Developers Assessment Report

For the Paramount Cameron Hills Extension

September 2003

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Paramount resources ltd.

ALLNORTH CONSULTANTS LIMITED

DEVELOPERS ASSESSMENT REPORT

FOR THE

PARAMOUNT
CAMERON HILLS EXTENSION

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LIST OF ALL ABBREVIATIONS

AB	Alberta
AENV	Alberta Environment
AEUB	Alberta Energy and Utilities Board
ASA	Aquatic Study Area
ATV	All Terrain Vehicle
CAPP	Canadian Association of Petroleum Producers
CASA	Clean Air Strategic Alliance
CEA	Cumulative Effects Assessment
CESA	Cumulative Effects Study Area
CH_4	methane
CO_2	carbon dioxide
CSA	Canadian Standards Association
DAR	Developer's Assessment Report
DFO	Department of Fisheries and Oceans
DIAND	Department of Indian and Northern Development
DOT	Department of Transport
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EPP	Environmental Protection Plan
EPPM	Environmental Protection Plan Manual
ERP	Emergency Response Plan
GCM	General Circulation Model
GHG	Greenhouse Gas
GIS	Geographic Information System
GNWT	Government of the Northwest Territories
GS	gathering system
GSA	addendum to the gathering system
H_2S	hydrogen sulfide
HRIA	Heritage Resource Impact Assessment
HSI	Habitat Suitability Index
HU	Habitat Unit
INAC	Indian and Northern Affairs Canada
IR	Information Request
ISC3	Industrial Source Complex
KIR	Key Indicator Resources
Kyoto	Kyoto Protocol to the United Nations Framework Convention on Climate Change
LUP	Land Use Permit
LWD	land spreading while drilling
MIS	Management Indicator Species
MSC	Meteorological Service of Canada
MVDS	Mackenzie Valley Environmental Impact Review Board Deficiency Statement
MVLW	Mackenzie Valley Land and Water Board
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
MVRMA	Mackenzie Valley Resource Management Act
N_2O	nitrous oxide
NEB	National Energy Board
NEB IR#	National Energy Board Information Request Number
NO	nitric oxide
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NT	Northwest Territories
NWT	Northwest Territories
OLM	Ozone Limiting Method
O_3	ozone
PAI	Potential Acid Input
PSCV	Patch Size Coefficient of Variance
QAES	qualified aquatic environmental specialist
ROW	Right of Way
RSA	Regional Study Area
RWED	Resources, Wildlife and Economic Development
SARA	Species at Risk Act
SDL	Significant Discovery Lease
SESA	Socio-Economic Study Area
SO_2	sulfur dioxide
SOP	Standard Operating Practices
TB	transborder
TCAI	Total Core Area Index
TDG	Transportation of Dangerous Goods
TK	Traditional Knowledge
TOR	Terms of Reference
TSA	Terrestrial Study Area
TSE	Toronto Stock Exchange
TSS	Total Suspended Solids
VCR	Voluntary Challenge & Registry
VEC	Valued Ecosystem Component
VSEC	Valued Socio-Economic Component
WHMIS	Workplace Hazardous Materials Information System
WL	Water Licence

1. INTRODUCTION / SUMMARY

1.1 NON-TECHNICAL SUMMARY

This section addresses Section A-1 of the MVEIRB ToR: Please provide a plain language, non-technical summary of the EA Report to enable the public to follow the proceedings.

This summary of the EA report proceeds as the report does, reviewing the EA report from a high level. The reader is enabled therefore to obtain more detail on any topic that follows, within the text of the report.

1.1.1 Introduction

The development of the Cameron Hills is described in the following as occurring in the three stages. The milepost points between the three development stages are referred to as:

Baseline Case – Existing and approved developments as of June 2003, including 39 well sites, approximately 214 km of linear disturbance from pipelines, access and production roads including 42 water crossings.

Application Case – five well sites, and 22 km of linear disturbance from pipelines, access and production roads including 6 water crossings. The incremental surface disturbance is estimated to be only 28 ha over the Baseline Case. This application triggered the Environmental Assessment.

Planned Development Case – 48 well sites, five satellite sites, and approximately 63 km of linear disturbance from pipelines, access and production roads including 14 water crossings. The incremental surface area disturbance is estimated to be only 147 ha over the Application Case.

The Baseline Case surface disturbance occupies 2.0% of the cumulative effects study area and even more importantly, and to emphasize the minimal nature of the future development, the incremental surface disturbance from the current Baseline Case to ultimate Planned Development is only 0.2% of the study area.

The environmental consequence of all cases, excluding socio-economic, were assessed to be negligible to moderate, and considered to be not significant (see Table 7.13-1).

1.1.2 Background

The Cameron Hills project is situated in a remote and sparsely populated area extending north from the boundary between Alberta and the Northwest Territories (see Figure 7.1-1). The closest communities on the Northwest Territories side of the border are outside a 60 km radius from the project. These communities are Enterprise, Hay River, the Hay River Dene Reserve, Kakisa and Fort Providence. Hay River is also home to the West Point First Nation. In addition, just across the Alberta border, is a small settlement of a few households called Indian Cabins.

The area has, for perhaps 8,000 years, been used for hunting, trapping, fishing and gathering by indigenous inhabitants. Dene tradition holds that the Hay River was used as a transport route between Great Slave Lake and northwestern Alberta. Although fur traders and the church had arrived in the area in the 19th century, establishing permanent centres in Fort Providence and Hay River, change accelerated with the development of transportation infrastructure after the Second World War.

In 1948, an all weather road was built from Alberta to Hay River to service the developing gold mines around Yellowknife. Subsequently, the communities of Enterprise and Kakisa were established. With the decision of the Northern Transportation Company to locate its headquarters in Hay River in 1959, this town also became the main base for supplying northern settlements down the Mackenzie Valley and on the Arctic Coast. In 1964, the Great Slave Railway was built and the Cominco mine near Hay River was operating. In 1974, the Hay River Reserve became the first reserve in the Northwest Territories.

There was some exploration drilling in the area between 1966 and 1971. Since this time, drilling has been quite limited due to a moratorium on activity related to aboriginal land claims. Most significant discoveries to date are located in the area of Cameron Hills. More recently there has been some commercial exploitation of forest resources in the region.

The Cameron Hills Significant Discovery License (SDL) held by Paramount lies within the Deh Cho administrative region of the Northwest Territories. The land is subject to the provisions of Treaty 8 between the federal government and the Deh Cho. Treaty 8 lands extend into Northeastern British Columbia and northern Alberta. The potentially affected communities also lie within the Treaty 8 territory, with the exception of Fort Providence and Kakisa, which are subject to Treaty 11. In 1970, the federal government agreed to renegotiate the treaties with the Deh Cho on the basis that Ottawa had not met all of its obligations under the treaties. No comprehensive agreements have yet been reached, however, the Deh Cho Process which is a unique negotiation between the Deh Cho First Nations, the Government of Canada, and the Government of the Northwest Territories is underway. The parties to the Deh Cho Process have negotiated key interim arrangements that provide additional clarity and predictability in the land access and regulatory regime for the Deh Cho region. Among those agreements are the Interim Measures Agreement, an Interim Resource Development Agreement, and Interim Land Withdrawals which protects certain lands such as cultural and spiritual lands, environmentally sensitive lands and major waterbodies and watersheds, and opens up other lands. The project area is exempt from these land withdrawals.

1.1.3 Developer Information

Paramount Resources Ltd. is operator, on behalf of the owners of mineral rights. Marathon Canada Ltd, is currently the only other working interest owner in the SDL.

1.1.4 Organization

Paramount is functionally organized within several geographic regions. The Cameron Hills property is managed within a larger area encompassing Paramount’s interests in an area also extending south of the border to Manning, Alberta. The property management team includes all functional disciplines in a mature intermediate oil and gas explorer and producer.

1.1.5 Performance Record

Paramount has lived up to its obligations and commitments. Monitoring of the project components has indicated the need for remedial measures. When called for, Paramount implemented supplemental mitigative measures in a timely manner.

1.1.6 Project Timing

Field development work is undertaken seasonally during the winter months. The terrain is too wet and soft to accommodate heavy equipment under thawed ground conditions. Production operations occur year round. Paramount currently anticipates a seven to ten year production life on new wells, projecting project termination in the year 2023.

1.1.7 Construction Methods

Conventional construction methods are used throughout the development except in the way pipelines cross major watercourses and in the way that erosion control measures are implemented.

Conventional construction measures include topsoil salvage wherever the ground is disturbed, the use of snow and ice to create access and work platforms, temporary work camps, and the complete removal of all termporary construction buildings and equipment at the end of each season.

Conventionally pipelines cross water under ground. In the case of pipelines crossing the Cameron River and its major tributary, above ground crossings are constructed by hanging the pipe from bridges. The result is a more secure crossing not susceptible to scour, and providing for guaranteed leak detection without release to the environment.

Conventional erosion control measures were implemented in the first year’s pipeline construction. They proved inadequate on sloped ground near watercourses. Supplemental measures were developed and implemented in the months following spring break to put in place a system of erosion and sedimentation control. The supplemental measures, including extensive use of geotextile, matting, silt fence and seed have proved adequate. The amended measures were implemented at the end of this past season's construction efforts and did not require remedial action after spring melt.

1.1.8 Operations

Paramount relies on thorough surveillance of its activities and assets to deliver early detection of malfunctions. Having early detection allows for timely implementation of Emergency Response, or other less drastic, measures as required. Drilling operations practice conventional techniques except for the use of remote pits for the disposal of cuttings and deep well injection for the disposal of waste liquids.

1.1.9 Waste Management

Paramount relies on conventional techniques to reduce, reuse, and recycle whenever it can, in order to minimize the generation of waste and deals with generated waste in accordance with industry standard accepted methods. The waste management plan developed for the Cameron Hills was excerpted from the corporate waste management plan. That plan is based on the CAPP, and industry accepted standards practiced by all operators.

1.1.10 Water Use

The use of water is seasonal and primarily for construction of access and work platforms at well and facility sites.

Water demand by the project is predicted to be available from at least two lakes in the project area. Water is recognized as a seasonally limited resource and is conserved so that, for the most part, it is not removed from the drainage basin.

1.1.11 Abandonment and Restoration

Once the decision is made to abandon a particular site, facility, or asset, the overall process is:

- In the case of well bore, abandon it in accordance with NEB regulations and requirements.

- Remove all equipment and cut-off all below grade fixtures 1 m below grade. (With respect to facilities, this is purely an aesthetic effort as there is no measurable negative impact to the environment or to other land uses by leaving pilings exposed. Removal of the wellhead is industry standard when wells are abandoned.)
- Redistribute salvaged topsoil and organic manner to encourage revegetation and predevelopment site stability.
- Seed any erosion prone areas and supplement simple seeding with other efforts where indicated.
- Monitor the site condition for one year to assure natural progression is proceeding to return the site to its pre-disturbance stability. Take what action is indicated and acceptable to the regulatory body having jurisdiction.

1.1.12 Alternatives

Alternatives to conventional wellsite drilling fluid sumps have been successfully sought. Sumpless drilling is practised by Paramount in the project area. Drilling fluids are stored on the wellsite in tanks so wellsite sumps are not used. The drilling fluid is reconditioned for reuse at other wells. The cuttings are analyzed and disposed of in surface pits.

With the objective of reducing surface disturbance, directional drilling is seen by regulators, and perhaps the neighbouring communities, as an alternative to conventional vertical drilling. Paramount has weighed the costs and benefits of directional drilling and has concluded the added risks and expense of directional drilling do not offset the perceived benefit from reduced surface disturbance.

In an effort to reduce surface disturbance, Paramount has been encouraged to consider alternative methods of transportation. It can be argued that additional laydown/assembly area requirements would offset any reductions in surface disturbance arising from saving in access. Paramount has weighed the costs and benefits of air ships as an alternative to conventional ground travel and has concluded the added risk to schedule delay, safety of personnel and cost, do not offset the perceived benefit.

In an effort to stretch the program over a longer period of time, Paramount has been encouraged to consider alternative scheduling. Paramount has examined the implications of a slower paced development and concluded that it would not reduce the surface disturbance, would delay the initiation of reclamation work, and would impact more wildlife species. The current seasonal development cycle avoids interference with migratory birds, spawning fish, and otherwise hibernating bears.

1.1.13 Regulatory Regime

Currently, Paramount holds land use permits and water licenses for the Baseline Case which includes the drilling, tie in and production of five wells not yet constructed. Paramount will seek to amend the locations of the five wells that were originally approved, preserving the essence of the original application.

Paramount seeks to reduce the burden to regulators, government, the public, and itself by making a future application for the Planned Development Case covering Paramount's reasonably foreseeable development objectives for the entire area of interest within the area of the Cameron Hills plateau. It is Paramount's expectation that as a result of this open and honest expression of its long-term objectives, it can reduce the formal regulatory obligation to the Environmental Assessment process and enhance the working relationship with the regulators and the potentially impacted public to facilitate a more routine review of its applications.

1.1.14 Public Consultation

Paramount has established a full time position to fill its need to understand the concerns and issues of other users of the land and, just as importantly, to get its message out to the concerned public. As a result of dealing with five aboriginal groups, the town of Hay River and the hamlet of Enterprise, public concerns will not likely ever be entirely absent. These concerns are addressed handled on an ongoing basis, with continued relationship building.

To date, Paramount has managed to satisfy most concerns brought forward by its neighbours and regulators. The ongoing issues are:

- Wildlife Harvesting Compensation Plan – the mediator retained by INAC and GNWT has informed Paramount that the communities have requested that the finalization of the plan be put on hold. As a result, this issue is not resolved.

- Kakisa has requested that Paramount enter into negotiations on a separate benefit plan with a scope indicative of land claims and outside of the regulatory process. Paramount has been discussing, and will continue to discuss, this expectation with Kakisa, the Deh Cho First Nations, GNWT and INAC.

1.1.15 Air

Air quality impacts are classified in all development cases as negligible to low.

Modelling of emission dispersion emphasizes the need to reduce the use of sour fuel and promote the use of cleaner energy alternatives where economically and practically reasonable.

Mitigative measures includes:

- taller stacks to enhance dispersion;
- use of electric drive chemical injection pumps;
- avoidance of raw gas venting; and
- use of low, to no, sulphur fuels in some cases.

1.1.16 Terrain

Project development will not alter the terrain in the long term or even in a significant way in the short term. Paramount does not foresee it's activities resulting in extensive grading that would impact natural drainage or other land uses, at any site or along any linear disturbance.

1.1.17 Soil

Conservation techniques, including primarily the salvage and replacement of topsoil/organic surface layer, enable the development to have no significant impact on soils.

1.1.18 Water

The availability of water in the area is limited and provides a staple economic and traditional activity for the nearby community of Kakisa.

The characteristics of four large lakes in the area were considered in determining that only two lakes in the area are reasonably capable of providing fresh water for use in the developer's activities. The capability of one lake is limited, while the other, based on the available data, provides the developer's ongoing water use through the entire development and production cycle.

Water use by the developer is seasonal and primarily in the construction of winter access. The water taken from the lake would therefore be returned to the water shed in spring when the snow melts.

1.1.19 Fish and Wildlife

The Cameron Hills holds a modest level of wildlife. It is not critical habitat for any endangered species and the development is forecast to have no significant impact on wildlife. There is very limited hunting due to difficulty of access. Two trappers conduct their activities in the area without interference from Paramount. On the positive side, the presence of the developer provides easier access for the trappers. The public is discouraged from using the winter road by the mere presence of the manned gate at its entrance.

Clearly, fishing in Tathlina and Kakisa lakes is a staple activity on which the community of Kakisa depends for traditional and commercial purposes. Kakisa has made clear its concerns about preserving the fishery and Paramount has responded with special measures undertaken in constructing pipeline and vehicle crossings of the Cameron River and one major tributary.

1.1.20 Vegetation

Through the use of the prescribed reclamation techniques, it is forecast that there will be no significant impact to vegetation.

No rare species have been identified in the project area.

No commercial logging is currently undertaken in the development area.

1.1.21 Cultural And Heritage Resources

A search of publicly available recorded data has not yielded any known heritage resource sites in the development area. A review of the nature of the physical character of the development area is not indicative that the discovery of a heritage resource would be expected. (This is not to say that heritage resource will not be discovered in future activities.) No heritage resources have been discovered by the heritage monitor or Paramount to date.

The likelihood of a significant heritage resource is low. If however a heritage resource were discovered, procedural guidelines are in place to assure its preservation and a member of the local aboriginal community is retained on site during all pipeline construction to assist in the identification of any unearthed traditional or heritage resource.

1.1.22 Traditional Harvesting

The effect of the planned development and activities leading up to it, on hunting, fishing, and trapping are described as low, negligible, and low respectively.

Because moose and caribou are sparsely populated in the project area, it is not now, nor ever has been a significant hunting resource for aboriginals. Aboriginal fishing activities within the development area lakes is infrequent at best so it is not a significant resource to the aboriginal community. Two trappers are active in the development area. Paramount works with the trappers to minimize its interference on the trapper's activities and as a result has established a positive working relationship with them.

1.1.23 Health and Social Indicators

Unemployment rates have been falling and participation rates peaking. (With the exception of some aboriginal communities, participation rates are much higher than those in Canada as a whole.) In the absence of an economic downturn, as educational achievement continues to improve and competition grows for northern employees, unemployment will continue to fall. There is already talk of a labor shortage; people not working are either those who chose not to participate in the labor force, or those that are very challenging to employ.

If total employment of territorial residents is to increase in response to the developing labour shortages, increasing the participation rates and skill levels of aboriginals will be necessary.

There is underway a transition to a wage based economy, and some evidence that pursuit of traditional economic activity has declined. This in turn has had impacts on a range of socio-economic parameters, from settlement patterns to aboriginal language use to nutritional status to weaker community support systems and family units. However, more enlightened terms of employment, evolving value systems, increased incomes and improved health and educational status may be contributing to slowing or reversing this decline. The Planned Development Case projects an increase in long-term jobs, by virtue of the increased number of wells.

1.1.24 Economic Factors

The benefit to the economy of the Northwest Territories, particularly over the ten year construction phase when the largest employment and procurement activity occurs, is considered positive, long-term and of low consequence however taking into account the need to diversify the economy, broaden the skill base of its population, and spread economic activity throughout the territories, the economic consequence is considered moderate.

Increased employment and participation by businesses in the project benefit not only those employees and businesses, but also the Northwest Territories as a whole. The employment and procurement are further increased through induced economic impact – as payments of wages and for goods and service contracts are made, the people who receive these in turn spend money elsewhere in the economy, creating more jobs and income.

1.1.25 Aesthetics

Based on the remoteness of the development area, the environmental consequences of changes to the aesthetics of the area are predicted to be low.

1.1.26 Effects of Environment and Malfunctions

Environmental considerations, along with safety of the public and employees of Paramount, have the greatest influence in the determination of how the project will proceed.

Starting with the resource, its whereabouts and character dictate the use of deep well drilling and completion to bring the resource to the surface. The use of seismic improves overall project commercial viability through the reduction of risk of drilling unsuccessful wells.

The nature of the climate and topography determines the seasonal basis of the development activity and the routing and siting of the surface disturbances.

The presence of wetlands, permafrost and the variety of subsoil conditions, dictates siting, and civil construction requirements.

