Level Concentration Predictions at the Norman Wells Compressor Station (cont'd)

Parameter	Averaging Period Predictions[a]		
	One–hour	24–hour	Annual
Expected occurrences exceeding objective[e]	0.0	0.0	0.0
Area exceeding objective[f] (ha)	0	0	0
NO_2 objectives[g,h] (µg/m³)	400	200	100

NOTES:
[a]The predictions in the table include the effects of combined emissions from project sources in the central airshed.
[b]Distance and direction are relative to the Norman Wells compressor station.
[c]SE – southeast
[d]WNW – west–northwest
[e]The *expected occurrences exceeding objective* is the number of hours, days or years with predicted concentrations exceeding the applicable objectives. It is the average of five years of modelling data, so it might not be a whole number.
[f]The *area exceeding objective* is the total area over which the predicted one–hour, 24–hour or annual concentrations exceeded the applicable objectives.
[g]Federal Ambient Air Quality Objectives from *The Clean Air Act* (Environment Canada 1981)
[h]There are no Northwest Territories standards for NO_2.

Carbon Monoxide

Carbon monoxide (CO) can result from the incomplete combustion of fuels used at the Norman Wells compressor station. It is also a regulated compound.

Table 7-5 summarizes the ground–level CO concentrations predicted by dispersion models in the area of the Norman Wells compressor station following implementation of mitigation measures. None of the predicted one–hour and 8–hour CO concentrations exceeds the objectives.

Table 7-5: Carbon Monoxide Ground-Level Concentration Predictions at Pipeline Facilities at the Norman Wells Compressor Station

Parameter	Averaging Period Predictions[a]	
	One–hour	8–hour
Maximum CO concentration (µg/m³)	699.2	300.1
Distance to maximum[b] (km)	0.1	0.1
Direction to maximum[b]	SE[c]	SE[c]
Expected occurrences exceeding objective[d]	0	0
Area exceeding objective[e] (ha)	0	0

Table 7-5: Carbon Monoxide Ground-Level Concentration Predictions at Pipeline Facilities at the Norman Wells Compressor Station (cont'd)

Parameter	Averaging Period Predictions[a]	
	One–hour	8–hour
CO objectives[f, g] (µg/m³)	15,000	6,000

NOTES:
[a]The predictions in the table include the effects of combined emissions from project sources in the central airshed.
[b]Distance and direction are relative to the compressor station at Norman Wells.
[c]SE – southeast[d]The *expected occurrences exceeding objective* is the number of 1–hour or 8–hour periods with predicted concentrations exceeding the applicable objectives. It is the average of five years of modelling data, so it might not be a whole number.
[e]The *area exceeding objective* is the total area over which the predicted one–hour or 8–hour concentrations exceeded the applicable objectives.
[f]Federal Ambient Air Quality Objective from *The Clean Air Act* (Environment Canada 1981)
[g]There are no Northwest Territories standards for CO.

Fine Particulate Matter

Most airborne particles emitted from the Norman Wells compressor station during peak operations will be in the smallest size ranges. Therefore, they will be assessed using fine particulate matter ($PM_{2.5}$) as an indicator.

Table 7-6 shows maximum ground–level $PM_{2.5}$ concentrations predicted by dispersion models in the area of the Norman Wells compressor station following implementation of mitigation measures. All values are below the Northwest Territories standard.

Table 7-6: Fine Particulate Matter Ground-Level Concentration Predictions at the Norman Wells Compressor Station

Parameter	Maximum Average Period Predictions[a]	
	24–hour	Annual
Maximum $PM_{2.5}$ concentration (µg/m³)	6.7	1.6
Distance to maximum[b] (km)	0.1	0.1
Direction to maximum[b]	SE[c]	SE[c]
Expected occurrences exceeding standard[d]	0	N/A[e]
Area exceeding standard[f] (ha)	0	N/A[e]

Table 7-6: Fine Particulate Matter Ground-Level Concentration Predictions at the Norman Wells Compressor Station (cont'd)

Parameter	Maximum Average Period Predictions[a]	
	24–hour	Annual
$PM_{2.5}$ standards[g] (µg/m³)	30	N/A[e]