Public influence and social pressures affect corporate values which are ultimately reflected in the way Paramount acquires goods and services, deals with waste, deals with other land users, conducts its production operations, and reclaims the surface when it is done. The tenet of Paramount's environmental policy is as follows:

> *"Paramount Resources Ltd. "Paramount" is committed to protecting the environment, maintaining public health and safety, and to compliance with all applicable environmental laws, regulations and industry standards. Paramount will do all that it reasonably can to ensure that sound environmental practices are followed in all of its operations and activities."*

1.1.27 Kyoto

The Prime Minister of Canada outlined specific principles with respect to the oil and gas industry that the Canadian Government is committed to. In summary they include:

1. Targets for new projects will be based on best practice of existing projects using similar technology, and will be locked-in for ten years from start-up.

2. Post-2012 policy will not make oil and gas uncompetitive, and industry will be involved in the development of post-2012 national targets.

Paramount's Cameron Hills project will continue to use best available technology and will rely on the following to guide operations past 2012:

- Emissions trading;
- Application of new technology to reduce GHG emissions; and
- Continue the production of natural gas to displace the use of coal around the globe.

1.1.28 Monitoring Evaluation and Adaptive Management

The project has focused on maximizing the success of the development, while minimizing the cumulative effects of the various phases as they proceed. Information that is collected during the assessments, inspections and monitoring programs is documented and evaluated to determine if remedial actions are required. Paramount practices the reporting of ALL unplanned events with the objective of rooting out the cause of the failure so that it can adapt procedures, facilities, or methods to prevent recurrence.

Based on the above, Paramount has, and continues to monitor the environmental conditions related to well and facility sites and rights-of-way (ROWs) in the Cameron Hills. The information that is collected is processed, and evaluated in relation to past experiences, so that improvements can be achieved through adaptive management.

1.2 CONFORMITY TABLE

This section addresses Section A-2 of the MVEIRB ToR:
The DAR should include a table cross referencing the items in these Terms of Reference with relevant sections of the DAR.

Table 1.2-1 Concordance Table for the Environmental Assessment in Response to the Terms of Reference for the Paramount Resources Ltd. Cameron Hills Drilling Project

Terms of Reference Section	Information Requested by the MVEIRB [ToR and Work Plan issued August 8, 2003]	EIA Section Containing the Information
A	**Summary**	
A-1	Non Technical Summary: Please provide a plain-language, non-technical summary of the EA Report to enable the public to follow the proceedings.	1.1
A-2	Conformity Table: The DAR should include a table cross referencing the items in these Terms of Reference with relevant sections of the DAR.	1.2
B	**Developer Information**	
B-1	Company Corporate History: Please summarize the company's corporate history in Canada and the Northwest Territories. Also include the corporate histories of any partners.	2.1
B-2	Development Ownership: List all current partners in the SDL and the portion each owns.	2.2
B-3	Organizational Structure: Identify the current corporate and individual responsibilities for the proposed development and associated operations.	2.3
B-4	Performance Record: Provide a record, preferably in form of a concordance table, showing how and to what extent commitments made by Paramount, measures ordered by the Minister and recommendations made by the Review Board during EA00-004 and EA01-005 have been implemented. Where measures and recommendations have not been implemented, or where commitments have not been followed, explain why. Only those measures ordered by the Minister and recommendations by the Review Board that were directed at Paramount have to be included.	2.4
C	**Development Description**	
	The Board requires a complete development description.	3.
C-1	Timing: Provide the proposed long-term schedule as well as generic seasonal schedules for the project, and identify any time constraints.	3.1
C-2	Construction Methods: Describe the methods used to build access roads, well pads, pipelines, and any other components.	3.2
C-3	Operations: Describe the operations in terms of normal activities and in terms of potential malfunctions and accidents.	3.3
C-4	Waste Management: Give a description of the existing and proposed waste management plans.	3.4
C-5	Water Use: Provide a water budget for access and lease construction as well as drilling operations. Identify potential water sources.	3.5
C-6	Abandonment and Restoration: Describe your plans for abandonment and restoration, including the well sites, sumps, and access roads, battery sites, etc.. Include any plans for long-term monitoring.	3.6
C-7	Other: Include any other relevant proposed activities or development components.	3.7

Terms of Reference Section	Information Requested by the MVEIRB [ToR and Work Plan issued August 8, 2003]	EIA Section Containing the Information
D	**Alternatives**	
	The DAR should discuss alternatives to the currently proposed development components, their environmental impacts, and their limitations. As a minimum the following alternatives should be considered: - alternative waste management, such as sumpless drilling systems; - directional drilling methods; - alternative transport modes, such as the use of airships to move heavy equipment; and - alternative scheduling, e.g., stretching the program over a longer period of time;	4.
E	**Regulatory Regime**	
E-1	Current Components: Provide a table summarizing relevant licences, permits or other authorizations required for the proposed development.	5.1
E-2	Future Components: Provide a table summarizing relevant licences, permits or other authorizations you anticipate to require for the proposed development components.	5.2
F	**Public Consultation**	
F-1	Records: Provide minutes and a summary of consultation undertaken with the public, Aboriginal organizations, land owners, federal, territorial and municipal governments, and others. Include dates and participants.	6.1
F-2	Issues: Identify the issues raised, how they were resolved and what issues remain unresolved.	6.2
G	**Effects on the Environment**	
	The DAR should examine ecosystem components and analyze how they will be impacted by all development components combined in space and over time, rather than presenting individual components and their impacts. In assessing effects on the environment the DAR will take into account section 4.1, and it will: a) Identify the valued components that may be affected. Baseline as well as current conditions should be reported. b) Identify the other past, present and reasonably foreseeable human activities and developments that may affect the same valued components. c) Predict the combined impact of the proposed development in combination with the past, present and reasonably foreseeable future activities and developments in (b) on the valued components identified in (a). d) Describe ways to avoid, mitigate or manage those impacts.	7.
G-1	Air: Include all emission sources. The DAR should address short and long-term effects and also include any changes in the operations that have occurred since the last EA, e.g., the use of sour gas for compressors.	7.2
G-2	Terrain: This section should include impacts on permafrost.	7.3
G-3	Soil	7.3
G-4	Water: This section should include impacts on surface and ground water, in terms of quantity and quality.	7.4 Surface Water; 7.5 Groundwater
G-5	Fish and Wildlife: This section should deal with direct impacts on fish and wildlife, e.g., through short-term disturbance, interruptions of fish and wildlife movement, and changes to habitat. In particular, the DAR is to address changes in effective or critical habitat for boreal woodland caribou. Also, the DAR should identify any species protected by the Species At Risk Act and describe how potential impacts will be minimized.	7.6 Wildlife; 7.7 Fish
G-6	Vegetation: In addition to the effects of vegetation removal this section should address potential effects of the introduction of foreign species, accidental or through re-seeding efforts.	7.8

Terms of Reference Section	Information Requested by the MVEIRB [ToR and Work Plan issued August 8, 2003]	EIA Section Containing the Information
G-7	Cultural and heritage resources: Identify archaeological and heritage resources as well as sites or areas of cultural significance in or near the project area. To protect these resources, their location should NOT be included in the DAR. The DAR should, however, demonstrate that the developer is aware of the locations of known archeological sites and has procedures in place to detect and protect yet unknown sites as the project progresses. The Prince of Wales Northern Heritage Centre may be contacted for further information on archeological sites. The developer is further encouraged to consult the people of Kakisa about cultural and heritage resources in or near the project area.	7.9
G-8	Traditional Harvesting: Describe the direct and indirect impacts this development may have on hunting, fishing, and trapping.	7.10
G-9	Health and Social Indicators: Describe how the proposed development may affect indicators such as use of social services (strain on infrastructure), alcohol and drug use, and teen pregnancy. Information on trends of these and other indicators to describe health and social well being may be obtained from the GNWT Bureau of Statistics or from service providers in the affected communities.	7.11
G-10	Economic Factors: The DAR should describe how the proposed development will impact on the economy in the NWT in general and on the economy of the affected communities in particular. This section should also include information on hiring policies with respect to NWT residents and residents of the affected communities, including barriers to employment, minimal skill requirements, availability of employees, and any proposed training or education initiatives.	7.11
H	**Contingencies**	
H-1	Effects of Environment: List and describe all effects that the environment may have on your development, including effects of global warming. Describe how the proposed development can be modified to address these effects.	8.1
H-2	Effects of Malfunctions: List and describe foreseeable malfunctions and how you will be dealing with those.	8.2
H-3	Koyoto Accord: Describe how Canada's obligations under the Kyoto Accord may impact on the proposed development and how these obligations may be dealt with.	8.3
J	**Monitoring, Evaluation and Adaptive Management**	
	Where the DAR identifies an impact and/or a mitigation measure it should also discuss how this will be monitored, if necessary, and how management practices may be adapted over time to ensure the long-term effectiveness of mitigation measures.	9.

2. DEVELOPER INFORMATION

2.1 PARAMOUNT RESOURCES LTD. CORPORATE HISTORY

This section addresses Section B-1 of the MVEIRB ToR:
Please summarize the company's corporate history in Canada and the Northwest Territories. Also include the corporate histories of any partners.

Paramount was incorporated under the laws of the Province of Alberta on February 14, 1978. Paramount commenced operations as a public company listed on the Alberta Stock Exchange on December 18, 1978. On November 30, 1984, Paramount was listed on The Toronto Stock Exchange. Paramount was added to the TSE 300 Composite Index (Subgroup 3.2 Oil and Gas Producers) and the TSE 200 Index, effective January 16, 1998.

The head and principal office of Paramount is located at 4700, 888 – 3 Street S.W., Calgary, Alberta T2P 5C5.

The management of Paramount is provided by eight officers, two of whom currently also serve as directors. There are nine non-management directors to complete the Board of Directors.

Paramount is a Canadian natural resource company involved in the exploration, development, and production of petroleum and natural gas in Alberta, British Columbia, Saskatchewan, the Northwest Territories, Wyoming, and California. Paramount's year 2002 natural gas production was approximately 6.82 10^6 m^3/d (241 MMSCFD) with oil and natural gas liquids sales averaging 900.5 m^3/d (5,663 Bbl/d).

Paramount's activities in the Northwest Territories began in the Cameron Hills area in 1979 and in Fort Liard in 1980. Activity was sporadic throughout the 1980's and 90's in Cameron Hills, but was only re-established in the Liard region in 1996. Paramount added a new area of activity in the Northwest Territories at Colville Lake in 2000.

Paramount's partner, Marathon Canada Limited, was established in Canada in August 1998 with a head office in Calgary, Alberta as a fully owned subsidiary of Marathon Oil Corporation headquartered in Houston Texas, United States. The corporate entity of Marathon Canada Limited is currently for sale with a closing date of October 1, 2003.

In 1998 Marathon Canada Limited purchased the shares of Paramount's prior partner in Cameron Hills commencing their only activity in the Northwest Territories.

2.2 PARAMOUNT RESOURCES LTD. CAMERON HILLS OWNERSHIP

This section addresses Section B-2 of the MVEIRB ToR:
List all current partners in the SDL and the portion each owns.

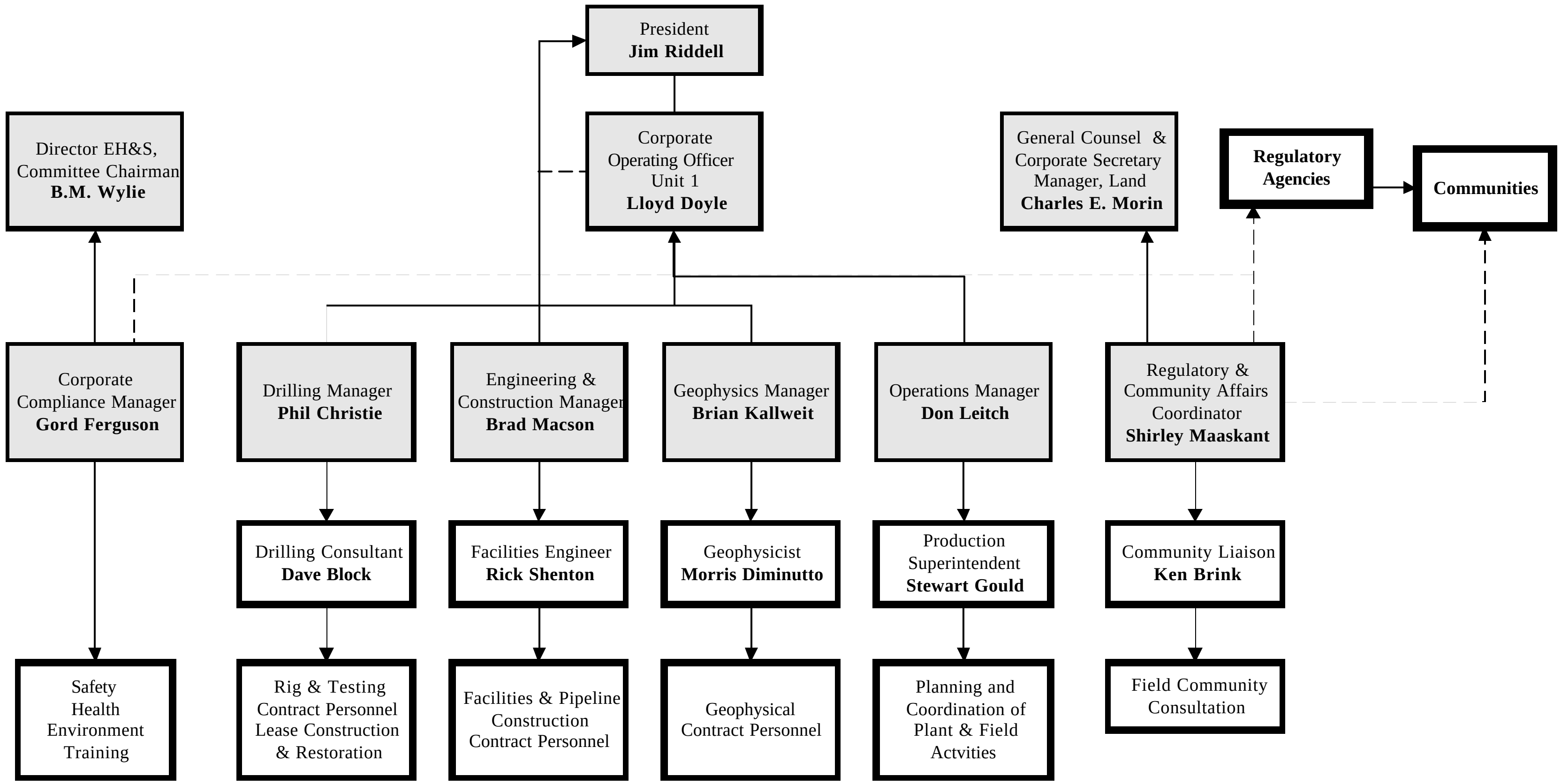
Paramount is the operator of the lands within the SDL at Cameron Hills and currently holds a 78% to 88% working interest, with Marathon Canada Ltd. holding the remaining 12% to 22% working interest. Paramount's overall effective working interest in the Cameron Hills Area is 85.228%.

2.3 PARAMOUNT RESOURCES LTD. CAMERON HILLS ORGANIZATIONAL STRUCTURE

This section addresses Section B-3 of the MVEIRB ToR:
Identify the current corporate and individual responsibilities for the proposed development and associated operations.

The following flow diagram depicts the reporting structure and denotes the rolls and responsibilities of each department to facilitate seismic, drilling, facilities, production and corporate compliance for the Cameron Hills area.

Paramount Resources Ltd. Cameron Hills Organizational Structure



2.4 PARAMOUNT RESOURCES LTD. ENVIRONMENTAL PERFORMANCE RECORD

This section addresses Section B-4 of the MVEIRB ToR:
Provide a record, preferably in the form of a concordance table, showing how and to what extent commitments made by Paramount, measures ordered by the Minister and recommendations made by the Review Board during EA00-004 and EA01-005 have been implemented. Where measures and recommendations have not been implemented, or where commitments have not been followed, explain why.

Only those measures ordered by the Minister and recommendations by the Review Board that were directed at Paramount have been listed below.

Table 2.4-1 Concordance Table

EA00-004 Cameron Hills Drilling Project MVEIRB Recommendations Addressed To Paramount		
MVEIRB Recommendation	**MVEIRB Recommendation**	**Implementation Status**
Recommendation #1	Paramount should continue to closely consult and work with the potentially impacted communities to ensure that potential impacts are minimized.	Consultation with the potentially impacted communities is ongoing. Appendix I lists the consultation events and the topic. Paramount is committed to continue this effort. Open houses, individual community meetings, one-on-one discussions, telephone, project updates, and electronic mail have all been utilized to share information with the communities and provide them with the opportunity to discuss the Project. The communities have participated in the supply of goods and services, employment, training, heritage, project planning and monitoring on the Project.
Commitments Made by Paramount	A list of all commitments made by Paramount from Attachment 1 of EA00-004 Final Report is included in Table 2.4-2.	Refer to Table 2.4-2.

EA01-005 Cameron Hills Gathering System and Pipeline Development MVEIRB Recommendations Addressed To Paramount		
MVEIRB Measure #	**MVEIRB Measure**	**Implementation Status**
Measure #13	Paramount is to discuss, develop and implement a Wildlife and Resource Harvesting Compensation Plan with potentially affected First Nation communities – Deh Gah Go'tie First Nation, Fort Providence Metis, Ka'a'gee Tu First Nation, K'atlodeeche First Nation and West Point First Nation. The scope of the plan is to include compensation for hunting, trapping, fishing and other resource harvesting activity losses resulting from the development as agreed to by Paramount and the communities. Paramount is to commence the consultations as soon as possible, with a draft plan submitted to the communities within 60 days of EA Report acceptance by the INAC Minister and a final plan submitted to the communities within 90 days of EA report acceptance. The plan is to apply retroactivity to impacts arising from the start of construction of the gathering facilities and pipeline. If requested by Paramount or any of the communities, the GWNT and INAC are to facilitate the discussions on the plan.	In fulfilling consultation requirements to develop the Wildlife and Resource Harvesting Compensation Plan, Paramount attended a meeting in Kakisa on January 29, 2002 and arranged a workshop with the other First Nation communities in Hay River on January 30 and 31, 2002. The First Nations cancelled the workshop on January 28, 2002. On February 6, 2002 Paramount requested that INAC and GNWT facilitate discussions on the Plan. On March 1, 2002 Paramount submitted a Draft Wildlife Harvesting Protocol to INAC for distribution to the First Nation communities. On March 12, 2002 Paramount submitted a Draft Wildlife Harvesting Compensation Plan to Deh Gah Got'ie Dene First Nation, K'atlodeeche First Nation, Fort Providence Metis Nation, Ka'a'gee Tu First Nation and West Point First Nation, the NEB, INAC, and RWED. On March 20, 2002 Paramount was notified by INAC that Steve Morrison would facilitate discussions on the draft Plan. In an effort to expedite resolving the issues, Paramount agreed to grant the facilitator authority to act as mediator commencing June 21, 2002. Paramount participated in meetings with the mediator and a September 2002 workshop in Hay River with First Nation communities. On March 17, 2003 the mediator notified Paramount that the First Nation communities wished to put the mediation process and the plan on hold.

EA01-005 Cameron Hills Gathering System and Pipeline Development MVEIRB Recommendations Addressed To Paramount		
MVEIRB Measure #	**MVEIRB Measure**	**Implementation Status**
Measure #15	Paramount and the communities are to cooperate to the fullest extent possible in developing the wildlife and resource harvesting compensation plan. If the parties are unable to come to an agreement on the contents of the plan within 90-day period, an independent arbitrator shall be jointly appointed within 30 days by the GWNT and INAC. The arbitration process shall conclude within 30 days of the appointment of the arbitrator.	Paramount has cooperated fully in discussions to develop a Plan.
Table 2.4-3 Commitments Made by Paramount	In response to Review Board IR #11, Paramount has compiled all of its commitments into the following table.	See Table 2.4-3.