NOTES:
[a]The predictions in the table include the effects of combined emissions from project sources in the central airshed.
[b]Distance and direction are relative to the facilities.
[c]SE – southeast
[d]The expected occurrences exceeding standard is the number of days or years with predicted concentrations exceeding the applicable standards. It is the average of five years of modeling data, so it might not be a whole number.
[e]N/A – not applicable
[f]The area exceeding standard is the total area over which the predicted 24–hour or annual concentrations exceeded the applicable standards.
[g]Northwest Territories Ambient Air Standards (RWED 2002, now ENR)

Benzene and BTEX Compounds

Volatile organic compounds (VOCs) can be released in small quantities from the incomplete combustion of fuel at facilities. Of the VOCs that could be released, this assessment focused specifically on benzene and BTEX, that is, the combination of benzene, toluene, ethylbenzene and xylene. Benzene and BTEX concentrations were included because of the perceived association between oil and gas operations and benzene and BTEX levels in the air.

Table 7-7 shows ground–level concentrations of benzene and total BTEX for the Norman Wells compressor station following implementation of mitigation measures. None of the predicted benzene or BTEX concentrations exceed the defined criteria.

Table 7-7: Benzene and Total BTEX Ground-Level Concentration Predictions at the Norman Wells Compressor Station

Parameter	Predicted Maximum Concentrations[a]	
	Benzene	BTEX
Maximum 1–hour concentration (µg/m³)	0.5	1.2
Distance to maximum[b] (km)	0.1	0.1
Direction to maximum[b]	SE[c]	SE[c]
Expected occurrences exceeding criteria[d]	0	0
Area exceeding criteria[e] (ha)	0	0

Table 7-7: Benzene and Total BTEX Ground-Level Concentration Predictions at the Norman Wells Compressor Station (cont'd)

Parameter	Predicted Maximum Concentrations[a]	
	Benzene	BTEX
Available criteria[f] (µg/m³)	30[g]	30[h]

NOTES:
[a]The predictions in the table include the effects of combined emissions from project sources in the central airshed.
[b]Distance and direction are relative to the Norman Wells compressor station.
[c]SE – southeast
[d]The *expected occurrences exceeding criteria* is the number of hours with predicted concentrations exceeding the applicable criteria. It is the average of five years of modelling data, so it might not be a whole number.
[e]The *area exceeding criteria* is the total area over which the predicted one–hour concentrations exceeded the applicable criteria.
[f]There are no Northwest Territories standards for benzene or total BTEX.
[g]Alberta Ambient Air Quality Guidelines (AENV 2000)
[h]The Alberta Ambient Air Quality Guidelines (AENV 2000) value for benzene was used for BTEX because it is the most stringent of the available criteria for benzene, toluene, ethylbenzene and xylene.

Since ground–level concentrations of SO_2, NO_2, NO_X, CO, $PM_{2.5}$ and selected VOCs are all below applicable federal and territorial guideline levels at the Norman Wells compressor station, no detectable air quality effects are expected.

Increased Acid Input

Emissions of SO_2 and NO_X from the Norman Wells compressor station, operations have the potential to react in the atmosphere to form acid compounds that could affect the environment when deposited on soils, vegetation or into waterbodies. Potential increase in acid deposition because of the Mackenzie Gas project has been evaluated by determining the expected sulphate and nitrate deposition, and from that, area PAI.

Table 7-8 summarizes predicted PAI values associated with Norman Wells compressor station emissions. Since the PAI levels predicted over the study areas are below the threshold for the most sensitive ecosystems, no measurable effects are expected due to PAI.

Table 7-8: Potential Acid Input Predictions at the Norman Wells Compressor Station

Area	Parameter	Results[a]
Norman Wells compressor station	Maximum PAI (keq/ha/a)	1.33
	Area PAI (keq/ha/a)[b]	0.008
	Maximum sulphate deposition (kg/ha/a)	0.26

Table 7-8: Potential Acid Input Predictions at the Norman Wells Compressor Station (cont'd)

Area	Parameter	Results[a]
	Maximum nitrate deposition (kg/ha/a)	82.12
	Area with PAI >0.17 keq/ha/a[c] (ha)	25
	Area with PAI >0.25 keq/ha/a[d] (ha)	12

NOTES:
[a]The predictions in the table include the effects of combined emissions from project sources in the central airshed.
[b]Area PAI represents integrated PAI levels over the entire 40,000 ha LSA, which is considerably smaller than 1°by 1°grid cells that are more than 500,000 ha in size at this latitude.
[c]0.17 keq/ha/a represents the monitoring load value for sensitive ecosystems.
[d]0.25 keq/ha/a represents the critical load value for sensitive ecosystems.

Increased Dust Deposition

Increased dust deposition will be caused by:

- facilities and rights-of-way construction
- extraction of borrow materials during construction
- vehicle movement along unpaved roadways

Dust deposition would be a localized effect as most of the dust particles will be deposited quickly and near their sources.

Greenhouse Gas Emissions

Greenhouse gas emissions are mostly CO_2, CH_4 and N_2O, which can all be expressed as ECO_2, that is, equivalent carbon dioxide values. Project infrastructure and associated traffic will all contribute to GHG emissions. However, the Norman Wells compressor station's construction contribution to GHG emissions is expected to be limited compared with operating the facilities.

A portion of the GHG emissions in the SSA will come from the operation of the Norman Wells compressor station. Table 7-9 shows annual expected GHG emissions from the Norman Wells compressor station.

Table 7-9: Greenhouse Gas Emissions from the Norman Wells Compressor Station

Area	Activity	Emissions			
		CO_2 (kt/a)	CH_4 (kt/a)	N_2O (kt/a)	ECO_2[a,b] (kt/a)
Norman Wells compressor station	Compression	87.28	0.01	0.00	88.60
	Power generation	4.17	0.05	0.00	5.88
	Process equipment	13.08	0.00	0.00	13.16
	Totals[c]	104.53	0.05	0.01	107.65

NOTES:
[a]ECO_2 – equivalent carbon dioxide
[b]ECO_2 emissions were calculated using greenhouse potentials of one for carbon dioxide (CO_2), 21 for methane (CH_4) and 310 for nitrous oxide (N_2O) (Environment Canada 2002).
[c]Numbers in this table have been rounded for presentation purposes. Therefore, the sum of the presented numbers might add up to values different than the totals.

Although the operation of the Norman Wells compressor station will result in increased GHG emissions in the NWT (about 6.5% based on year 2000 GHG levels), the increase in GHG emissions on a national level will be very low (about 0.02% based on year 2000 levels).

Noise Setting

The noise setting for this site is expected to be similar to the regional setting for the SSA described in Section 8.

Noise Potential Effects and Mitigation

Potential effects on noise levels associated with the development of the facility site are expected to be limited and localized. Site–specific effects and mitigation are expected to be similar to regional effects and mitigation for the SSA described in Section 8.

Construction noise will be centred at the facility site.

During operations, there might be intermittent short duration events that would cause an increase in noise levels above normal operational levels. Examples include the occasional venting of natural gas as a result of station upset conditions or for routine maintenance. Another example is the testing or use of emergency generator sets. These occurrences are expected to be uncommon and limited in duration.

Operations will raise sound levels near the compressor station. Noise caused by operations is continuous sound from constantly operating machinery. Models used

to predict sound levels at various distances up to 1.5 km from each of the facility fence lines based on normal operations.

The Norman Wells compressor station includes:

- pipeline compressor buildings with associated equipment
- compressor suction and discharge pipes
- compressor discharge aerial cooler fans
- utility building with associated equipment
- power generator building

Soils, Landforms and Permafrost Setting

The Norman Wells compressor station lies immediately north of Norman Wells on a fluvial terrace adjacent to the Mackenzie River. The southern end of the site has been disturbed by development associated with Norman Wells. The facility site lies within the zone of extensive discontinuous permafrost.

The fluvial terrace is level to very gently sloping, moderately well drained and has probably developed soils of the Cryosolic Order. Areas of permafrost within fluvial sediments typically contain ice contents between 30 and 70% by weight. Permafrost is expected beneath 40 to 60% of the area. To the east, fluvial sediments are locally overlain by organic veneers. Organic areas are poorly to very poorly-drained and have commonly developed soils of the Organic and Cryosolic Orders. Permafrost might be encountered within those organic veneers over fluvial areas (60 to 80% of area) and ice contents might range from 1000 to 2000%, by weight in the organics and 30 to 70%, by weight in the fluvial.