Table 2.4-2 contains the commitments made by Paramount to the MVLWB, and the adherence status.

Table 2.4-2 Commitments Made By Paramount – EA00-004 Cameron Hills Drilling Project

Commitment	Adherence
General	
The development will occur under frozen ground conditions in the winter months.	Drilling, service rig and evaluation operations continue to be conducted on frozen ground conditions.
The local communities will be notified prior to commencement of activities so that anyone utilizing the area will be aware of the construction/drilling activities and to ensure appropriate avoidance or precautionary measures can be implemented.	Communities and the two Cameron Hills trappers have been notified through regular consultation, specific telephone calls and project updates.
All work connected to the development will comply with the recommendations and conditions identified in the Land Use Permit, Water License and other relevant permits, as well as any other regulatory requirements.	Wellsite drilling activity clean up is an ongoing activity. Compliance with all requirements will be achieved. As the snow melted this spring, some evidence came forth for ongoing garbage pickup.
Access road, camp and well lease construction will comply with applicable INAC guidelines.	INAC guidelines have been adhered to.

Commitment	Adherence
If any heritage resources are encountered, work will halt and the local communities, the MVLWB, the Prince of Wales Northern Heritage Centre and INAC will be notified immediately to discuss mitigation options.	Heritage resources have not been encountered to date.
Concerns identified from the traditional knowledge study will be incorporated into the development to ensure that the potential for negative impacts to traditional land use is minimized.	Concerns identified relative to the project have been mitigated through project design and ongoing consultation with the two trappers identified.
Following completion of the drilling and testing operations, all equip ment, materials and other debris from the development will be removed and transported out of the area.	Equipment has been transported out of the area. Some clean-up of residual drilling mud remains for next season.
All sites associated with the construction and drilling program will be stabilized and reclaimed to a condition that will mitigate residual impacts, promote re-vegetation and not impair pre-disturbance land use activities.	Work is ongoing to clean up minor trash and drilling mud deposits after last year's drilling program.
In conjunction with the Emergency Response Plan (ERP), Paramount will ensure staff and associated contractors are adequately trained, including first aid, to deal with emergency situations. The ERP will be rigorously enforced. The contractors must have approved health and safety plans and procedures.	Each contractor has its own safety program and is obliged to review Paramount's ERP, before work commences.
Any relevant industry standards pertaining to safety and environmental protection will be incorporated into the operation of the development. This applies to Paramount and it contractors.	Industry standards are incorporated into all aspects of the operation.
No form of illicit drug and alcohol use will be tolerated by anyone while engaged in field operations.	Paramount's drug and alcohol policy is made known to all personnel, at all levels, through prework orientation. Paramount's supervisors are empowered to implement disciplinary action, including immediate dismissal, on all/any offenders.
The well drilling and evaluation equipment and the equipment set-up will be checked for safety on the routine basis by the contractor's safety supervisor.	All equipment is checked regularly as part of an ongoing preventive maintenance program to assure safe work conditions prevail at all work sites.
Paramount will continue to provide regular community development updates to communities and regulatory agencies.	Project updates were distributed on Aug 3, Nov 16, Oct 1, 2000; Jan 15, Apr 27, Oct 1, 2001; Feb 7, Jul 29, Nov 26, 2002; May 30, 2003.
Winter Access Road	
A combination of snowmobiles/all-terrain vehicles and lightweight tracked vehicles will be initially used to compact the snow and subsurface vegetation on the access ROWs to induce subsurface frost penetration.	Done.
Snow plowing in low-lying areas will be limited and a minimum of 15 cm of snow will be left to protect the surface vegetation.	Close supervision of equipment operators assures conservation of the surface duff.

Commitment	Adherence
When feasible and required, natural openings will be utilized for push-outs or passing lanes. If brush clearing is required, brush will be mowed with a hydro-axe or brush flail to mitigate disturbance to the surface organic layer.	The original access road from south of 60 to the SDL is utilized today. Increased traffic, giving rise to safety concerns, has necessitated some upgrading of the winter access. The ROW width south of 60° has been increased. North of 60°, corners have been cleared to increase the line "of" sight. Except for these modifications the clearing of undisturbed land adjacent to the access for push-outs and passing lanes has been minimal.
Generated debris and slash will be windrowed and utilized for rollback.	Slash and debris volumes are minimal and handled easily within the approved ROW
Construction of the winter snow road will be consistent with the methodology and guidelines in the GWNT Department of Transportation Handbook.	The abundance of natural snow and cold weather have made it relatively easy to provide competent access.
Frost penetration will be sufficient on access ROWs to support the weight of drilling equipment and traffic prior to accessing the development area.	No incidents have occurred due to inadequate bearing capacity on access or wellsites.
If necessary, an ice-capped snow road will be built to mitigate surface disturbances.	Through careful timing of activity it has not been necessary to invoke special measures to protect the surface vegetation.
Water for winter road construction will be obtained from the water source lake and/or the drilled water wells.	To date, water has been entirely sourced from water source lakes. Well water has not been used.
While the winter access road from Indian Cabins is open, access will be monitored with a staffed or locked gate.	The gate has been staffed.
Water Crossings	
The work will be scheduled during frozen drainage conditions.	Activity was scheduled during the winter months.
Ice bridge construction will be consistent with the methodology and guidelines identified in the GWNT Department of Transportation Handbook.	The abundance of natural snow and cold weather has made it relatively easy to provide competent access, including ice bridges.
Only clean snow and ice are to be used for construction of water crossings.	Clean snow and ice was used for water crossings.
It is prohibited to deposit any deleterious materials onto the ice or into the water of a watercourse or water body. If this should occur, the material will be immediately removed with measures taken to contain any pollutants.	Only clean snow and water were used to construct ice bridges.
Crossings will be removed completely or a "V" notch will be placed in the middle of the crossing to allow flow.	Crossings are removed at the end of the season as equipment moves out.
No refueling will be allowed within 100 m of the watercourse crossing sites.	Refueling was a minimum of 100 m from water crossings
Vehicles will be checked for oil and/or fuel leaks that could find their way into streams.	Vehicles were checked for oil and fuel leaks.

Commitment	Adherence
If necessary, a pre-disturbance bank profile will be re-established which may include using riprap, organic cribbing, bundled logs or other stabilization measures.	No steep banks requiring supplementary stabilization were encountered.
No drilling waste fluid, treated or otherwise, with be discharged to surface waters.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
Well Sites	
Only the minimal area necessary to safely allow the drilling operations will be cleared.	Sites are 110 m by 110 m – the minimum requirement.
All construction/drilling activities will be confined to the surveyed well site boundaries.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
The potential of using a non-square lease will be evaluated for environmental advantages.	The use of a non-square lease greatly reduces on-site equipment mobility and storage capacity, both of which can contribute to an unsafe working environment.
All timber will be felled onto the lease and away from the undisturbed timber adjacent to the surveyed boundaries.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
Standing timber and shrubs within the surveyed boundaries will be cleared with brush rakes and the resulting slash will be pushed into windrows for eventual rollback at the end of the development.	Any slash is windrowed for distribution over the lease at the time of reclamation or is walked into the compacted snow base at the time of construction.
Equipment operators will be instructed to keep the bottom edge of the brush rake elevated approximately 20 cm above the surface to avoid unnecessary disturbances to the ground layer.	Careful review of land disturbance objectives on pre-job orientation assures knowledge of objectives and close supervision assures results. Disturbance of the surface duff is minimal.
A cutter blade outfitted with mushroom shoes will be used for clearing understory vegetation and non-salvageable timber.	Careful review of land disturbance objectives on pre-job orientation assures knowledge of objectives and close supervision assures results. Disturbance of the surface duff is minimal.
Slash windrows will be located along the high side of the lease with a break maintained between it and the standing forest.	Any slash is windrowed for distribution over the lease at the time of reclamation or is walked into the compacted snow base at the time of construction.
No slash material will be pushed into or against standing timber adjacent to surveyed boundaries or into natural drainages or wetland features.	Careful review of land disturbance objectives on pre-job orientation assures knowledge of objectives and close supervision assures results. Disturbance of the surface duff is minimal.
A compacted snow pad will be used to level micro-relief variations to the maximum extent feasible, thus avoiding leveling or surface disturbance of the surface organic soil layer. Should insufficient snow be available on the well site, water will be trucked in to create an ice pad.	Adequate inventories of natural snow have facilitated easy construction of snow packed work surfaces.

Commitment	Adherence
Residual slash will be walked down into the snow to help create a protective surface buffer.	Any slash is windrowed for distribution over the lease at the time of reclamation or is walked into the compacted snow base at the time of construction.
If leveling is required, the organic material will be stripped and salvaged prior to any grading activity for replacement during reclamation.	Careful review of land disturbance objectives on pre-job orientation assures knowledge of objectives and close supervision assures results. Minimal cut and fill leveling has been required but when required, the organic layer is salvaged for use during reclamation.
A snow/ice berm may be constructed on the low sides of the well site to contain any accidental surface spills or container leaks.	A snow berm is used on drilling sites for spill containment.
Above ground tanks will be used to contain drilling fluids, which, in turn, will be transported to the remote pits.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
Only fresh water, environmentally friendly Gel/Chem mud system will be used.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
Drilling waste will be sampled and analyzed to ensure that it does not contain mud contaminants that exceed regulatory parameters or guidelines.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
Upon completion of the drilling program, the mix/bury/cover disposal technique will be utilized for disposal of the muds.	Drill cuttings are disposed of in remote pits and drilling mud is recycled to reuse. None is disposed whole on the lease or on any surface.
If a well proves to be viable, the well will be completed and production tested to the end of the winter drilling season.	Completion and well evaluation is conducted as required under frozen ground conditions.
Water for drilling will be obtained from the source lake or water wells. Drilling fluids will be reused from well to well to reduce water consumption.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Drilling fluid is reconditioned for ongoing use.
Cement returns will be segregated from the drilling waste pit to avoid a pH problem during disposal. The cement returns will be buried on-site, below a minimum of 1 m of cover once they have set up.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
All chemicals will be marked as per WHMIS requirements and stored in an appropriate location prior to use.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
Produced water and other liquids will be tanked and tested to determine disposal options, pending regulatory approval. Excess water will be sampled and analyzed on-site to confirm it is non-toxic and conforms to regulatory requirements.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Waste produced fluid is taken to licensed waste handlers south of 60.
Litter and debris will be stored in covered bins for disposal off the well site at an approved landfill location.	All of the terms and conditions of the Land Use Permit and the Water License have been met.

Commitment	Adherence
Following drilling and testing operations, the organic material and desirable soil that was salvaged from the pit location will be spread during reclamation. Natural encroachment will be encouraged.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Minimal surface disturbance at the time of construction minimizes the need to implement remedial erosion control measures.
All well sites will be monitored during construction, reclamation and one year after construction to determine if remedial seeding, site stabilization or other additional reclamation work is required.	Minimal surface disturbance at the time of construction minimizes the need to implement remedial erosion control measures. No supplementary seeding has been undertaken to date.
Unsuccessful wells will be abandoned and reclaimed in accordance with NEB requirements immediately following drilling operations.	Minimal surface disturbance at the time of construction minimizes the need to implement remedial erosion control measures yielding more expeditious site reclamation on well abandonment. Wellbore abandonment will adhere to NEB guidelines.
Until such time as the Northwest Territories has its own Drilling Waste Management guidelines in place, Paramount will adhere to the AEUB Guide 50 – Drilling Waste Management and AEUB Guide 58 – Oilfield Waste Management Requirements for the Upstream Petroleum Industry.	Conditions and requirements of AEUB Guides 50 and 58 are met.
All potential contaminants and other drilling wastes will be characterized, manifested and transported to an approved waste facility for disposal in accordance with the Transportation of Dangerous Goods Regulations.	All of the terms and conditions of the Land Use Permit and the Water License have been met. All shipments are dealt with in accordance with TDG regulations.
Temporary Camps	
Surface disturbance mitigation measures and clearing techniques will be as previously described for other development elements.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Minimal surface disturbance of surface duff at initial stages of construction assists greatly in stabilizing the site for the long term.
A disposal sump will be used for disposing grey water.	All of the terms and conditions of the Land Use Permit and the Water License have been met. The grey water sump is treated with lime and closed with the mix and bury technique.
Camp fuel storage at each camp will use two above ground tanks that will be stored in a common area. Containment berms will be constructed in impervious material around the perimeter of the storage site and the tanks will be placed on impermeable liners. Berms will be large enough to contain 110% of the bulk storage capacity.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Attention to avoid spills around the refueling area is emphasized at pre-job orientation.
All combustible garbage will be burned in a diesel-fired incinerator on-site.	All combustible garbage is incinerated or is disposed of at an approved land fill
Metal, plastic and other wastes will be contained in bins for removal to approved landfills.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Waste disposal of a domestic and industrial nature is managed by contract to licensed service providers.

Commitment	Adherence
Secured storage containers for fuel, filters, used motor oil and special handling wastes will be placed away from low-lying areas and appropriate containment measures such as catch trays and berms will be used as necessary.	Hazardous wastes are stored independently and disposed of under contract at an approved site.
Oily wastes will be transported to an approved recycling or disposal facility.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Hazardous wastes are stored independently and disposed of under contract at an approved site.
Good housekeeping practices will be enforced.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Close supervision assures compliance and the right result.
Following camp closures and regulatory approval, the sewage will be properly treated and the sumps backfilled and compacted. Furthermore, all equipment, garbage, wastes and structures will be removed from the site.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Sewage sumps are treated with lime and closed using the mix and bury technique. All equipment is removed and the site is abandoned. These sites will be monitored to assure ongoing surface stability.
If required, disturbed areas within the campsites will be re-seeded with an approved seed mix if natural regeneration is unsuccessful. The campsites will be monitored during construction, reclamation and one year after construction to determine if remedial seeding or other work is required to promote site stability and enhance local flora establishment.	Minimal surface disturbance at the time of construction minimizes the need to implement remedial erosion control measures. No supplementary seeding has been undertaken to date.
Air and Noise	
Vehicles, heavy equipment and diesel-powered generators will adhere to the appropriate federal, territorial and provincial emission standards and will be equipped will mufflers.	All equipment is fitted with manufacturer's noise abatement device and it is maintained.
The flare stack will be of sufficient height and design to ensure efficient comb ustion and to maintain ground level concentrations below NT air quality standards.	Continuous total sulfation monitoring indicates that ground level concentrations are below detectable limits.
AEUB Guide 60 – Upstream Petroleum Industry Flaring Guide will be adhered to during well evaluations.	All conditions of AEUB Guide 60 are met.
Only the amount of gas required to accurately assess the technical and economic validity of each well will be flared.	Waste of natural resources is discouraged in every aspect of Paramount's activities. It is important to get a withdrawal volume of sufficient size to provide for informed decision-making, but that is also weighed against the potential sale of the gas. Paramount is in the business of producing gas for profit, and does not flare it unless there is a specific and offsetting purpose.

Commitment	Adherence
Wildlife	
All efforts will be made to reduce contact with wildlife and not restrict wildlife movements.	Very limited population of wildlife yields very little interaction with the workforce. Breaks in berms are left in game trails so as not to inhibit movement.
Work crews will be instructed not to harass wildlife in any manner.	Work crews risk dismissal if they take any action to engage wildlife.
Firearms are not permitted on-site unless authorized by the GNWT for personal safety reasons.	Firearms were not on site.
No dogs will be allowed.	Employees and contractors were not allowed to bring dogs on site.
No feeding, hunting or harassment of wildlife will be tolerated.	Only ravens appeared in numbers worthy of mention. Tight control of waste containers was maintained in an effort to control their numbers around camp and work sites. Work crews risk dismissal if they take any action to engage wildlife.
All garbage will be collected and stored properly so as not to attract nuisance animals such as wolverines or fox.	Tight control of waste containers was imperative in controlling ravens. The presence of other nuisance animals was not noticed.
Food waste will be placed in secured containers that will be either transported to an approved disposal location or incinerated daily on–site.	Tight control of waste containers was imperative in controlling ravens. The presence of other nuisance animals was not noticed.
Kitchen sumps will be treated with lye or lime to render them unattractive to scavenging wildlife species such as wolverines and wolves.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
Safety in Bear Country practices will be followed in the event that bears are encountered. GNWT bear safety literature will be distributed to development personnel.	Precautionary measures to deal with bears is not relevant for the majority of the work program since it occurs during hibernation. The small amount of work that does occur in the fall does warrant bear awareness. The bears in the Cameron Hills area have not evidenced any significant numbers or curiosity to our activity as few sightings of bears have been noted by production operations personnel.
In the event that a bear den is encountered, the appropriate Resources, Wildlife and Economic Development (RWED) Renewable Resources Officer will be notified.	No bear den have been encountered.
Drivers will be instructed to maintain safe and appropriate speeds and to be aware of potential wildlife encounters on roads.	No animal/vehicle accidents have been reported. Close supervision of driving habits is encouraged through Paramount inspectors.
Drivers will not herd or chase animals down the road and will be instructed to stop and turn the headlights off for a moment to allow the animals to disperse off the road.	Respect for wildlife is pervasive throughout the oil and gas industry. Conservation of wildlife is a growing concern in all members of society and peer pressure is the most effective tool in and out of the workplace.

Commitment	Adherence
Snow windrows will be created adjacent to the road corridors during the construction and operation phases. The windrows will have gaps (8 m) at regular intervals (every 300 to 500 m) to allow animal movement and to provide escape routes off the roads.	Breaks also left at obvious game and trapper trails.
Land and Resource Use	
All crews will respect traditional areas.	All activities are confined to surveyed boundaries.
Every effort will be made to avoid destroying traps or snares during construction of access routes.	Early notice of activity to trappers has facilitated safe keeping of trapping equipment.
Trappers that have set lines in the area will be contacted prior to Paramount working in an area.	Early notice of activity to trappers has facilitated safe keeping of trapping equipment.
If trap lines are affected by the development, the trappers will be compensated for any demonstrable loss.	Early notice of activity to trappers has facilitated safe keeping of trapping equipment.
Snowmobile trails and game trails will not be blocked.	Breaks are left at game and snowmobile trails.
Activity will be restricted to within approved leases and ROWs.	All activity is confined to surveyed boundaries.
Paramount will meet with the trappers identified by the Ka'a'gee Tu First Nation.	Paramount has ongoing and specific discussion with the two trappers identified by Hay River and Hay River Reserve and many other members of the neighboring FirstNnation communities. Kakisa has not identified any Kakisa trappers on the project site.
Socio-Economics	
Northern businesses will be contracted to provide goods and services whenever possible on the basis of availability, reliability, qualified personnel and cost competitiveness. Paramount will make every reasonable effort to notify local communities and companies about opportunities.	Goods and service providers are provided an opportunity to participate in the project and are made aware of Paramount's needs through the regularly published project updates.
The names of successful contractors will be published in the Project Updates and distributed for the benefit of those interested in employment and sub-contracting opportunities.	Project updates continue to be published in a timely manner to give local businesses the opportunity to participate.
Successful contractors will be required to outline in their bid documents their hiring strategy for local communities and describe their contribution to the communities.	Major contractors have local hiring strategies and were required to report on their success in hiring locally.
The number of jobs provided to northerners, the number of contracts awarded to northern businesses and the total dollar value of these contracts will be tracked to ensure that local and regional skills are recognized and retained for future consideration.	This information is tracked and reported to INAC in the annual report.
The primary contractors will adhere to the terms of the Benefits Plan.	All contractors, primary or otherwise, are made aware of the terms and condition of the benefit plans and their activities are monitored to assure compliance.