Soils, Landforms and Permafrost Potential Effects and Mitigation

Landform-related environmental effects are not predicted for the Norman Wells compressor station site. Stripping of soil before further development could result in a reduction of soil quality by mixing.

General mitigation strategies to offset potential effects are outlined in Section 8.

Vegetation Setting

Most of the Norman Wells compressor station site is charred because of a fire in 2003. Areas that have not been burnt consist of black spruce – Labrador tea/mountain cranberry and ground birch/water sedge wetland. Vegetation and rare plant surveys have been conducted. No rare plants were observed.

The black spruce – Labrador tea/mountain cranberry vegetation community is common in both lowlands and upland areas. Black spruce is the dominant species in the tree canopy, with Labrador tea, ground birch, tamarack, black spruce, shrubby cinquefoil and bog bilberry frequent in the shrub layer. Ground cover

species include red bearberry, sedges and mountain cranberry. Reindeer lichens are also prominent along with club lichens and pelt lichens.

Ground birch/water sedge wetlands are found scattered in areas of poor drainage with fluctuating water tables. Ground birch, black spruce, sweet gale and willows comprise the shrub layer, while water sedge, leatherleaf, Labrador tea and marsh cinquefoil compose the ground cover.

The north side of the compressor station site borders the pipeline right-of-way, therefore, an access route is not needed to the pipeline. An access route is, however, proposed to the Esso Dock Barge Landing. This route will follow an existing cutline through black spruce – Labrador tea/mountain cranberry forest, ground birch/water sedge wetlands and charred vegetation, through to town roads.

All of the vegetation types associated with the Norman Wells compressor station site and access are common.

Vegetation Potential Effects and Mitigation

Nitrogen deposition is expected to exceed critical loads at the Norman Wells compressor station facility site. Nitrogen deposition might lead to:

- changes in species composition
- decline in plant species diversity
- loss of rare and uncommon species

Sensitive vegetation might be affected in a small area near the Norman Wells compressor station. Although nitrogen oxide emissions are expected to be limited to the area of the compressor station, nitrogen deposition will still exceed the World Health Organization critical loads. Vegetation that is sensitive to nitrogen deposition could be affected if maximum nitrogen deposition occurs. Vegetation monitoring will be done to determine if changes in vegetation are occurring because of nitrogen deposition.

Vegetation affected throughout operations could take several years to stabilize, so duration is long term. If nitrogen deposition affects nutrient cycling, the resulting mature vegetation type might be different from the original type.

Development of the undisturbed portion of this site and its associated access road will affect vegetation through clearing and mechanical damage to trees, shrubs, forbs and non-vascular species, the permanent loss of vegetation and underlying substrates through facility site expansion and potential changes in site drainage and along the access road.

The majority of effects on vegetation will occur because of project activities arising from site construction and operations. These effects might include the potential influence of dust deposition on the health and growth of nearby

vegetation, as well as the potential accidental introduction of non-native plant species to the facility site and along the access road. Effects on vegetation due to the facility site and access road will persist into the far future (effect extends beyond 30 years past decommissioning and abandonment) given the slow rate of vegetation growth in the North. When the facility site and access road are decommissioned, introduction of non-native reclamation species might also occur. Vegetation on the site and along the access road might develop into a different vegetation community than what was there before development.

Implementation of primary mitigation measures, as described in Section 8, will help reduce the magnitude of effects on vegetation at this site and its access road.

Wildlife Setting

Wildlife habitat at the Norman Wells compressor station site is comprised of closed black spruce and tamarack, both unburned and post-fire regeneration communities. Willow and alder are the dominant shrubs. The types of habitats at the compressor station are common in the area. The site includes lichen for woodland caribou and berries and forbs for grizzly bears, as well as snags and coarse woody debris, which add to the structural complexity of the area, making it suitable for marten. The site is located close to the town of Norman Wells. The all-weather road passes through the site and other rights-of-ways will pass through or proximate to the site, thus the area will experience human disturbance.

Key wildlife species recorded at the Norman Wells compressor station site included moose and caribou. Key species are species selected because of their importance in the subsistence economy or because they are listed as species of conservation concern or as species of particular ecological relevance. Other species detected included grizzly bear.

An assessment of key habitat features, such as percent cover of forage species, indicated that the compressor station site is considered to provide high quality foraging habitat for woodland caribou and spring foraging for grizzly, as well as moderate quality winter foraging habitat for moose, marten and lynx, and fall foraging habitat for grizzly (Table 7-10). However, the site is considered to have low quality denning habitat for grizzly bears. Habitat quality is considered to be low for all key bird species.

Habitat quality at the Norman Wells compressor station site, based on habitat complexity and diversity, habitat rarity, proximity to disturbance, and wildlife species occurrence, is rated as moderate for mammals and low for birds. The habitat types at the site are common in the region and existing access disturbance occurs at the site.

Table 7-10: Habitat Quality for Key Wildlife Species at Norman Wells Compressor Station

Group	Species	Habitat Use	Habitat Quality[a]
Mammals	Woodland caribou	Winter foraging	High
	Moose	Winter foraging	Moderate
	Grizzly bear	Fall foraging	Moderate
		Spring foraging	High
		Denning	Low
	Marten	Winter foraging	Moderate
	Lynx	Winter foraging	Moderate
	Beaver	Cover	Low
		Foraging	Low
Birds	Scaup	Nesting	Low
	Peregrine falcon	Nesting	Low
	Lesser yellowlegs	Nesting	Low
	Boreal chickadee	Nesting	Low

NOTE:
[a]Habitat quality was determined by comparing the vegetation and terrain characteristics at each site to each species' habitat requirements, such as shrub availability for moose.

Based on habitat availability a variety of species might inhabit the site. These include several species that have special status designation at the national and territorial levels, as determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Department of Resources, Wildlife and Economic Development (RWED, now ENR), respectively. These species are summarized in Table 7-11.

Wildlife Potential Effects and Mitigation

The Norman Wells compressor station site is composed of moderate quality habitat for mammals and low quality habitat for birds. Habitat types at the site are common in the region, indicating they are not a limiting resource for wildlife. The site provides high quality winter foraging habitat for woodland caribou and high quality spring foraging habitat for grizzly bear. The site does not provide suitable denning habitat for grizzly bear.

General potential effects resulting from development and operation of the Norman Wells compressor station site include direct and indirect habitat loss, disruption of wildlife movements and wildlife mortality. The timing of project activities, as well as the small footprint of disturbances relative to regional habitat availability suggest that the magnitude of project effects on birds and most mammals,

including those with special status designation, will be low. However, specific issues of concern at the borrow site and along the access road include:

- attraction of grizzly bears to the borrow site and potential mortality of problem grizzly bears
- disturbance of nesting birds during summer
- displacement of woodland caribou from high quality foraging habitat during winter

Table 7-11: Special Status Species That Were Observed or That Might Occur at Norman Wells Compressor Station

Species	Status[a]			
	RWED[b]	COSEWIC[c]	SARA[d]	IUCN[e]
Grizzly bear (northwestern population)	Sensitive	Special concern	Schedule 3 – special concern[f]	Lower risk – least concern
Woodland caribou	Sensitive	Threatened	Schedule 1 – threatened	Lower risk – least concern
Rock ptarmigan	Sensitive	-	-	-
Northern flicker	Sensitive	-	-	-
Olive-sided flycatcher	Sensitive	-	-	-
Blackpoll warbler	Sensitive	-	-	-
American tree sparrow	Sensitive	-	-	-
Harris' sparrow	Sensitive	-	-	-
White-throated sparrow	Sensitive	-	-	-

NOTES:
[a]A hyphen indicates no status has been assigned for that species.
[b]RWED – Resources, Wildlife and Economic Development (known as ENR since April 1, 2005)
[c]COSEWIC – Committee on the Status of Endangered Wildlife in Canada
[d]SARA – *Species at Risk Act*
[e]IUCN – The World Conservation Union
[f]SARA status is to be reassigned (i.e., potentially added to Schedule 1) pending results of public consultation, stakeholder consultation and final Ministerial approval.

Some displacement of woodland caribou from high quality winter foraging habitat might already be occurring, based on the proximity to Norman Wells and winter access through the site. Although development of the site might result in displacement of grizzly bear from high quality foraging habitat during the spring, the proximity of Norman Wells and the access road might already be limiting grizzly bear activity in the vicinity of the site. Development of the site is unlikely to alter access, and therefore increased hunting or trapping of key wildlife species, in the area.