Commitment	Adherence
Water Source Location	
Vehicles and heavy machinery will not be refueled within 100 m of the water source and vehicles will be routinely checked for oil and fuel leaks. Absorbent pads and/or socks will be readily available to pick up any spilled fuel or lubricant.	Fuelling stations were >100m from any water. Equipment is monitored for leaks and is taken out of service until it is repaired. Spill kits are carried by maintenance vehicles.
It will be prohibited to deposit any deleterious materials on the ice or in the water of a watercourse or water body.	All of the terms and conditions of the Land Use Permit and the Water License have been met. Only clean snow and water are used to construct accesses over/to water bodies and any deleterious materials are removed immediately.
At no time will any drilling waste fluid, treated or otherwise, be discharged to surface waters.	Waste fluid is all disposed of by deep well re-injection in Alberta. None is disposed of in NT.
Water usage and withdrawal will be staggered through the winter as the wells are drilled.	Water withdrawals are minimized and spread out over the available sources to minimize the stress on any one source.
Water pumps with intake screens of 5 mm will be used to prevent potential entrainment of over-wintering fish.	All of the terms and conditions of the Land Use Permit and the Water License have been met.
Should any soil or other materials be inadvertently introduced into the watercourse or water body, they will be removed as soon as possible.	Only clean snow and water are used to construct accesses over/to water bodies and any deleterious materials are removed immediately.
Equipment operators will be careful to avoid gouging or otherwise disturbing banks or lake/stream bottoms.	Careful review of land disturbance objectives on pre-job orientation assures knowledge of objectives and close supervision assures results. Disturbance of the banks is eliminated.
If water wells are used for drilling water, care will be taken to ensure water withdrawal is completed at a rate to protect water well integrity.	No well water has yet been used for drilling purposes.
Remote Sumps and Pits	
Cleared materials will be stockpiled for the duration of the drilling operations and utilized for roll back over the site upon pit or sump closure.	Minimal slash volumes are easily distributed to reclaim the site.
If the site soil conditions at either site are not suitable, alternate remote sump locations will be evaluated and determined in consultation with the local land use inspector.	Soil conditions were suitable in alleviating the need to identify and develop alternate sites.
Prior to pit excavation, the organic material and topsoil horizons will be stripped from the pit location and stored in a pile or windrow.	Organic material is salvaged and spread over the disturbed surface in reclaiming the site.
The underlying subsoils will be excavated and stored in a spoil pile but kept separate from the previously windrowed/poled organic material.	A last out/first in policy is practiced to preserve the natural soil horizon distribution. Some admixing is unavoidable due to winter conditions but this is not significant.
If the subsoil is pervious, the pit will be sealed with bentonite or other liner prior to use.	Native soil was found to be impermeable eliminating the need to install other liners.

Commitment	Adherence
Pits and sumps will be restored in a manner suitable to INAC using the standard mix, bury and cover method.	DIAND has graded the pits and sumps"acceptable".
Before backfilling, any snow cover on the surface and salvaged pile materials will be removed to the extent feasible.	Snow cover is removed to successfully limit subsidence.
Backfill material will be compacted during each lift replacement and a cap 1 to 1.5 m in height will be created over the pits and sumps.	Sites are reclaimed in accordance with permit conditions and are monitored to assure satisfactory long-term conditions prevail.
The locations will be re-contoured, as necessary. This will include rolling back any salvage slash or organic debris.	Salvage slash is spread over the contoured reclaimed pit to provide additional stability.
Remedial seeding will occur if required.	To date no remedial seeding has been required.
Site visits will occur to evaluate reclamation work and implement any additional mitigation measures.	Production personnel passively monitor reclaimed sites in the course of their day-to-day duties.
Borrow Pits	
Borrow Pits will be re-contoured and/or terraced as necessary.	All slopes are stabilized to alleviate erosion concerns.
All cuts and fills will be back-sloped to a slope ratio of not less than 3:1.	Recontouring to effect stable slopes is an essential part of pit reclamation.
Slash roll back and re-seeding would occur as for the pits.	Slash is rolled back as it is available.
Spills	
Fuel tanks will have secondary containment.	Double wall tanks or liners and berms provide secondary containment.
Waste disposal bags and spill kits will be in the area and readily accessible.	Spill kits are carried by maintenance vehicles.
Any spills will be evaluated and appropriate remedial measures implemented.	All spills are reported, and cleaned up immediately to the satisfaction of the DIAND Resource Management Officer.
The spill area will be restored in a manner suitable to INAC and other relevant regulatory agencies.	The drilling and construction operations have not yielded any major spill sites. All spill sites have been relatively minor in size and nature and have been cleaned up to the satisfaction of all regulators, or have ongoing remedial action plans acceptable to the DIAND Resource Management Officer.

Table 2.4-3 provides Paramount's commitments to MVLWB for EA01-005, and the adherence status.

Table 2.4-3 Performance Record EA01-005 – IR 11

Commitment	Current Adherence
Air Quality and Noise	
Burning of slash will be done in accordance with local restrictions. Slash volumes will be minimized by using slash for rollback.	To date, all slash has been rolled back.
Automatic emergency shutdown system and Emergency Response Plan in place.	Annual review of ERP ensures that it is current.
Construction will be completed in an expeditious manner, with all work limited to the surveyed ROW and work place. In addition, the adjacent forest will attenuate the noise. Emissions are expected to be below air emissions guidelines. Equipment will also be outfitted with appropriate mufflers.	Ground level concentrations of SO_2 are below maximum permissible limits. The noise survey was completed in June 2003 for the third time to ensure compliance. The findings indicate the facility complies with the allowable noise levels.
Emissions will be required to meet federal emission criteria. If the total volumetric flowrate of H_2S being emitted at the gas wells exceeds 94 m^3/d on a continuous basis then the emissions modelling will be redone. If the total volumetric flowrate of H_2S being emitted at the oil wells exceeds 16 m^3/d on a continuous basis then the emissions modelling will be redone. If requested, Paramount will provide fluid samples to the GNWT annually.	Emissions were within limits so no new modelling was done.
Facilities will be designed to meet a nighttime target sound level of 40 dBA at a distance of 1.5 km from the facility. If there is a valid concern or complaint then Paramount will take reasonable steps to ensure the noise guideline is met.	Noise survey completed in June 2003. The findings indicate the facility complies with the allowable noise levels.
Air Quality	
When the Cameron Hills Gathering System and Facilities Project commences production operations, the greenhouse gas emission from the project will be included as part of Paramount's annual submission to Voluntary Challenge and Registry Inc. (VCR).	Complete.
Paramount will be installing total sulphation monitoring stations at two locations at or near the H-03 Central Battery.	Measured total sulfation falls within prescribed limits, and is even below detectable limits.
Hydrology and Water Quality	
No trees will be purposely felled off of the ROWs or into any watercourses.	Complete. Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
The facility equipment will be placed on steel skids with sealed floors and housed in metal insulated buildings. Tanks will have secondary containment consisting of either lined dykes or double-wall construction.	Complete. All process skids complete with sealed containment pans and tanks with double walls, all to prevent liquid spills and contain them.
Construction traffic will only be allowed to cross the local drainage courses along the pipeline by using a	Complete. Pre-construction meeting with Contractor's

Commitment	Current Adherence
compacted snow and/or ice-capped snow roads in conjunction with temporary ice bridges or snow-fills as necessary.	supervisors and Paramount's supervisors insures awareness of requirements and compliance.
The travel corridor including, the placement of ice bridges and snow-fills would be confined only to the surveyed working area of the ROWs.	Complete. Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
The work schedule will be adhered to, to take advantage of frozen ground and frozen or low-flow conditions at drainage crossings.	Late spring aided construction efforts on frozen ground.
For streams that are not frozen to the bottom and an open cut is used, the recommendations of a qualified aquatic environmental specialist ("QAES") will be adhered to. In the event that these recommendations cannot be met, an isolated crossing will be used.	No flowing streams were encountered during the past year's pipeline construction season, and the only flowing streams encountered in the prior year were crossed aerially avoiding instream work issues.
The access routes were selected to employ crossing locations that have been used during previous seismic and/or drilling operations.	Access is provided using previously used crossing locations.
Extra workspace cleared close to the stream crossing will be separated from the streams by a minimum buffer of 5 m from the top of the bank.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Ice bridges will be constructed over those drainages not frozen to the bottom at the time of access construction.	Complete. Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
One vehicle and three ATV bridges will be installed across the Cameron River and its tributaries. There will be block valves on the pipelines that are strung across on the bridge.	These crossings were completed in compliance with commitments during the early 2002 construction season.
Attention will be made to avoid introducing foreign material into a stream.	Environmental inspectors insure compliance and removal of ice bridges before spring break up.
Clean snow and ice will be used to construct ice bridges. Should any soil or other material be accidentally introduced onto the ice of the watercourse, it will be removed before spring break-up so that no deleterious materials are allowed into the water.	Environmental inspectors insure compliance and removal of ice bridges before spring break up.
The crossing will either be removed completely or "V" notched to allow flow during the spring break-up.	Environmental inspectors insure compliance and removal of ice bridges before spring break up.
No refuelling will be allowed within 100 m of the watercourse crossing sites.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Vehicles will be checked regularly for oil and/or fuel leaks.	Compliance assured by thorough inspection and work force awareness of requirements.

Commitment	Current Adherence
If banks of a drainage are disturbed during construction, a pre-disturbance bank profile will be re-established which may include using rock rip-rap, organic cribbing, bundled logs, or other stabilization measures.	Compliance assured by thorough inspection during construction.
The Paramount Construction Inspector will determine the requirements for additional stabilization measures (e.g., rip-rap on banks at crossings).	Stabilization of banks and slopes is an ongoing activity managed by Paramount production personnel and the environmental inspector.
A disposal sump will be used for disposing grey water and sewage.	Complete. The sump was reclaimed by the “mix and bury” method to the satisfaction of the DIAND Resource Management Officer.
Fuel at each temporary camp will be stored in above ground tanks.	Complete. Fuel storage areas are afforded secondary containment using impermeable membranes or double wall tank construction.
Secured storage containers for fuels, filters, used motor oil and waste which requires special handling will be placed away from low-lying areas. Oily wastes will be transported to an approved recycling or disposal facility.	Industrial waste is handled by contract hauling to an approved disposal facility.
Winter construction during no to low flows will minimize disturbances to the steam banks. No slash material will be pushed into drainages or wetlands. Any extra workspace required near stream channel and progress into the sag-bend excavation area to reduce the volume of silted water forced into the stream during excavation. Spoil generated during excavation will be piled on the banks above the high water mark. Directional drilling or isolated crossing will be used if flowing water is encountered. Construction traffic will use a compacted and/or ice capped snow road in conjunction with temporary ice bridges or snow-fills. Streambed material will be salvaged and replaced during final reclamation where open cut is used. Pipelines will be attached to three of the bridges. Travel corridors will be confined to the working area of the ROW. ROW will be left in a stable profile.	All pipeline/stream crossings were frozen to the bottom except for the three aerial crossings. Open cut crossing technique reviewed with contractor and monitored by environmental inspector to assure compliance with commitments.
Safe storage and handling practices (i.e., no chemicals, fluids or privies will be stored or located within 100m of a drainage). Emergency response plan will include a spill response plan.	Complete. Annual review of ERP ensures that it is current. Pre-construction review with Contractor’s supervisors and Paramount’s supervisors assures awareness and compliance.
The facilities would incorporate drainage control including site grading and a secondary containment berm around liquid containing equipment where appropriate.	All liquid storage tanks are double walled and all process skids are equipped with skid collection pans, to prevent liquid spills.
All sites will be contoured to promote positive drainage across the site.	At all sites other than the central battery, the original site contours have been left as found to preserve natural drainage. Since the central battery has a large amount of liquid storage on site, it has been graded to contain any possible spill within the site and to

Commitment	Current Adherence
	minimize the impact of runoff originating off site. Off site runoff is diverted at the site boundary to keep it from entering the site, thereby reducing offsite runoff's ability to carry contaminants off site.
In the event of an accidental spill, including fuel and chemicals within the facilities, appropriate containment and cleanup measures will be implemented immediately. Appropriate regulatory agencies will be contacted. A contingency plan that takes site-specific sensitivities into account will be in place before construction. Similarly, an acceptable plan for the handling and disposal of wastes will be developed.	Pre-construction and pre-commissioning review ensures spill reporting requirements awareness and compliance. The ERP is reviewed and updated annually to assure competence.
All fuel trucks and service vehicles will carry commercial sorbent material to treat both water and permeable surfaces to ensure adequate response capability in the event of a fuel spill. Cleanup procedures will immediately be undertaken.	Spill containment and clean up kits are carried by fuel dispensary and equipment maintenance vehicles, located throughout the construction operation to assure timely response and capability.
Spill kits will be at the work sites.	Spill kits are maintained at work sites and by select maintenance vehicles to assure timely response.
Hydrology	
Pipelines will be buried to accommodate a 1:100 year flood event.	Complete except in the case of the three aerial crossings.
Drainage distribution will be assessed through periodic inspections.	Periodic inspection effected by production personnel as part of daily/weekly routine. Specific mitigative erosion control measures effected by environmental inspector
The bridges will be designed to withstand a 1:100 year flood event, with piles located outside the wetted channel and protected by rip-rap.	Complete. Design accepted by DFO and construction compliance assured by thorough inspection during construction.
The Transborder Pipeline's ROW will not be used for access during production operations when ground conditions are not frozen. This does not apply to the Gathering System since all terrain vehicles will be used to travel the ROWs for access during production operations.	Complete. Use of ATVs has been suspended during extreme conditions to prevent the spread and initiation of forest fires. The use of very low ground pressure ATVs using tracks instead of tires is under trial to test applicability to this environment.
During gravel extraction, no excavation shall be below the water table or the present water level of the Cameron River. There will be a vegetated buffer zone of 25 m from the top of the riverbank.	Due to difficulty in assuring compliance with terms of the permit, Paramount has not excavated any gravel under the terms of the current LUP and WL.
Terrain	
All construction activities will be restricted to the designated ROWs and approved extra working space. Construction traffic will be restricted to the ROW, existing access and appropriate detours. All safety and road closure regulations will be adhered to by construction traffic.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
The boundaries of the pipeline ROW will be surveyed	Complete

Commitment	Current Adherence
and clearly marked with stakes and flagging tape prior to construction to minimize the potential for construction vehicles to trespass off the ROW.	
Construction of the Transborder Pipeline will be within a surveyed 20 m wide ROW, with approximately a 1 m wide trench to accommodate both the multiphase pipeline and the sweet natural gas fuel pipeline.	Complete except the sweet fuel gas pipeline was not installed at the time the multiphase pipeline was constructed. Paramount continues to consider the installation of another pipeline along this disturbance.
Paramount's operating guidelines for working in permafrost areas will be adhered to when areas of permafrost are encountered.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
As a mitigative measure to avoid problems potentially associated with regions of permafrost, Paramount will install heavy-walled pipe.	In operation hoop stress levels are far below maximum permitted by CSA to afford extra protection against possible stress from permafrost.
It may be necessary to designate turn-around areas for stringing trucks and construction traffic. These areas will be used for only that purpose and not used for general construction traffic. Natural or existing clearings will be used for this purpose where possible.	Ongoing review of land use, during construction, with the DIAND Resource Management Officer assures appropriate location of turn-arounds.
Temporary workspace at water crossings, debris storage and vehicle turn-arounds will be determined by the Paramount Construction Inspector. The following areas may require additional ROW width: Watercourse crossing: approximately 15 m X 30 m on each side of the ROW. Bridge crossing: approximately 10 m X 30 m on each side of the ROW. Timber decking area: approximately 30 m X 60 m.	Ongoing review of land use, during construction, with the DIAND Resource Management Officer assures prudent use of the resource considering site-specific conditions and conservation requirements.
Heavy walled pipe, concrete coating or concrete weights will be installed through poorly drained sites where required to reduce the potential for future pipe surfacing	Regular review of pipe buoyancy and terrain with construction inspection personnel assures competent installation of weights or heavy walled pipe to provide optimum negative buoyancy.
Cross drains, parallel ditches and diversion berms will be installed on reclaimed slopes susceptible to water erosion to divert runoff into vegetated areas adjacent to the ROW.	A significant construction effort was expended in early 2003 on frozen ground to implement the erosion remediation plan espoused by Golder Associates in their November 2002 report entitled "Erosion Survey and Mitigation Plans for the Cameron Hills Gathering System and Pipeline".
Berms will be constructed at a maximum 5° (9%) angle from the horizontal to minimize the velocity of the water and extend from the trenchline roach to undisturbed ground adjacent to the disturbed portions of the ROW.	Cross berms and ditches were constructed within prescribed limits to mitigate the effect of fast flowing runoff.
Breaks will be left in the pipeline roach following backfilling to maintain cross-ROW drainage as	Breaks in the roach were left at locations where drainages were identified in the field as

Commitment	Current Adherence
required.	final cleanup was being done. Ditch blocks were added at some locations in early 2003 to arrest ditch line channelling.
Trees and brush will be windrowed along the edge of the campsite to be used for rollback during site reclamation. Snow will be used to level minor irregularities on the surface as much as possible.	Vegetative matter has been windrowed at lease edges for salvage at the time of site abandonment.
The campsites will be assessed within one year after construction to determine if remedial seeding or other work is required to promote site stability and enhance local flora establishment. If required to prevent erosion, disturbed areas within the campsites will be seeded with an approved seed mix if natural regeneration is unsuccessful.	No follow up work has been needed. All campsites are stable.
Where slopes are present, the ROW will be two-toned to minimize grading requirements. Graded areas will have organic soils replaced and the area will be stabilized.	As a result of routing selection criteria preferring to avoid severe side hill traverses, no two toning of the ROW has yet been required.
If blasting is required, it will be conducted in accordance with all relevant regulations, permit stipulations and safety considerations. Blasting blankets/mats will be used to control fly-rock as appropriate.	To date, no blasting has been required.
The final ROW width for the majority of the gathering system will be 20m, except for the oil well ROWs, which will be 30m wide to facilitate the power lines.	In the 2002 construction season, the cleared ROW width was 18m on the gathering system using the permitted additional 2m for push-outs at the construction supervisor's discretion. Individual oil pipeline ROW cleared widths were constructed 15 m wide in 2003 to allow for potential future power line or fuel line construction. In 2003 where oil gathering lines were constructed paralleling the prior year's construction, an additional 6m was cleared in 2003, in addition to the 18 m clearing of 2002, leaving the current cleared width 6m under the approved 30m. Ultimate ROW width may exceed the currently approved 30m width depending on realization of cumulative effects as area development proceeds.
The surface duff or moss layer will not be bladed off, to protect potential permafrost areas.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
Terrain Hydrology	
Upon completion of backfilling, the ROWs will be stabilized and the banks of drainage channels will be stabilized and protected.	Ongoing ROW stabilization and erosion monitoring has required ongoing attention to assure satisfactory conditions exist in the field.
In the event that water enters the trench and it affects the installation of the pipeline, it will be pumped onto stable surfaces to avoid erosion.	No action required to date.