Implementation of general mitigation measures, as outlined in Section 8, will reduce effects on wildlife during borrow site and access road development and operations. Specifically, the following mitigation measures are considered important for this site:

- adherence to the waste management plan
- reduce project activities during the nesting period to the extent practical
- prohibit the recreational use of project roads and rights-of-way by project staff while on the job site
- establish and enforce regulations to prevent wildlife harassment

Hydrology Setting

The facility site is located 0.5 km upslope of the Mackenzie River. Most of the runoff from the site would potentially flow into the Mackenzie River. The area encompassing the site that contributes runoff to the Mackenzie River is about 3 km^2.

Hydrology Potential Effects and Mitigation

An increase in mean annual runoff flow due to the higher runoff coefficient of the disturbed area and an increase in mean sediment concentration on the Mackenzie River are expected to be limited because of the relatively large flows in the Mackenzie River and the high dilution capacity of the watercourse.

Groundwater Setting

Shallow groundwater is expected to flow to the south following the surface topography.

At site locations where continuous permafrost exists, groundwater flow is expected to be limited, seasonal and restricted to the active layer.

Groundwater Potential Effects and Mitigation

Groundwater data for this site is expected to be similar to regional data described in Section 8.

Water Quality Setting

Water quality data for the Mackenzie River at Norman Wells is expected to be similar to regional data described in Section 8.

Water Quality Potential Effects and Mitigation

The Norman Wells compressor station might affect water quality through acid deposition, the release of treated domestic wastewater from the camp, leaks and spills, sediment releases from disturbed land, and changes in surface water flow and level resulting from water withdrawals.

Modelled acid deposition rates resulting from the compressor station emissions were found to be negligible and there are no sensitive waterbodies in the area of elevated acid deposition, which is largely located within the Mackenzie River floodplain. Therefore, based on available information, no effects are predicted on water quality because of acid deposition are predicted.

Effects of small-scale leaks will be reduced through management practices, contingency plans, mitigation and emergency response plans. Therefore, effects are not expected from leaks.

The effects of land disturbance on surface runoff and suspended sediment concentrations were assessed on a site-specific basis. Limited effects were predicted on mean annual flow and mean annual total suspended sediment (TSS) concentrations in the Mackenzie River because of changes in runoff. These effects represent a non-detectable change in the natural range in flows and water levels, and in mean annual TSS levels. Consequently, no effects are expected on water quality.

Fish and Fish Habitat Setting

The Mackenzie River is about 500 m away from the Norman Wells compressor station site. There are no other watercourses with fisheries potential within 500 m of the Norman Wells compressor station site.

Fish and Fish Habitat Potential Effects and Mitigation

This compressor station is located sufficiently far away from local waterbodies so that the direct effects on fish habitat or effects related to runoff and sediment yield are not expected. Maintaining a vegetated buffer zone between the site and local waterbodies, if required, and implementation of site-specific erosion and sediment control plans will prevent sediment from the site from reaching surface waters.

Human Environment

This topic contains a description of the protected areas and heritage resource setting and potential effects and mitigation for this facility site. Other human environment information is described in Section 8.

Protected Areas Setting

The Norman Wells compressor station is located within the proposed Mackenzie River Special Management Zone. This area was identified in the Sahtu Preliminary Draft Land Use Plan as a very important regional and territorial travel and transportation corridor, heritage place and traditional use location.

Protected Areas Potential Effects and Mitigation

The development of this site in the proposed Mackenzie River Special Management Zone will result in a decrease in the land base available for other land uses within this area. The presence of development within this zone will be a permanent change to the landscape. The Sahtu Preliminary Draft Land Use Plan allows for development within this area if the conditions outlined in the land use plan are met.

Heritage Resources Setting

The Norman Wells compressor station site was inspected during the 2004 programs. The location was considered to have low potential for the discovery of heritage resources. A heritage resource site has been previously recorded within a 5.0 km range of the development area, indicating prior use of this region. The proposed site is also within 2.0 km of the Town of Norman Wells. No new heritage sites were recorded as a result of the reconnaissance.

The nature of the heritage resource potential and results of preliminary investigations at this site will be provided to the Prince of Wales Northern Heritage Centre in a report under permit 2004–956.