Commitment	Current Adherence
Terrain Vegetation	
Only disturbed sites that are susceptible to erosion be seeded.	Seeding of slopes has been done over the summer of 2002 with poor results. (The climate in Cameron Hills is not conducive to quick establishment of vegetation, natural or otherwise.) In 2003 areas not revegetating satisfactorily and newly disturbed areas requiring attention were re-seeded. (On the gathering system, the rate of seed application has increased in an attempt to improve results.) Preliminary indication is that the seeding effort of 2003 is much more successful and will not likely need further attention. Regular monitoring will assure appropriate action is taken if needed.
Terrain Vegetation Soils	
If the number of pipelines is reduced in the corridor between the H-03 Central Battery to the A-04 well then the following approximate ROW widths may be used provided there is no power line installed: 1 to 3 pipelines – 20 m 4 to 5 pipelines – 25 m 6 to 7 pipelines – 30 m The widths of the ROWs are approximations since factors like the stability of the ditch walls, the size of pipes, and deviations in the pipeline alignment would affect the ROW widths.	In the 2002 construction season, the cleared ROW width was 18m on the gathering system using the permitted additional 2m for push-outs at the construction supervisor's discretion. Individual oil pipeline ROW cleared widths were constructed 15 m wide in 2003 to allow for potential future power line or fuel line construction. In 2003 where oil gathering lines were constructed paralleling the prior year's construction, an additional 6m was cleared in 2003, in addition to the 18 m clearing of 2002, leaving the current cleared width 6m under the approved 30m. Ultimate ROW width may exceed the currently approved 30m width depending on realization of cumulative effects as area development proceeds.
Soils	
In the event that weather conditions create wet or thawed soils conducive to rutting, construction will be postponed, equipment travel will be suspended, or construction alternatives will be implemented. If thawing has penetrated and persists to a depth of 30 cm or more, then construction activities will be suspended or terminated until ground conditions improve, or low ground pressure equipment may be used.	To date, the implementation of special measures has not been required to address thawing conditions. Paramount makes a significant effort to gear up with men and equipment to avoid the difficult conditions that arise from spring construction. Regulators too can assist in the avoidance of late season construction by expediting the regulatory process to effect timely approvals.
Any graded areas would be subject to organic layer salvage. Minimal disturbance to the moss layer on potential permafrost areas will be stressed. However, due to the nature of winter construction, frozen lumps of organic material and mineral soil with subsoil will be at the surface. Admixing will be minimized but can not be totally prevented.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
Areas marked on the alignment sheets as "potential	The environmental inspector has worked

Commitment	Current Adherence
permafrost" will be assessed prior to trenching operations by the inspector. The physical attributes of the area and the environmental surrounding will be assessed to determine if permafrost exists.	closely with the contractor to assure compliance with requirements.
The upper 15 cm of the mineral profile and any overlaying organic material will be salvaged and stockpiled on the spoil side of the trenchline to the extent practical. The intent will be to follow the "last out, first in to the trench" principle to limit the potential for admixing. However, due to the nature of winter construction, frozen lumps of organic material and mineral soil with subsoil will be at the surface. Admixing will be minimized but can not be totally prevented.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
Topsoil and organic material from the airstrip will be removed to a depth of approximately 15 cm and will be stored in an area where it can be retrieved for reclamation upon abandonment.	To date construction of the airstrip has not been started.
During backfill operations, the last lifts of spoil will be slightly crowned over the trenchline to compensate for settlement. Efforts will be employed during backfill to minimize the amount of snow placed in the trench to mitigate additional soil subsidence in the ensuing spring.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
Organic material, which will be salvaged for the eventual reclamation of the facility sites, will be windrowed on the high side of the lease. If completed under frozen ground conditions, it is expected that clumping, and therefore limited admixing, will occur.	On all sites other than the central battery, no grading has been undertaken. Natural contours have been retained to preserve natural runoff. At the central battery, site grading has been done and includes windrows and diversion berms on the high side of the lease to divert off-site runoff from flowing through the site.
Organics will be stripped and salvaged from any graded areas, for use during project closure, before grading of the subsoil occurs.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
Construction of the access routes will require moving material from pre-selected borrow pits. Borrow pits will be stripped and the organic material stored separately. The topsoil and overburden piles will be allowed to revegetate and will consequently be protected from erosion.	Thorough, competent inspection during construction assures compliance
Approved construction and material handling procedures will be adopted, as discussed in the emergency response plan. Any spill will be isolated and cleaned up immediately	Annual review and update of the ERP assures that it is current and competent.
The success of restoration measures will be evaluated and necessary remedial action will be undertaken following project completion as weather and ground conditions permit and as equipment is available. Inspections will be conducted as required to identify any potential erosion and/or other problems with	The need for supplemental erosion remediation measures was evidenced by late spring in 2002. Since that time, regular ROW inspection and training of production operations personnel has facilitated enhanced response, and a continual field construction

Commitment	Current Adherence
particular attention paid to slopes and watercourses. If erosion becomes evident, restabilization and corrective efforts to revegetate will be undertaken.	effort.
The potential for rutting or scalping of organic layers will be minimized by constructing under frozen ground conditions, and by conscientious clearing practices.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
An attempt to maintain a shallow layer of snow on the ROW path will help to protect the underlying soils from inadvertent damage.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
Ditch plugs will be used as appropriate; diversion berms, check dams, slash rollback and seeding used as required on erosion prone areas to mitigate erosion and promote site stabilization.	Field experience has yielded the "Erosion Survey and Mitigation Plan for the Cameron Hills Gathering System and Pipeline". A variety of remedial measures have been implemented to check erosion and ditch line channelling.
Paramount will attempt to minimize the potential for admixing by keeping the subsoil separate from the organic layer to the extent practical. In the event that some subsoil pile overlaps with some organic material, it will be feathered off to minimize the admixing.	Pre-construction meeting with Contractor's supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
On-going assessment of the ROWs and appropriate restoration plans implemented as required.	Regular surveillance by, and training of production personnel, has facilitated expedited responses to erosion issues. Inspections by the DIAND Resource Management Officer have confirmed satisfactory performance by Paramount in assessing the effectiveness of construction techniques and the implementation of alternate techniques when dictated by field circumstances.
Soils Wildlife Land Use	
Timber cleared from the ROWs will be salvaged for the corduroy where feasible. Excess merchantable timber not rolled-back or used for corduroy will be decked, and the appropriate companies notified of the volume and location.	All timber and slash has been rolled back. No timber salvage has been affected despite Paramount's notification of the availability of timber on the ROW. All merchantable timber was used as rollback on slopes for erosion control and to encourage revegetation.
Soils Vegetation Wildlife	
On level and gently sloping terrain, and where available, slash will be rolled back to minimize erosion and encourage natural revegetation from the soil seed bank and adjacent areas.	Slash is rolled back whenever available to make use of the natural seed bank, and provide surface stabilization.
Soils Hydrology	
To mitigate erosion and water pooling, positive drainage will be maintained on the facility sites.	Natural drainage patterns have been maintained to the extent practical while affording a safe working platform during construction, production, and maintenance.

Commitment	Current Adherence
	At the central battery, diversion berms/ditches have been constructed on the high side of the lease to limit the ability of off site runoff to carry contaminants offsite. No facility sites have demonstrated active erosion.
Soils Vegetation	
Low-lying areas will require induced frost penetration only. When snow plowing in these areas, a minimum of approximately 4 cm of snow will be left to protect the surface vegetation. In areas of no or minimal snow cover or in patches of bare ground after plowing, the surface will be protected by the frost penetration.	Snow cover is left on travel and work areas to protect the natural vegetative cover. Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Organic material will be stripped and kept separate from excavated or graded subsoils to the extent practical. To protect the natural root mat, where feasible, stumps and roots will only be grubbed over the trenchline.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Soils Terrain	
Paramount will ensure frost penetration is sufficient on access ROWs to support the weight of construction equipment and vehicular traffic prior to access.	The environmental inspector works closely with the contractor to assure adequate bearing capacity on access and on ROWs.
In peatland or swampy areas, where frost penetration may be insufficient to support equipment travel, snow packing and/or water spraying may be used with swamp mats or log corduroy to stabilize surface conditions. Timber cleared from the ROW will be used for corduroy, where feasible.	To date, snow packing and watering have been the preferred method to treat swampy areas. Results have been satisfactory in providing reliable access while preserving the natural vegetative cover.
Operational access to the wells and central battery will be by four wheel all-terrain vehicles ATVs in the summer and regular vehicles and/or snowmobiles in the winter.	The use of ATVs has been suspended in dry periods to prevent forest fires. The use of even lower ground pressure ATVs, using tracks as opposed to tires, is under trial to determine effectiveness in preserving the delicate fabric of the wetlands environment while maintaining reliability of field transportation.
Operators will be instructed to minimize their speeds when crossing corduroy with ATVs, to minimize the potential that attached dirt and mud are shaken off and deposited on the corduroy.	Slash and rollback have not been available in sufficient quantity to provide corduroy platforms, and thus the need to protect them using reduced vehicle speed has been alleviated.
A built-up, ice-capped snow pad may be required at specific locations along the ROWs to further mitigate site specific surface disturbances and to ensure the travel lane will carry the anticipated loads.	Conscientious review of surface conditions by the construction inspectors has produced acceptable results.
Following timber and brush removal, organic material and desirable mineral soils will be stripped and salvaged only over those portions of the ROW that will be subject to grading and trenching.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.

Commitment	Current Adherence
Soils Vegetation Compliance	
Emergency pump-to tanks will have the capacity to hold 110% of the largest tank in the tank farm. Fuel will either be stored in containers less than 4,000 litres or in aboveground steel storage tanks with secondary containment.	The use of double wall tanks has given rise to the waiving of the requirement for "pump to" tanks so the size requirement of "pump to" tanks is irrelevant for the time being.
In the unlikely event that accidental surface contamination occurs, the affected location will be evaluated and appropriate remedial techniques will be implemented. The affected location will be restored in a manner suitable to Department of Indian Affairs and Northern Development ("DIAND") or Alberta Environment ("AENV") and other relevant regulatory agencies.	Unfortunately, Paramount's ability to respond to and reconcile major accidental spills has been tested twice. To date, spill reporting, cleanup, and reclamation, have been conducted to the satisfaction of DIAND, the NEB, and other relevant regulatory agencies. Paramount's primary effort is to avoid accidental spills and takes seriously its obligation to spill response readiness.
Vegetation	
Contractors and subcontractors will ensure that all construction equipment that arrives on the job site is clean (reasonably free of mud and weed seeds) and in good working order (no oil or hydraulic leaks).	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
If grubbing outside the area above the trenchline is required, it will be limited to a point 30 cm from the surveyed edge of the ROW to prevent damage to adjacent, standing timber.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Wetlands will be restored to approximate their pre-construction profile. Revegetation will be through natural encroachment by native vegetation on the ROWs. Peatland areas will not be seeded or fertilized.	Inspections by regulatory agencies have not given rise to any remedial work.
To minimize introduction of noxious weeds into the project area, any seed utilized to stabilize erosion prone areas will be Certified Canada #1 seed, and appropriate seed certificates will be available for inspection at the time of seeding.	The use of certified seed is assured by the environmental inspector.
Push-outs will be located approximately every 400 m along the access route but the locations will be determined by the Paramount Construction Inspector. If brush clearing is required at push-out sites, brush will be removed; generated debris and slash will be windrowed and utilized for roll back.	Complete. Where push-outs are required their placement is reviewed with the DIAND Resource Management Officer before placement.
Slash material will be pushed to the edge of standing timber adjacent to surveyed boundaries. Grubbing will be limited to within 30 cm of the edge of the ROWs.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisor's insures awareness of requirements and compliance.
Vegetation cover will be assessed during the next growing season. Inadequately vegetated areas will be assessed and appropriate revegetation programs will be designed and implemented.	Ongoing surveillance has provided evidence of the need for ongoing intervention. Seeding and erosion mitigation are ongoing activities.
Any areas noted during the inspections during the first growing season as requiring remedial seeding will be reseeded with the following mix at 10 kg/ha (rotary	On the gathering system, results of initial seeding efforts were disappointing so the rate of seed and fertilizer application have been

Commitment	Current Adherence
seeding equipment). Seed Species % Regreen wheat x wheatgrass 15 Awned wheatgrass 25 Fall Rye 50 Slender Wheatgrass 10 Total 100	increased, with the prior approval of the MVLWB and NEB. Paramount will continue to assess the effectiveness of mitigative measures and revise them where necessary to achieve satisfactory results.
The falling and salvaging of merchantable timber, and removal of all other vegetation from the ROW that may obstruct or impede safe construction operations, will be limited to the extent necessary to safely facilitate construction.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Mechanical weed control at the central battery and campsite.	The need for chemical herbicides has not arisen.
Following facility decommissioning and abandonment, the site will be stabilized and natural encroachment will be promoted.	While no facility abandonment is being undertaken at this time, there is evidence along the pipeline ROW that natural encroachment is occurring and that it can be relied upon in some cases to provide site stabilization against erosion when the site is abandoned. Where natural encroachment does not occur, bare land will be seeded where erosion occurs after site abandonment.
Maximum use of existing disturbances as practical and constructing during the winter to reduce impact on rare plants.	Use of existing clearing is maximized to the extent practical
The disturbance of roots will be generally limited to the trench line except if grading is required. Clearing will be primarily conducted in the winter when frozen ground conditions will promote the top growth to break-off or be sheared-off at or slightly above ground level.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Winter construction minimizes fire risk. Fire fighting equipment will be readily available if required, and fire safety measures, response and evacuation procedures will be reviewed with GNWT and Alberta Land and Forest Service. If complete slash disposal is required, slash piles will be burned only during low fire hazard periods.	Fire fighting equipment is maintained as required. To date no slash disposal by burning has been required. Evacuation, fire safety, and response measures, are outlined in the ERP, which has been submitted to the GNWT for review and acceptance.
A scan will be undertaken to ensure all smouldering embers are extinguished in the spring of 2002.	To date no burning of slash has been required so no IR scan has been required.
In regards to the Transborder Pipeline, there will be no general requirement to maintain a clear ROW and natural revegetation will be allowed to invade. Access will not be kept open along the pipeline ROW.	No effort has been made to maintain a cleared ROW. Revegetation is being allowed to progress naturally.
Vegetation Hydrology and Water Quality	
Timber will be felled onto the ROW and away from	Pre-construction meeting with Contractor's

Commitment	Current Adherence
wetlands, drainages and undisturbed timber adjacent to the surveyed boundaries.	supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Wildlife	
Paramount employees and contractors will be instructed to notify the Construction Inspector of bison sightings, who would then contact RWED.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Paramount will instruct construction personnel to comply with established speed limits on Paramount ROWs to minimize collisions with wildlife.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
The recreational use of all-terrain vehicles and snow machines by construction personnel will not be permitted in the project area.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
All construction and production operations personnel will be instructed to record on Paramount Wildlife Sighting Cards any sightings or signs of wildlife (i.e. wolves, caribou, moose, and bison)	Pre-commissioning and pre-construction meeting with production personnel and Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Cougars will be added to the list of animals to be recorded on the Wildlife Sighting Cards.	Paramount requests that all sightings of wildlife be reported. All species are of interest to Paramount so the need to be specific with field personnel is alleviated. By keeping the task simple and uncomplicated the probability of reporting a wildlife sighting is increased.
All personnel will be prohibited from carrying firearms (except with written permission from Paramount) and being accompanied by dogs. No hunting will be allowed by company employees in the Project area.	Facility pre-commissioning and pre-construction meeting with production personnel and Contractor's supervisors and Paramount's supervisors, respectively, ensures awareness of requirements and compliance.
The pipe will be set on skids to raise it off the ground. If the trench is to be left open for longer than 48 hours, a ditch plug and breaks in the windrows will be inserted at appropriate intervals to minimize potential blockage of animal movements.	To date the ditch has not been left open for more than 48 hours, but breaks and plugs will be left if the need arises.
Where required, 10 m wide breaks in windrows will be created every 500 m, and at known game trails along the ROWs.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
No feeding or harassment of wildlife will be allowed. All garbage will be collected and stored in containers so as not to attract nuisance animals.	Combustible domestic waste is incinerated or disposed of with non-combustible waste in an approved landfill. The need to leave wildlife alone is assured through training and a pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
All domestic combustible garbage at temporary camps	Pre-construction meeting with Contractor's

Commitment	Current Adherence
will be burned in a diesel-fired incinerator on-site. Non-combustible materials will be contained in garbage bins and removed to an approved landfill.	supervisors and Paramount's supervisors insures awareness of requirements and compliance.
During camp occupation, good housekeeping practices will be enforced.	Regular inspection by supervisory personnel and corporate site audits assures compliance.
Construction completed during winter to avoid sensitive breeding and nesting periods. Nest trees encountered during construction will not be cut down if possible.	No known nest trees were encountered during construction. All construction has been completed to avoid conflict with nesting and breeding periods.
In the unlikely event that a bear den is encountered during the project, the appropriate regulatory agency (i.e., RWED or AENV) will be notified by the Construction Inspector, and mitigative measures determined at that time.	To date no bear den has been encountered during construction.
Scheduling construction during the winter will help mitigate potential impacts to the spring nesting and rearing periods for raptors.	All construction has been completed in winter to avoid conflict with nesting and breeding periods.
Human and vehicular activity will be restricted to the surveyed property boundaries and access.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Construction and operation crews will be informed that harassment of wildlife is an offence under the NT Wildlife Act. No dogs will be allowed in the project area, and hunting will be prohibited.	Facility pre-commissioning meetings and training with production personnel, and pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
Project will be kept free of litter and garbage, and food wastes will be placed in secured containers, which in turn, will be transported to an approved disposal location or incinerated on site.	There is no evidence of any wildlife habituation, other than ravens, during the winter months. In the case of ravens habituating the garbage containers, Paramount supervisors make an effort to remind the caterer to keep the garbage containers closed. Surprisingly, there is no evidence of bears around the facility sites during the summer months.
Drivers will be instructed to maintain safe and appropriate speeds, and be aware of potential encounters with wildlife. Drivers will be instructed not to herd or chase animals along roads and, as an avoidance measure, will be advised to slow down or to stop and turn headlights off for a moment, thereby allowing animals to disperse off the travel route.	Pre-construction meeting with Contractors supervisor's and Paramount's supervisor's insures awareness of requirements and compliance.
All activity related to the construction of the Project will be completed in as expeditious a manner as safety allows. Activities related to the operations of the Project will be concentrated at the battery and camp locations, the airstrip and the access, and the operational access to the wells.	Compliance has been achieved through conscientious construction operations.
Larger diameter slash will be placed near riparian areas and treed buffer strips to improve wildlife habitat	Thorough review of site activities by the environmental inspector has achieved

Commitment	Current Adherence
and provide movement corridors.	maximum protection to wildlife travel corridors and to prevent stream siltation without importation of riprap or slash.
Wildlife Vegetation Terrain Soils	
Surface disturbances, such as grading and vegetation clearing, will be kept to a minimum, recognizing the sensitivities associated with wetlands and wildlife habitat.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance.
Wildlife Aesthetics Compliance	
All construction debris and other refuse will be collected and disposed of at an approved facility.	Compliance has been achieved by engaging a local contractor to dispose of all construction debris at an approved disposal site in Alberta.
Wildlife Land Use	
A 24-hour staffed or locked gate on the winter access road from Indian Cabins, Alberta will be operated during construction or when the winter road is in service. Any vehicles entering and leaving the project area will be recorded and the harvesting of wildlife will be documented.	The gate was staffed on a 24-hour/day basis while the road was open and in operation.
Wildlife	
For portions of the pipeline in Alberta, Paramount's Caribou Protection Plan will be followed.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
Fisheries	
Banks and exposed soil to be revegetated. Banks to be recontoured to a pre-disturbance or stable form. Erosion and sediment control measures in place during construction.	Regular inspection by Paramount and regulators has assured that areas requiring attention are noted and acted on in a timely manner.
Use of explosives in or near fish bearing streams will not be allowed.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors insures awareness of requirements and compliance. No explosives have been used during construction.
Water intake screens as per DFO guidelines will be used.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
If bank instability observed, the appropriate remediation measures will be completed quickly.	Regular inspection by Paramount and regulators has assured that areas requiring attention are noted and acted on in a timely manner.
Activity restrictions will be adhered to in Alberta from April 16 to July 15 to protect spawning fish. Paramount will comply with the Alberta Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body. Paramount will have crossing plans in place, and provide notice to the Director-Regional Water Manager, in Peace River at least 14	Compliance is assured by thorough review, by environmental inspector and construction supervision personnel, of permits, field conditions, and other regulations.

Commitment	Current Adherence
calendar days before any works are carried out. Recommendations, if any, of a QAES will be followed.	
Fisheries Hydrology and Water Quality	
As per the Alberta Code of Practice for Pipelines and Telecommunication Lines crossing a Water Body, upon completion of the works, the quantity and productive capacity of the aquatic environment, including fish habitat, at and adjacent to the pipeline crossing site will be equivalent to or exceed that which existed prior to commencing the works.	Conscientious review of construction results by the environmental inspector assures compliance.
Regular tank/berm integrity inspection.	Liquid storage facilities are complete with double walled tanks with regular inspection and reporting made part of production operations routine.
Battery will be graded to control surface runoff.	The battery site has been graded to divert offsite runoff around the site to minimize its ability to flow through the site and potentially carry contaminants offsite. Double containment is provided in all storage and process equipment as environmental protection.
Graded banks will be recontoured and stabilized. Ice/snow bridges will be constructed of clean snow/ice and "v" notched and/or removed prior to spring thaw.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
Trenching at stream crossings will not commence until the pipeline section is complete. Excavated spoil will be placed on the banks. Hard ditch plugs will be retained at each bank.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
A minimum of 1.5 to 2.5 m of cover will be required over the trench for the in-stream section	Competent and thorough inspection during construction assures compliance.
Heavy walled pipe will be welded and coated prior to in-stream construction.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
Existing gravel or cobble substrate in creeks will be salvaged during trenching and stockpiled separately from remaining ditch spoil. This coarse substrate will be used to cap the instream ditchline after backfilling.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
ROWs will be left in as stable a form as possible with silt fences placed at strategic locations to limit harmful alteration of fish bearing waterbodies.	Ongoing post construction inspections and remedial work have achieved satisfactory results.
Aesthetics	
Following camp closure, the sewage sumps will be properly treated with lime, backfilled and compacted. All equipment, garbage, waste and structures will be removed from the site.	Post construction site inspection assures closure of sumps.
Paramount attempted to limit and concentrate the disturbance with conscientious siting of the various	Conscientious design and construction practices have yielded satisfactory results.

Commitment	Current Adherence
project components, use of existing disturbance corridors to the extent practical, and maintaining the Project as a remote operation.	New disturbance has been minimized and the site is accessible by road in the winter only incorporating a staffed gate to deter public access.
Paramount will utilize the existing winter access road (initially constructed in the late 1980's and the 1990-1991 winter season for their exploratory drilling program) for access into their significant discovery license area (SDL).	The original access road routing is utilized today. Increased traffic, giving rise to safety concerns, has necessitated some upgrading of the winter access. The ROW width south of 60° has been increased. North of 60°, corners have been cleared to increase the line of sight.
Aesthetic Vegetation Wildlife	
Existing seismic cutlines will be used for access within the project area; additional clearing along these seismic lines is anticipated to be minimal for winter access and operational access. This will minimize disturbance to native landscapes.	Additional clearing along seismic lines has been minimized.
Aesthetics Hydrology	
An all weather access route between the battery and the airstrip will be within a surveyed 15 m wide ROW. Culverts will be placed appropriately to ensure that ponding does not occur. Water control measures (i.e. berms) will be constructed in the ditches as required to prevent erosion.	To date, construction of the airstrip and the associated access has not yet started.
Land Use	
Continue to coordinate Traditional Knowledge Study with Aboriginal Communities that have traditionally used the project area. Concerns identified will be incorporated into the construction program.	Traditional Knowledge gathered to date has been incorporated into the project design. West Point First Nation and the two Cameron Hills plateau area trappers identified have confirmed their traditional knowledge gathered is accurate resulting in those studies being completed.
Applicable regulators and affected land users will be kept appraised of all construction schedules through Paramount's published project updates.	Project updates were distributed to the local communities October 2001, February, July, November 2002, May 2003.
The local communities will be notified with Paramount's published project updates.	Project updates were distributed to the local communities October 2001, February, July, November 2002, May 2003.
Efforts will be made to minimize interference with existing land uses through route selection and timing of construction activities.	Local community members participated in site and route selection and monitored construction activity.
Potentially affected trappers will be notified approximately 2 weeks in advance of construction.	The two trappers identified to date were notified verbally prior to activity commencing for the 2001/02 and 2002/03 season activity
All non-merchantable timber and slash not used for rollback will be burned in a controlled manner and in accordance with local restrictions.	To date, no burning of slash and timber has taken place.

Commitment	Current Adherence
Timber rights holders in the region will be notified of the location, and an appropriate time when the timber could be accessed and hauled away.	Timber rights holders were notified before and after construction, to maximize timber salvage. Merchantable timber however has not been harvested for sale. It has been used as corduroy, and roll back to aid erosion mitigation efforts.
Trapper's cabin located south of the Cameron River, north of A-05 will be avoided.	The trapper's cabin was avoided.
Any snow machine trails and associated trap line access encountered during construction would be kept open, and not blocked by snow or pushouts.	Snow machine trails and trap line access was kept open.
Concerns identified from the traditional knowledge gathering, will be incorporated into the construction program to ensure that the potential for negative impacts to traditional land use within the project area is minimized.	The only traditional land use identified within the project area was trapping activity by two trappers. There were no reported negative impacts to their activities.
If traplines are affected by Project activities, the trappers will be compensated for any demonstrable loss.	We have no reports that the traplines in the project area were negatively affected.
Paramount will review, on a case-by-case basis, claims filed by trappers who can conclusively establish that they have sustained lower harvests directly attributable to Paramount's operations in the area. Paramount will comply fully with any requirements relative to this matter as set out in the Mackenzie Valley Resource Management Act or applicable legislation.	No claims were filed by trappers since pipeline construction commenced. One claim was made before pipeline construction started; that claim has been settled.
Following the installation of the flowlines and facilities, all construction equipment and materials, other than materials required for maintenance and inventory, from the Project will be removed and transported out of the area.	Construction areas have been cleaned up. Equipment and supplies are maintained at permanent campsites, operating sites, and wellsites only. No other caches exist.
To maintain the environmental integrity of the Project area, all sites associated with the construction will be stabilized and reclaimed to a condition that will mitigate residual impacts, promote revegetation and not impair pre-disturbance land use activities.	All abandoned sites and ROWs have been stabilized or are subject to ongoing remedial action. Over time, residual impacts are expected to be minimal and insignificant.
The temporary camp locations will be left in a stable condition and natural encroachment of vegetation is expected. The sump locations will be left in a stable condition.	Abandoned campsites are stable, and being revegetated by natural encroachment.
Any borrow pits used for construction and not required for operations will be recontoured and/or terraced as necessary to promote site stability and all cuts and fills will be backsloped to a stable condition.	All borrow pits have been stabilized and are free from erosion.
The Project will utilize a temporary, 100-150 person construction camp that is proposed to be located adjacent to the H-03 Central Battery in the NT. The camp will eventually support the permanent camp, which will accommodate up to 20 people. Camp specifications will be to NT and federal standards.	The permanent 20 person camp is complete and is in operation. The H03 battery site supported a 150 person temporary construction camp in early 2003. The construction camp equipment has been moved off and the site is reclaimed.

Commitment	Current Adherence
Heritage	
Should archaeological sites be discovered during construction, appropriate authorities will be notified, and mitigative measures established.	No archaeological sites have been discovered as a result of construction efforts. A heritage monitor was hired and was on site during the 2002 and the 2003 construction seasons. The monitor was present during all aspects of construction and verified that no archaeological sites were discovered.
Should unexpected heritage resources be encountered during construction, all work in the immediate area of the discovery will cease until an archaeologist is able to examine the find and develop an appropriate site management plan.	No archaeological sites have been discovered as a result of construction efforts. A heritage monitor was hired and was on site during the 2002 and the 2003 construction seasons. The monitor was present during all aspects of construction and verified that no archaeological sites were discovered.
All members of the construction crews will be given a "handout" outlining the general items that would identify a heritage resource and will be instructed to notify their supervisor or the Paramount Construction Inspector when a heritage resource is found.	Pre-construction review with the contractor has assured adequate pre-disturbance training.
The draft document for the traditional knowledge (TK) study will be reviewed by the communities to ensure its accuracy. Any changes recommended by the communities will be incorporated into the final TK study. Information from the TK study will be considered in the design and operation of the Project.	Traditional Knowledge gathered to date has been incorporated into the project design. The draft TK studies were submitted to the communities. West Point First Nation and the two Cameron Hills plateau area trappers identified have confirmed their traditional knowledge gathered is accurate resulting in those studies being completed.
Socio-Economic	
Paramount intends to maximize the positive benefits that may accrue from its project and eliminate or at least mitigate any adverse impacts through their commitment to the principles of fair and equal employment and training opportunities.	Paramount actively patronizes local communities. Paramount has encouraged its contractor's to hire locally, and has sought reporting from its contractors to provide evidence of the contractor's effort to hire locally.
Paramount will give first consideration to qualified individuals resident in the regional communities.	Paramount gives preference to hiring locally when qualified personnel are available.
Paramount will make every reasonable effort to notify local communities about available employment opportunities.	Paramount notifies communities of employment opportunities by way of the project update. Contractor's names are included to assist local personnel in their job search.
Paramount will make every reasonable effort to notify local communities and companies about available procurement opportunities.	Paramount notifies communities of supply opportunities by way of the project update. General descriptions of the types of equipment and material requirements are outlined to provide local suppliers an opportunity to follow up on supply opportunities.
Paramount intends to track the number of jobs provided to northerners and the number of contracts and total dollar value provided to northern businesses	These statistics were gathered and reviewed for future activity consideration.

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to ensure that local and regional skills are recognized and retained for future consideration.	
Paramount proposes to train two northerners for long-term employment required on site if appropriate candidates are identified	Three northerners have been retained as full time operators and have been receiving training as required.
Paramount will attempt to locate individuals for long-term employment in the communities by advertising in the Hay River local newspaper "The Hub", send letters to each band office, and by "word of mouth".	An advertisement was placed on GNWT EC&E website, however, positions were filled by word of mouth.
On-site paramedical services will be available to camp residents during the construction phase. Those requiring intensive medical care will likely be airlifted to Hay River or elsewhere as appropriate for treatment.	On-site medical assistance was maintained in compliance with federal regulations reflecting the number of persons on site. In the one instance requiring helicopter evacuation of a patient, the patient was taken to High Level in Alberta.
Compliance	
Contract agreements will ensure that all personnel involved with the development of the Project and their contractors, sub-contractors and inspectors will be made aware of and must abide by both Paramount's corporate policies for environmental protection and any site-specific environmental concerns and procedures identified for these projects. Personnel involved with field activities will be made aware of the emergency procedures for injuries, fires, and spills.	Pre-construction meeting with Contractor's supervisors and Paramount's supervisors assures awareness of requirements and compliance.
The mitigation section of the EIA will be a part of the bid package to all bidding contractors and final documents for the project.	The contract documents include the EPP making the mitigative measures part of the contractor's obligations under the contract.
Cleanup on the ROW and temporary workspace will be an on-going activity throughout the construction phase. Cleanup will occur immediately following backfilling operations, and all cleanup activities are expected to be completed by the summer of 2002, depending on weather conditions. Cleanup activities will be suspended if weather conditions are such that rutting, erosion and sedimentation will occur.	Substantial clean up is effected immediately upon completion of construction. However, ongoing ROW maintenance includes picking up miscellaneous trash that is exposed as the snow melts, and erosion control.
The primary pipeline contractor will be responsible for providing housing for the workforce and will be contractually obligated to comply with applicable regulations.	The contract documents require the contractor to provide housing for its work force, and requires that the contractor comply with all applicable laws and regulations.
All work associated with the Project will comply with the recommendations and conditions identified in the Land Use Permit, Water License and other relevant permits, and other regulatory requirements as applicable.	Pre-construction review of the permits by the construction supervision work force assures awareness of requirements and compliance.
In addition to a sudden loss of pressure, leaks may be indicated by colour changes in the vegetation or active bubble formation in standing water over the line. These changes will be noted and the site inspected for potential leaks as soon as practical.	Unfortunately, Paramount has experienced two line failures. Both were detected and investigated expeditiously. Routine surveillance of the ROW is on going and part of the regular duties of the production operation.

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Should a leak occur, appropriate agencies will be notified and the affected segment of the pipeline will be shut down using block valves. Maintenance crews repairing damaged pipe would utilize the same environmental protection techniques employed during initial pipeline construction.	Unfortunately, on two occasions Paramount has had the opportunity to demonstrate that it is prepared for such emergencies and has met the reporting and site management requirements.
In the case of future abandonment, regulations at that time will be adhered to.	No pipeline or facility abandonments have been effected yet.
The proponent will ensure that staff and associated contractors will receive an orientation on how to deal with emergency situations.	The initial pre-construction review with prime contractors, and their follow-up safety meeting, assures timely training of contractor's personnel
In the event of a fuel spill or any other environmental emergency, the appropriate regulatory agencies and response groups will be contacted.	This requirement is reviewed exhaustively with all personnel prior to the commencement of construction.
Paramount will utilize inspectors during construction. The inspectors will have a minimum of eight years of pipeline and facility construction experience in Western Canada and the NT to qualify as a construction inspector for the Project. The inspector will be provided with Safety Manual, the EIA's, the construction specifications, the regulatory approvals and their terms and conditions, the Emergency Response Plan, the Environmental Protection Program, the land use permit, and the MVEIRB's EA Decision Report. The Paramount Project Manager will review these documents with the inspector. Deficiency notices will be written to the inspector if the requirements of the project are not being met during construction. Follow-up measures may require further review of the project requirements or the replacement of the inspector depending on the severity of the deficiencies.	Review of the LUP, WL, EPP, etc. are conducted with construction supervisors, and the contractor's supervisors alike. The need to conduct work on the basis of knowledge is reinforced. ("If you are not sure…….STOP and ask. Make sure.") The project requirements are reviewed at a pre-construction meeting. Specific task requirement are reviewed with construction supervisors and contractor's supervisors, in a daily meeting to highlight such requirements in upcoming tasks.
The Transborder Pipeline will be equipped with emergency shutoff devices.	The transborder pipeline is equipped with Emergency Shutdown Valves at both ends.
To prevent pipeline rupture corrosion inhibition chemicals will be injected into the pipeline, corrosion monitoring will be performed, and facilities will have protective devices to prevent overpressuring of the pipeline. The facility producing into the pipeline will be equipped with monitoring and automatic shutdown devices to protect against malfunctions and overpressuring.	Corrosion inhibitor is injected continuously and batched. The effectiveness of the corrosion inhibition program was verified by intelligent pigging which detected no aggressive internal corrosion sites. The Pipeline is protected by High/Low pressure shutdown valves.
Low pressure shutdown devices will isolate the surface facilities from the pipelines in the event of a pipeline failure.	The inlet and outlet of the transborder pipeline is equipped with High/Low pressure shutdown valves. The inlets to the battery are equipped with High/Low pressure shutdown valves.
A cathodic protection system will be installed within one year after the installation of the Gathering System and Transborder Pipeline.	The impressed current cathodic protection system was installed March 2002 and is monitored regularly to assure effective

Commitment	Current Adherence
	operation.
When remedial actions are taken and if it is generally requested by the Board, a letter report would be submitted to the Board identifying the concern, the location and the actions taken.	The NEB is informed of all significant incidents and accidents requiring remedial action.
Compliance Hydrology	
During construction, an Inspector appointed solely by Paramount will be on-site to ensure the effective implementation of approved environmental specifications for watercourse crossings and measures identified in the "EIA". The inspector will have the authority to suspend operations where unacceptable situations with serious environmental implications arise.	Paramount engaged a third party environmental inspector. He was responsible for insuring contractor compliance, and company compliance to applicable LUP, WL, EA report, EPP requirements. He, along with others, was given the authority to stop activities where unacceptable situations with serious environmental implications arose.
Paramount's inspector will have the authority to suspend operations if the mitigative measures described in the EIA's are not followed, or in compliance with the conditions of authorization.	The environmental inspector had the authority, and the responsibility, to suspend operations if the mitigative measures described in the EIA's were not followed, or were not in compliance with the conditions of authorization.
Compliance Soils Vegetation	
The flowline ROWs will be routinely checked. The reconnaissance, which may be completed with an aircraft and supported with ground inspection, would be used to assess creek crossing stability, erosion, slope stability, leak detection, and revegetation.	The environmental inspector has made regular aerial surveys with the sole purpose to assure stable conditions prevail. The production operation makes regular aerial, and on the ground, surveys of the flowline ROWs. They are trained to report unsatisfactory conditions so that mitigative measures can be affected.
Compliance	
100% of the total circumference of all welds on the pipelines will be radiographed.	100% of all pipeline welds have been examined by radiographic non-destructive techniques, in accordance with the OPR.

3. CAMERON HILLS EXTENSION DEVELOPMENT DESCRIPTION

3.1 LONG-TERM SCHEDULE

This section addresses Section C-1 of the MVEIRB ToR: Provide the proposed long-term schedule as well as generic seasonal schedules for the project, and identify any time constraints.

Depending on several conditions, including the timing of freeze-up, economics, equipment availability and drilling success, the level of activity may vary from year to year. The approximate long-term schedule is outlined below.

3.1.1 Seismic

Acquisition of seismic data is not projected to be an ongoing annual activity. However, when active, over the next five years or so, reconnaissance 2D, may precede the acquisition of the projected 510 km of 3D seismic.

3.1.2 Drilling

Drilling is not projected to be an annual activity, as in some years no wells may be drilled. Conversely, under certain economic conditions, Paramount may decide to drill, evaluate and tie-in more than 8 wells in one season. For evaluation purposes, this DAR assumes that an average of five wells, range of three to eight, will typically be drilled in any given winter season, in the timelines outlined in Table 3.1-1. Although a 48 well scenario is the basis of this DAR, it is more probable that only approximately 66% of these, or 33 wells, will be successful and actually tied-in and produced, based on Paramount's past experience in the Cameron Hills. The balance of the wells (17) would be abandoned and the site reclaimed, likely in the same year drilled.

3.1.3 Service Rigs

This activity would be dependant on the drilling activity and success and would likely follow immediately after drilling to complete the wells. The DAR assumes that one service rig can service four new wells per winter. As such, during a typical winter, two service rigs would be required to complete the new wells and service existing wells. In the event that a successful well was drilled late in the season (i.e., a service rig could not complete its work prior to break-up), the well would be suspended and the service rig would be moved in the following season. It is also anticipated that all oil wells and 10% of gas wells will require annual service rig maintenance.