Heritage Resources Potential Effects and Mitigation

Before the development of this site, a Heritage Resource Impact Assessment will be conducted and provided to the Prince of Wales Northern Heritage Centre. If it is determined that the development will affect any heritage resources, mitigation plans will be prepared.

PUBLIC INVOLVEMENT

The EMLC requested that the Norman Wells compressor station be located on Tulita private lands. This site was evaluated and it was determined not feasible without shifting the location of other compressor facilities upstream or downstream of the Norman Wells compressor station site. The public involvement activities are documented in Section 10 of this application.

EQUIPMENT (PART 10)

The following tables show an estimate of the equipment that might be required at the Norman Wells compressor station. An exact list and numbers will not be known until immediately before construction. Table 7-12 lists site construction equipment. Table 7-13 lists the site operations equipment.

Table 7-12: Estimated Site Construction Equipment

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Trucks – 8	4x4 pick-up and crew cab	Personnel transport
Trucks – 2	4x4 mechanic rig	Field mechanic
Ambulance – 1	4x4 and 4x2	First aid, med-evac
Trucks – 2	Fuel and Service S/A and T/A	Equipment fuelling
Truck – 1	Tandem water	Water hauling
Cranes – 4	Mobile 65 ton	Lifting and loading
Cranes – 2	Mobile 150 ton	Lifting and loading
Trucks – 20	Tandem dump – 18 m^3	Hauling earth
Trailers – 4	Warehouse van	Parts and supplies
Trailers – 4	Office skid	Administration
Trailers – 2	Mechanics/welders setup	Pipe welding and equipment repair
Buses – 6	36, 24 and 12 Pass. 4x2 and mini-bus	Personnel transport
Bulldozers – 2	Large sized bulldozer (405 HP)	Earth moving
Mechanical ditchers – 1	Medium sized excavator	Excavation
Shelters – 4	Mech weld	Shelter welders
Loaders, FE – 2	Large sized loader (5.5 m^3 bucket loader)	Loading and excavation
Loaders, FE – 3	Large sized loader (5.5 m^3 bucket loader)	Loading and excavation
Grader – 1	Large sized grader (4.3 m blade)	Road and pad grading
Pumps – 4	Ditch, 3”	Ditch dewatering
Pumps – 4	Ditch, 2”	Ditch dewatering

Table 7-12: Estimated Site Construction Equipment (cont'd)

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Compressors – 10	150, 185, 350, 1,600 cfm	Pipe work, dewatering and testing
Radio – 1	Base	Communications
Radios – 45	Mobile	Communications
Propane tanks – 6	500 gallon	Propane storage
Light towers – 10	As required	Work area lighting
Generators – 8	6 kV	Power for hand tool, lighting and pumps
Tool cribs – 6	25 person	Tool storage
Welders – 6	300 amp portable diesel	Welding
Welders – 4	8 pack, with generators	Welding
Vibratory roller/packers – 2	As required	Compaction
Portable shelters – 4	20' by 20'	Shelter workers
Truck – 1	4x4 utility vehicle	Personnel transport and hauling
Loader – 1	Large sized loader ($5.5\ m^3$ bucket loader)	Loading and excavation
Crane – 1	As required	Lifting and loading
Truck – 1	Utility welder	Maintenance and repair
Mechanical ditcher – 1	Medium sized backhoe and loader	Loading and excavation

PERIOD OF OPERATION (PART 14)

Construction activities will take place year-round, at varying levels of activity, from 2006 to 2010 (see Section 3). The Norman Wells compressor station is expected to be in operation for 25 years or more.

LOCATION OF ACTIVITIES BY MAP COORDINATES (PART 16)

Map coordinates of the northwest corner of the facility site are given in Table 7-14 and a map showing the location of the site is in Figure 7-2.

Table 7-13: Location of Activities by Map Coordinates

Latitude (DD)	Longitude (DD)	UTM Easting (m)	UTM Northing (m)	UTM Zone
65.2928	-126.9014	597863	7242718	9

FEES (PART 18)

The total land area required for activities contained in this section is 11.3 ha, comprised of 9.5 ha for the facility site and 1.8 ha for access to the facility site.

The land requirements are shown in Appendix A.

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Figure 7.3 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.