3.1.4 Pipeline

Flowlining would be completed for successful, viable wells only. Where practical, successful wells will be tied-in the same season that they are drilled and evaluated.

3.1.5 Production

The successful wells that are tied-into the existing system will also be produced and operated on a year-round basis for approximately seven to ten years for each well, the program production extending for perhaps 20 years.

3.1.6 Reclamation and Abandonment

Wellsites and pipelines will be either be abandoned and reclaimed, as production ceases, or within the same season as drilled if the well is not successful.

3.1.7 Generic Seasonal Schedule

Table 3.1-1 outlines a generic seasonal schedule for Cameron Hills. Activity commencement is primarily determined by the onset of frozen ground conditions that facilitate access for the winter season and a stable work platform. This generally occurs during the period from December 1 until approximately April 15. The exception is production operations, which occur year-round.

Conditions may arise that would cause Paramount to alter the typical scheduling. For example, wells that are drilled and evaluated near the end of the winter season may not be tied-in to the gathering system that year, therefore tie in and gathering line construction may start the middle of December of the following or subsequent years.

Table 3.1-1 Generic Seasonal Schedule to Drill, Complete, Evaluate, and Tie-in Five Wells, Conduct Seismic, and Produce All Available Wells

Activity	December	January	February	March	April	May to November
Access/ Lease Construction, Maintenance and Reclamation	-XXX	XXXX	XXXX	XXXX	XX--	
Drilling Rig		XXXX	XXXX	XXXX		
Service Rig		---X	XXXX	XXXX	X---	
Tie-In Gathering Line			--XX	XXXX	XX--	
Seismic		XX	XXXX			
Production	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

3.2 CONSTRUCTION METHODS

This section addresses Section C-2 of the MVEIRB ToR:
Describe the methods used to build access roads, well pads, pipelines, and any other components.

3.2.1 General

Generally, known heritage resources are not utilized as a criteria for access or pipeline routing, as no sites have been recorded within the project area. A local resident of an aboriginal community is retained during pipeline construction to identify heritage resources if they are encountered. If heritage resources are encountered, the work will stop at the point where the heritage resources have been uncovered, and work will continue in other unaffected areas. The discovery of historical resources will be made known by the Paramount construction inspector to Paramount's project engineer, who will in turn notify the local communities, MVLWB, Prince of Wales Northern Heritage Centre and DIAND to establish the need to preserve them and if so how that will be done. If the discovery is determined to be of historical significance, the area of interest could be avoided by obtaining approval to go around, use an alternate site, or in the case of pipeline construction, the area could be crossed without disturbing the surface, and therefore the heritage resource, using horizontal directional drilling.

Merchantable timber exists in the project area. However, the size and volume of the trees, in conjunction with the travel distance may reduce the economic viability of salvaging timber for sawmill operations. Excess timber not rolled-back or used for corduroy will be decked, and the appropriate companies notified of the volume and location.

Paramount prefers to rely on natural encroachment to revegetate disturbed areas. However, when natural encroachment is not progressing quickly enough, or in especially erosion prone areas, seeding will be undertaken. When seeding is undertaken only Certified Canada #1 seed will be used. The seed mix used will be:

Seed Species	Percent Composition
Regreen wheat x wheatgrass	15
Awned wheatgrass	25
Fall rye	50
Slender wheatgrass	10

When applied the seed will be applied at a rate of 30 kg/ha with 30 kg/ha of 20-20-20 chemical fertilizer.

Other protection measures, which apply to the entire project, are as follows:

1. Applicable regulators and the two identified trappers will be kept apprised of all construction schedules through Paramount's published project updates.

2. The local communities will be notified with the published project updates so that anyone using the area will be aware of construction activities and to ensure appropriate avoidance or precautionary measures can be implemented.

3. In the event that weather conditions (e.g., warm temperatures) create wet or thawed soils conducive to rutting, construction will be postponed, equipment travel will be suspended or construction alternatives will be implemented to minimize disturbance to the soil and terrain (e.g., scheduled for evening and early morning). Paramount defines winter ground conditions as frozen ground, which adequately supports construction equipment to effectively operate in wet terrain. As a general guideline, if rutting persists to a depth of approximately 30 cm or more, then construction activities will be suspended or terminated until ground conditions improve, or low ground pressure equipment may be used to mitigate rutting.

4. All construction activities will be restricted to the designated ROWs and approved extra workspace. Construction traffic will be restricted to the ROWs, existing roads and appropriate detours. All safety and road closure regulations will be adhered to by construction traffic.

5. Paramount's operating guidelines for working in permafrost areas will be adhered to when areas of permafrost are encountered. These guidelines are included in Appendix II of this DAR.

6. The recreational use of all-terrain vehicles and snow machines by construction personnel will not be permitted in the project area.

7. All contractors and subcontractors will ensure that all construction equipment that arrives on the job site is clean (free of mud and weed seeds) and in good working order (no oil or hydraulic fluid leaks).

8. Efforts will be made to minimize interference with existing land uses (e.g., trap lines) through route selection and timing of construction activities. The two identified trappers will be notified of the construction schedule at lease two (2) weeks prior to clearing. If possible, agreements will be made to have the trap line owners clearly identify trapping access routes and equipment (e.g., remove their traps and snares) in the vicinity of the ROW prior to industrial activity to ensure that they are protected during construction.

9. Surface disturbances, such as grading and vegetation clearing, will be kept to a minimum, recognizing the sensitivities associated with wetlands and wildlife habitat.

10. All construction and operations personnel will be instructed to record on Paramount Wildlife Sighting Cards any sightings of wolves, caribou, moose, bison and cougars.

11. All personnel involved with field activities on the roject will be prohibited from carrying firearms (except with written permission from Paramount) and being accompanied by dogs.

12. When secondary containment is installed for the tanks (e.g., lined berm or secondary wall on the tank), a spare, empty emergency pump-to tank will not be provided.

13. Vehicle and equipment operators will be instructed to maintain appropriate speeds, and to be aware of potential encounters with wildlife while on access routes, and to allow any animals the opportunity to disperse from the route before proceeding.

14. Equipment operators will be careful to avoid gouging or otherwise disturbing banks or lake/stream bottoms.

15. At no time shall any waste fluid, treated or otherwise, be discharged to surface waters.

3.2.2 Access Roads

There are two different types of access associated with the project. The first type is that associated with drilling and pipeline construction, and the second type is that associated with seismic and production operations. The type of access associated with drilling and facility construction requires greater load carrying capacity. This greater load carrying capacity is reflected in the amount of water and snow used on the roadbed to provide that extra carrying capacity. All other aspects of road construction are the same for the two types of roads.

3.2.2.1 Route Selection

Proposed access to each new wellsite will follow existing cutlines to the extent practical. The proposed winter access routes are selected to limit creek crossings and use previous crossing locations (i.e., areas where ice bridges had been previously constructed). For the most part, the access routes traverse level to gently sloping terrain that pose little challenge to equipment movement.

3.2.2.2 Travel Surface/Road Bed Construction

Winter access will be completed by packing snow with a bladed Nodwell, or similar equipment, to drive frost into the ground. (Packing of the snow and natural grass and surface duff, reduces its thermal insulative quality to increase the rate of frost penetration.) Snow, and water if required, are added to the rough natural surface and graded, to ultimately create a winter road capable of supporting the transport of equipment related to the applicable program. (This technique is used conventionally throughout the oil and gas industry in northern Alberta, British Columbia, and Northwest Territories.)

Mitigative measures to minimize disturbances resulting from the construction of winter access roads include:

1. Use of the existing linear disturbance whenever practical. Additional clearing along seismic lines, to widen them, is anticipated to be minimal.

2. Light-weight tracked vehicles, snowmobiles and all terrain vehicles, will be used initially to compact the snow and surface vegetation on the access ROWs. Ideally, this operation would be initiated in the late fall to ensure that a satisfactory base has been prepared for the ensuing winter road construction and use.

3. Low-lying areas will require induced frost penetration only. Snow ploughing in these areas is expected to be limited and a minimum of 4 cm of snow will be left to protect the surface vegetation.

4. When required and when feasible, natural openings will be utilized for push-outs or passing lanes. Push-outs may add an extra 3 to 6 m of width to the ROW edge and will be approximately 20 m long. Ideally, push-outs will be located every 300 m along the access route. If brush clearing is required at push-out sites, brush will be mowed with a hydroax or cut with a dozer blade to minimize disturbance to the surface organic layer. Generated debris and slash will be windrowed and utilized for roll back.

5. Construction of a compacted winter snow road will be consistent with the methodology and guidelines identified in the Department of Transportation (DOT) Handbook (GNWT 1993).

6. Due to the low slope profile, grading on access routes is not anticipated.

7. Paramount will ensure frost penetration is sufficient on access ROWs to support the weight of relevant equipment and traffic prior to access into the project area.

8. Water required for winter road construction will be obtained from the preferred water source Lake and/or the drilled water wells.

9. Depending on snowfall and other climatic conditions during the winter season, a built-up, ice-capped snow pad may be required at specific locations along the ROWs to further mitigate site-specific surface disturbances and to ensure the travel lane will carry the anticipated loads.

3.2.2.3 Water Crossings

Winter access roads will cross small creeks, the Cameron River and main tributaries to the Cameron River. All water crossings will be completed with an ice bridge. The ice bridge is built using snow placed onto the crossing and watered down to transform the compacted snow into ice. The snow can be sourced from the existing overland access and pushed onto the crossing, or if natural snow inventories are inadequate, snow makers can be used. If snow makers are used, it is preferable to use water from the creek being crossed, but water can be imported from a nearby water source lake to the snow maker/crossing site if water is not available from the water being crossed. The majority of water crossings are small, will freeze to the bottom in the period of interest and do not pose any concern for load carrying capacity. In these cases compacted snow crossings are built only to provide a graded travel surface protecting the natural banks.

Mitigative measures for minimizing disturbances at drainage crossings include:

1. The work schedule will be adhered to, to take advantage of frozen ground and frozen drainage crossings wherever practical.

2. The access routes were selected to employ crossing locations that have been used in previous seismic and/or drilling operations.

3. Ice bridges as described in the DOT Handbook (GNWT 1993) will be constructed over those drainages not frozen to the bottom at the time of access construction. This is expected to be relevant to the crossings of the Cameron River and its major tributaries.

4. Special attention will be made to avoid introducing foreign material (e.g., slash, debris, rocks and soil) into the stream.

5. Clean snow and ice will be used to construct the ice bridges to the extent feasible. Should any soil or other material be accidentally introduced onto the ice of the watercourse, it will be removed before spring break-up so that no deleterious materials are allowed into the water. Depending on snow conditions, logs may be placed in the channel to facilitate ice bridge construction to ensure safe vehicle operation. If this method is used, all logs would be removed prior to spring break-up.

6. The crossing will either be removed completely, or "V" notched to allow flow during the spring break-up.

7. No refuelling of vehicles will be allowed within 100 m of any watercourse. (Snow making equipment if it is in use/operation will be fuelled where it stands even if within 100 m of a waterbody.)

8. Vehicles will be checked for oil and/or fuel leaks, and if faulty will be taken out of service until it is repaired.

9. If banks of a drainage are disturbed during construction, a pre-disturbance bank profile will be re-established which may include using rock riprap, organic cribbing, bundled logs, or other stabilization measures.

3.2.3 Well Pads and Satellite Sites

No clearing or grading will be required on existing well sites as only access, including a turn-around area at the well head, is required for the service rigs to set-up. This will be achieved by grading snow to create a snow/ice surface. Minimal disturbance is anticipated at these locations.

New satellite sites and well sites will be cleared. If marketable timber is present it will be cut and decked for use as corduroy. If marketable timber is not present, the lease will be cleared using a hydroax, or dozer with cutter blade, to minimize the disturbance of the surface duff. Excess slash will be windrowed to the high side of the lease for use in roll back in reclaiming the site. A stable, level and flat work surface is created by compacting snow and sometimes adding water. The natural topography does not often require grading, but it cannot be eliminated. Where grading is required, the high side of the lease will be cut to fill the low side to the extent necessary to create a surface large enough to accommodate the applicable equipment.

Mitigative measures for minimizing disturbances resulting from the construction of the satellite and well sites include:

1. The local communities will be notified prior to commencement of activities so that anyone utilizing the area will be aware of construction/drilling activities and to ensure appropriate avoidance or precautionary measures can be implemented.

2. Wellsite areas will have maximum dimensions of 110 m by 110 m (1.21 ha) and satellites 100 m by 100 m (1.0 ha); however, only the minimum area necessary to safely facilitate planned operations, equipment placement and snow/slash storage, will be used. All activities will be confined to the surveyed boundaries.

3. All timber will be felled onto the lease and away from undisturbed timber adjacent to the surveyed boundaries. The resulting timber and slash will be pushed into windrows for eventual rollback at the end of the project. During this activity, equipment operators will be instructed to keep the bottom edge of the blade elevated no less than 4 cm above the surface to avoid unnecessary disturbance (e.g., soil gouging) to the surface vegetation. Slash windrows will be located along the high side of the lease with a break maintained between it and the standing forest. Trampling slash may also be conducted to reduce volume and space occupation. No slash material will be pushed into or against standing timber adjacent to surveyed boundaries, or into natural drainages or wetland.

4. Minimal levelling or surface disturbance of the surface organic soil layer will be undertaken. To the extent feasible, a frozen snow/ice pad will be constructed on the site to create a level

area for rig set-up. Should insufficient snow be available on the wellsite for levelling purposes, water will be trucked in to create an ice pad. Residual slash will be walked down into the snow to help create a protective surface buffer. Walking down of the snow will help promote deeper frost penetration below the active surface area on the site.

5. Where the terrain is not conducive to minimal disturbance approach, due to topographical relief, cut and fill of the lease will be required to create a level surface. In these instances, the organic material at this site will be stripped and salvaged prior to any grading activity, for replacement during reclamation.

6. As a precautionary measure, a snow/ice berm may be constructed on the low sides of the site to contain any accidental surface spills or container leaks.

7. To mitigate erosion and water pooling, positive drainage will be maintained on the site. If appropriate, sediment traps, brush barriers and check dams may also be placed in a small ditch to trap sediment and dissipate the erosional force of running water from the site.

8. Well and satellite site equipment will be packaged on steel skids with sealed floors and housed in metal insulated buildings. Tanks will have secondary containment consisting of either lined dykes or double wall construction. This modular construction approach provides maximum containment of storage and processing equipment and reduces the potential risk of site contamination.

3.2.4 Pipelines

To ensure a safe and reliable installation of the project, the facilities are designed and constructed in accordance with the Canadian Standard Association (CSA) codes and standards. Access to the pipeline construction site will be as described above under Access,(Section 3.2.2).

3.2.4.1 Routing

Factors considered during the initial stages of selection of the routes for these facilities were as follows:

1. Utilize existing linear disturbances (i.e., access routes, seismic cutlines) to obtain the shortest route possible;

2. Limit disturbance of sensitive habitat and, in particular, the riparian areas associated with the Cameron River and the larger tributaries; and

3. Limit the number of water crossings, particularly the Cameron River.

Terrain stability is considered an issue despite the land being crossed being generally level to gently rolling. We now know that the terrain is quite unstable and sensitive to erosion by spring run-off. Because even gently sloping terrain is susceptible to erosion, and cannot be avoided through route selection criteria, special measures have been developed and implemented effectively to mitigate the erosional force of spring runoff. The special measures include the use of diversion berms, diversion cross and parallel ditches, ditch blocks, and roach breaks. These tools are described in detail in Golder's November 2002 report entitled "Erosion Survey and Mitigation Plan for the Cameron Hills Gathering System and Pipeline".

3.2.4.2 Water Crossings

Construction traffic will only be allowed to cross the local drainage streams along the pipeline by using a compacted snow and/or ice-capped snow roads in conjunction with temporary ice bridges or snow-fills as necessary. The travel corridor, including the placement of ice bridges and snow-fills, would be confined to the surveyed working area of the ROW, and will be constructed as described for Access (Section 3.2.2) above.

Pipelines crossing water will be achieved by one of four methods:

1. Open Cut: If no flowing water is present, by virtue of the drainage being frozen to the bottom or the stream bed is dry, the crossing will be made by the open cut method. In this technique the ditch is dug with an excavator, and pipe laid in it. The last out, first in, method is used in backfilling to retain the natural stratigraphy of the streambed. Excavated soil is stored on the stream bank to minimize its entry into the stream at break up. Coarse cobble from the

excavation is placed in the ditch last to mitigate erosion. Ditch backfill is compacted with the excavator to minimize ditch line subsidence.

2. Aerial Crossing: If the open cut technique is not an option, Paramount prefers the aerial crossing technique. In-stream work is limited to the driving of support piles so stream bed disturbance is minimal. Pipeline leaks, no matter how small, are easily detected and repaired. This option also provides the easy installation of a bridge for ground travel and therefore avoids sedimentation arising from fording creeks. (Paramount has several applications before the DFO for aerial pipeline crossings and ATV bridges on the long east/west run from I-06 to L-46.)

   For the purpose of this DAR, hanging another pipe from an existing bridge is not considered to be a new crossing.

3. Horizontal Directional Drilling: Where there is flowing water and the substrate permits it, Paramount prefers to directionally drill across the stream, below the stream bed so that the stream bed is not disturbed at all. It is important to note that the substrate does not always permit horizontal drilling. Cameron Hills does not lend itself to directional drilling due to the presence of subterranean cobble. For this reason, Paramount does not promote horizontal drilling as a feasible means of stream crossing in Cameron Hills. Horizontal drilling is a common crossing technique used throughout the oil and gas industry. Mitigative measures that would be employed if horizontal drilling were attempted are detailed in the "Environmental Protection Plan Manual" that has been filed by Paramount with the Mackenzie Valley Land and Water Board, and others.

4. Isolated: In instances where open cut and horizontal drilling methods are not options, an isolated crossing technique can be attempted. The isolated crossing isolates the work area from the flowing water in an attempt to minimize stream sedimentation. This isolation is accomplished by damming the stream up and downstream of the work area, draining the section between the dams and then performing the crossing as if it were open cut. Mitigative measures include maintaining the pre-disturbance water flow by pumping or the use of a flume. If pumping is used, the intake is screened to prevent the ingestion of fish into the pump. In some techniques, where the stream is not frozen to the bottom and water flow is

minimal, the isolation can be accomplished by using weighted curtains on either side of the work area, to contain the sediment to a confined area. Once the curtain is in place, construction proceeds as if open cut.

The following mitigative measures will be implemented at water crossings to minimize sediment entrainment to the receiving streams:

1. The work schedule will be adhered to, to take advantage of frozen ground and frozen or low-flow conditions at drainage crossings.

2. Extra workspace cleared close to the stream crossings will be separated from the streams by a minimum buffer of 5 m from the top of the bank.

3. Effort will be made to avoid introducing foreign material (e.g., slash, debris, rocks and soil) into the stream.

4. Trenching at stream crossings will not commence until the pipeline section is ready to bury.

5. Excavated spoil will be placed on the banks.

6. Hard ditch plugs will be retained at each bank.

7. A minimum of 1.5 to 2.5 m of cover will be required over the trench for the in-stream section.

8. Heavy walled pipe will be welded and coated prior to in-stream construction commencing.

9. Existing gravel or cobble substrate in creeks will be salvaged during trenching and stockpiled separately from remaining ditch spoil. This coarse substrate will be used to cap the in-stream ditch line after backfilling.

10. Pipeline crossings, where flowing water is encountered and an isolated crossing is used, shall be completed as quickly as possible using conventional methods having due consideration for safety and environmental conservation.

3.2.4.3 Pipeline Construction

In general, the ROWs for flowlines have been surveyed to be 20 m wide. Of this 20 m, only 18 m will usually be cleared, and the remaining 2 m used for snow storage, or to provide for push outs as determined by the Construction Inspector. The width of the pipeline ROW will be similar to existing ROWs (i.e., 20 m), where 15 to 18 m will be cleared for the pipeline installation and the remaining 2 to 5 m will be used to store snow or to provide push outs as determined by the Paramount Construction Inspector. The ROW width will take into consideration constraints related to construction efficiency and feasibility, safety, and environmental impact. In the main corridor from H-O3 to A-05, 30 m of clearing has been approved due to the number of pipelines in the ROW and to accommodate the power line.

All flowlines will be buried to a minimum depth of 1.2 m of cover at the time of construction. This depth of cover allows for some subsidence and settling to ultimately satisfy the requirements of the CSA code. If subsidence and settling reduces the depth of cover to less than that required by CSA code, remedial actions will be taken, with the prior approval of regulators. The trench will vary in width, depending on the number of pipelines located within the trench, but will generally vary between approximately 0.7 to 1.2 m. Determination of the final size of the flowlines will be based on an optimization of cost and capacity to ensure the flowlines will meet the long-term potential development of the project.

The flowlines will be hydrostatically tested using methanol.

Conventional construction techniques are proposed for the gathering flowlines. Temporary workspace at watercourse crossings, and 30 by 60 m extra workspace for debris storage and vehicle turn-around will be required along the flowline routes as determined by the Paramount Construction Inspector.

Merchantable timber will be decked and used for corduroy or made available to sawmill operators. Non-merchantable timber cleared from the ROWs will be used for corduroy.

Following clearing operations, the ROW will be graded as required to facilitate equipment travel. Grading in this terrain is usually limited to the dragging of tires along the cleared workside of the

ROW to provide a smooth surface capable of carrying construction equipment. In very limited instances the terrain will require the movement of soil in the process of grading the ROW. In areas where soil movement is required, the organic layer will be salvaged, windrowed and spread back on the ROW at clean up.

Due to frozen ground conditions, limited soil horizon admixing is expected. This is not predicted to significantly affect the soil condition.

Organic salvage will include removing the layer from over the trench line or graded areas, to the extent practical considering frozen conditions. Once removed, the organic layer will be stored within the ROW for use during reclamation. Minimal disturbance to the moss layer on potential permafrost areas will be stressed. Moss and organic soil segregation from the underlying clay will occur during trenching operations to the extent that frozen ground conditions allow. It is recognized that limited admixing is likely to occur during this component of the construction.

To avoid problems potentially associated with regions of permafrost, Paramount will install heavy-walled pipe. Where the Inspector identifies permafrost, the extra thickness will protect the pipe from buoyancy and stress related problems due to ditch subsidence. Paramount has extensive experience in permafrost areas and has found it effective to use a ripper shank on the excavator or wheeled excavator during soil handling to help maintain the integrity of the surface duff. In addition, replacement of the organic layer over the trench, following backfilling, and rollback of slash (i.e., where hydroaxing is not used) will assist to re-establish insulation to minimize the potential for thawing of discontinuous permafrost, where encountered.

Specific mitigative measures, which apply to the construction phase of the gathering flowlines and the water disposal pipeline, are as follows:

1. The ROW will utilize existing seismic and access routes to the greatest degree practical.

2. The boundaries of the pipeline ROW will be surveyed and clearly marked with stakes and flagging tape prior to construction to minimize the potential for construction vehicles to trespass off the ROW. Temporary access, extra work space and push outs for decking will be determined by the Paramount Inspector.

3. Clearing will be primarily conducted in the winter when frozen ground conditions will promote the top growth to break-off or be sheared-off at or slightly above ground level.

4. All timber will be felled onto the ROWs by a bulldozer equipped with a cutter blade or a hydroax, as appropriate. The initial pass will be made with an angled blade along the ROW boundaries to reduce the risk of timber falling off the ROW. No trees will purposely be felled off of the ROWs or into any watercourses.

5. All non-merchantable timber and slash will be salvaged in designated areas for use as rollback and corduroy. All non-merchantable timber and slash not used for rollback will be burned in a controlled manner and in accordance with local restrictions.

6. If grubbing outside the area above the trench line is required, it will be limited to a point 1 m from the surveyed edge of the ROW to prevent damage to adjacent, standing timber.

7. It may be necessary to designate turn-around areas for stringing trucks and construction traffic. These areas will be used for only that purpose and not used for general construction traffic. Natural or existing clearings will be used for this purpose if possible.

8. The upper 15 cm (approximate only, recognizing that frozen subsoil will clump with the organics) of the mineral profile and any overlying organic material will be salvaged and stockpiled on the spoil side of the trench line to the extent practical. The intent will be to follow the “last out, first in to the trench” principle to limit the potential for admixing.

9. The pipe will be set on skids to raise it off the ground. If the trench is to be left open for longer than 48 hours, ditch plugs will be inserted at appropriate intervals to minimize potential blockage of large and small animal movements.

10. Heavy walled pipe or weighted pipe will be installed through all poorly drained sites to reduce the potential for future pipe surfacing.

11. During backfill operations, the replaced subsoil will be slightly crowned over the trench line to compensate for settlement. Efforts will be employed during backfill operations to

minimize the amount of snow placed in the trench to mitigate additional soil subsidence in the ensuing spring. Subsidence of the soil over the trench line is anticipated.

12. Paramount prefers a liquid media for strength and leak tests. Methanol will be used for this purpose. Qualified personnel will be on-site to manage all equipment and carry out all testing procedures. Paramount requires a minimum of 48 hours notice prior to the start of any pressure testing to allow notification of Regulatory Authorities.

13. Upon completion of backfilling, the ROWs will be stabilized and the banks of drainage channels will be stabilized and protected (e.g., rip-rap) as determined necessary by the Paramount Inspector.

14. Breaks will be left in the pipeline roach following backfilling to maintain cross-ROW drainage.

15. In the event that unwanted water enters the trench, it will be dewatered onto stable surfaces to avoid erosion.

16. Wetlands will be restored to approximate their pre-construction profile. Revegetation will be primarily through natural encroachment by native vegetation on the ROWs. Peat land areas will not be seeded or fertilized.

17. To minimize introduction of noxious weeds into the project area, any seed utilized to stabilize erosion prone areas will be Certified Canada #1 seed, and appropriate seed certificates will be available for inspection at the time of seeding.

18. Where available, slash will be rolled back to minimize erosion and encourage natural revegetation from the soil seed bank and adjacent areas. Larger diameter slash will be placed near riparian areas and treed buffer strips to improve wildlife habitat and provide movement corridors.

19. Cross drains, parallel ditches and diversion berms will be installed on reclaimed slopes susceptible to water erosion to divert runoff into vegetated areas adjacent to the ROW. The

final spacing will depend on the slope and surface material and will be determined on-site by the Environmental Inspector in consultation with the DIAND Resource Management Officer, as per the recommendations contained in Golder's November 2002 report entitled "Erosion Survey and Mitigation Plan for the Cameron Hills Gathering System and Pipeline". The spacing of diversion berms on slopes will be decreased by half compared to the 2001/2002 Cameron Hills project, and will be:

Slope	Spacing
>3H: 1V (33%)	15 m
4H: 1V (25%)	22 m
5H: 1V (20%)	30 m
6H: 1V (16%)	37 m
<7H: 1V (14%)	50 m

20. Seeding with a certified Canada #1 seed mixture will be applied up to a maximum seeding rate of 30 kg/ha with fertilizer in late winter or early spring prior to the spring runoff or rainfall. This will increase the success of revegetation in erosion prone areas.

21. Berms will be constructed at a maximum 5^{o} (9%) angle from the horizontal (strike of slope), to minimize the velocity of the water, and extend from the trench line roach to undisturbed ground adjacent to the disturbed portions of the ROW.

22. Cleanup on the ROW and extra workspace will be an ongoing activity throughout the construction phase. Final cleanup will occur immediately following backfilling operations, and all cleanup activities are expected to be completed by the early summer following winter construction, depending on weather conditions. Cleanup activities will be suspended if weather conditions are such that erosion and sedimentation will occur.

3.2.5 Remote Pits

Above ground tanks will be used on each lease to contain the drilling mud. After the completion of drilling operations, water will be stripped from the drilling mud. The water will be re-used at another location or injected into an approved water disposal well. Drill cuttings from the wellsites will be trucked to one of the proposed remote pits. The remote pits will be located on high ground in close proximity to the access roads.

The proposed pit will be located on level to slightly undulating upland terrain. Upland ridges transect the proposed area from east to west and extend towards the main winter access road. Additional clearing and levelling will be required to accommodate the pit and temporary campsite. Access to the central pit will be via an existing seismic cutline.

Mitigative measures for minimizing disturbances resulting from the construction of the pits include:

1. Additional clearing of the forest cover will be required. Cleared material will be stockpiled for the duration of drilling operations and utilized for roll back over the site upon pit closure.

2. Specific soil conditions are necessary for siting the pit. The presence of impermeable soil will be verified before access preparation and pit site clearing commences. Prior to pit excavation, the organic material and topsoil horizons will be stripped over the pit location and salvaged in a pile or windrow. Following this procedure, the underlying subsoil will be excavated and stored in a spoil pile but kept separate from the previously windrowed/piled organic material. If the subsoil is pervious, the pit will be sealed with bentonite or other liner prior to use.

3.2.6 Access To and Use Of Water Source Lakes

Accesses to water source lakes will be constructed as all other access will be constructed, as described above.

Mitigative measures for minimizing disturbances resulting from the use of the proposed water sources include:

1. Vehicles and heavy machinery will not be refuelled within 100 m of the water source and vehicles will be routinely checked for oil and fuel leaks. Absorbent pads and/or socks will be readily available to pick up any spilled fuel or lubricant.

2. It will be prohibited to deposit any deleterious materials on the ice or in the water of a watercourse or water body.

3. At no time will any waste fluid, treated or otherwise, be discharged to surface waters.

4. Water usage will be staggered through the winter drilling season as the wells are drilled; water will not be drawn all at once and thus the potential for impact would be further reduced.

5. Paramount will use water pumps with intake screens of 5 mm that will prevent potential entrainment of over-wintering fish.

6. Should any soil or other materials be inadvertently introduced into the watercourse or water body, they will be removed as soon as possible. Equipment operators will be careful to avoid gouging or otherwise disturbing banks or lake/stream bottoms.

7. If water wells are used for drilling water, care will be taken to ensure water withdrawal is completed at a rate to protect water well integrity.

3.2.7 Temporary Campsites

Temporary accommodations are required throughout the work area. These camps are made up of portable modules to yield quarters capable of accommodating from a single person to two hundred persons. The determination of the campsite location will be based primarily on the location of existing clearing, existing access, level terrain and proximity to the work. The preferred campsite locations will take advantage of previous campsite use or airstrip clearings on relatively level terrain and will maintain a 100 m buffer from any watercourse.

Mitigation measures to minimize disturbances resulting from the construction and operation of the temporary campsites include:

1. Temporary camp construction may require brushing of the surveyed area to accommodate trailers, parking, a welding shop, sewage disposal sumps and a fuel storage location. Trees

and brush will be windrowed along the edge of the campsite to be used for rollback during site reclamation. Snow will be used to level minor irregularities on the surface as much as possible. If required, wide tracked vehicles will be used to compact the insulating snow cover to promote deep frost penetration, which provides a solid foundation below each active campsite area. A disposal sump will be used for disposing grey water and sewage.

2. Fuel at each temporary camp will be stored in above ground tanks using either double walled tanks or impermeable liners to minimize the contamination of soil in the area around the tanks.

3. No feeding or harassment of wildlife will be allowed. All garbage will be collected and stored in containers so as not to attract nuisance animals such as ravens, wolverines or foxes.

4. A sump will be dug for domestic waste water. The sump will be treated with lime and closed with the mix and bury technique when the site is reclaimed.

5. During camp occupation, good housekeeping practices will be enforced.

6. The campsites will be assessed within one year after construction to determine if remedial seeding or other work is required to promote site stability and enhance local flora establishment. If required to prevent erosion, disturbed areas within the campsites will be seeded with an approved seed mix if natural regeneration is unsuccessful.

3.2.8 Borrow Pits

Borrow pits will be stripped and the organic material stored separately. The topsoil and overburden piles will be allowed to revegetate and will consequently be protected from erosion. On abandonment, the side slopes will be contoured to provide a stable slope revegetating by natural encroachment.

3.2.9 Electrical Distribution System

The power distribution system will be one of two formats. The most likely format is a conventional above grade system using wooden poles. The other possible format is a below grade system using buried high voltage insulated conductors. Either format utilizes ROWs common with the oil flowlines, and will only require a 7 to 10 m widening of the ROWs. Widening is required to keep adjacent forest from falling on the conductor in a strong wind, and to provide an area to either locate cross support poles or to plough in the buried cable.

The conventional above grade system requires a cost effective means of elevating the cable. This is normally achieved easily with wooden poles founded in competent soil. The Cameron Hills area however, is predominantly swampy wetland, and discontinuous permafrost that does not lend itself easily to boring post holes and tamping them, so, in swampy areas a steel driven pile would be used as a foundation to bolt the wooden pole to. The structures would consist of wooden poles, approximately 9 m tall and buried 2.0 m below grade. The poles will be placed approximately 90 m apart and will maintain an approximate 7 m buffer from trees at the edge of the ROW. Cross-bracing and side-bracing will be used as required to ensure that the poles remain vertical in soft terrain.

The buried system would provide the cable either buried with the flowline(s) or most likely in a separate trench. If the buried cable system were selected, and if the cable were not installed in the trench with the flowlines, every effort would be made to install the cable by ploughing. Ploughing would yield the least possible surface disturbance because no trench would be dug. If ploughing due to permafrost or rock is not possible, a trench, like that for pipelining, would be substituted.

3.2.10 Temporary Winter Airstrip

Temporary airstrip preparation is similar to that used during access route preparation, requiring the same type of equipment.

For the airstrip:

1. Re-use of the existing winter use airstrip; no additional forest clearing will be required.

2. A combination of snowmobiles/all terrain vehicles and lightweight tracked vehicles (e.g., Nodwell) will be used initially to compact the snow and surface vegetation on the airstrip. This trampling will be conducted to induce subsurface frost penetration by reducing the insulating capability of the snow pack and vegetation.

3. Paramount will ensure that frost penetration is sufficient to support the weight of airplane traffic prior to use of the airstrip.

4. During maintenance, snow removal will be accomplished with grader blades positioned approximately 4 cm above the ground so that disturbance to the organic layer is avoided (i.e., snow/ice barrier is maintained to protect underlying vegetation and soils).

3.2.11 Seismic Program

Paramount will be utilizing Vibroseis for source energy. The receiver lines are spaced at an average distance of 300 m and will be produced using a combination of existing lines (6 m wide), and new cut lines (4 m wide, 6 m wide for receiver lines needed for vibrator detours every third or fourth line), and hand cut lines (1.5 m wide) where required. The source lines are spaced at an average of 300 m and will be produced using avoidance cutting methods with a width of 6 m. It is necessary for line widths to be 6m in order for vibrators to operate in a safe and efficient manner.

Paramount will work closely with contractors to ensure that all regulatory conditions are followed.

Line widths will be minimized and avoidance cutting techniques will be utilized where possible in order to reduce the impact of the disturbance of the standing cover. Line cutting will focus on establishing a route through the area in a direct manner without cutting a straight line. This methods provides a reduce line of sight for wildlife management purposes and can also be utilized to avoid large timber.

Source lines will be cleared by small bulldozers (D5 or D6 size) to a width of approximately 6 m. All debris will be pushed into windrows on one side of the line with breaks every 400 m of at least 10 m in length to minimize the potential wicking effect during forest fires and to promote wildlife movement. The proposed 6 m wide line is the minimum workspace required for windrow placement and safe passage for men and equipment. All debris will be slashed into 2 m lengths or less and bucked to lie flat.

Receiver lines will be cleared utilizing small cats (D3 or D4), to a width of approximately 4m. Paramount also requires that every third or fourth receiver line be cut to a width of 6 m for safety evacuation concerns and to provide access for the vibrators to pass between source lines where other access is not available. Any receiver lines approaching watercourses or water bodies will be hand cut up to the banks.

In areas of sensitive terrain, no source lines will be cut and receiver lines will be hand cut to a maximum of 1.5 m to minimize surface disturbance.

Seismic operations will be conducted on frozen ground conditions only.

Existing seismic trails and roads will be utilized as much as possible and practical.

Line widths will be kept to a minimum and equipment operators will be instructed not to disturb the duff layer.

All contractors involved on the seismic program will be reminded of permafrost at daily and weekly safety meetings.

Upon choosing a contractor, to help coordinate and shoot the proposed seismic program, Paramount will review the LUP with the contractor. At that time individual personnel will be identified and charged with ensuring that specific mitigative measures are followed. Personnel will include an Advance Man, Party Manager, and Health/Safety/Environmental Manager. There will be a comprehensive pre-commencement meeting to inform all field personnel of specific conditions and mitigative measures. Daily monitoring meetings will be held with all field personnel throughout the program discussing specific requirements, conditions, field operations and safety.

Paramount will adhere to The Canada Oil and Gas Geophysical Operations Regulations 27.1(1), regarding an archaeological site or a burial ground, and The Mackenzie Valley Land Use Regulations 12, regarding a suspected historical or archaeological site or burial ground. Paramount will immediately notify the NEB conservation officer and the MVLWB or DIAND Resource Management Officer in addition to suspending operations in the vicinity of such discoveries.

Low ground pressure vehicles, 4x4 trucks, tracked units, quads, and snowmobiles will be used to move personnel and equipment as well as to acquire data. Heavier equipment (vibrators) will be buggy-mounted on low ground pressure tires.

The criteria to be used to determine when there is potential for rutting or gouging is by monitoring, through observation, the frozen ground condition. In the even that conditions change (if the frozen ground begins to thaw) such that there is potential for rutting or gouging and damage to the vegetation mat, operations with the equipment will be suspended. Paramount will not move any equipment or vehicles unless the ground surface is in a state capable of fully supporting the equipment or vehicles without rutting or gouging. Paramount is proposing an early in/early out scenario.

3.2.11.1 Water Bodies/Watercourse Crossings

All work done on ice over flowing streams, will be governed by the Ice Strength Chart as per the IAGC. All completely frozen vehicle watercourse crossings will be done by snow fill. The remainder of the lines that are "walk-through" only, will have no vehicle traffic, and are personnel only, if required. All snow/ice fills will be constructed using clean snow only; no dirt or other material that could adversely affect the watercourse will be used. All snow/ice fills will be removed at the end of the program or prior to spring break-up. The balance of the watercourse crossings are unnamed drainages and tributaries of the Cameron River. To prevent erosion, all watercourses will be crossed at a 90-degree angle where the shoreline slope is shallow.

If lakes within the project area are frozen through to the bottom, Paramount plans to place the vibrators on the ice to acquire program data. This will depend on both the depth of the lake and the depth of ice covering the lake. Ice thickness testing will be done to ascertain safety thicknesses for both man and machine. If any lake is not frozen to bottom, Paramount will stack the vibrator points on either side to build up the coverage. Receiver lines crossing watercourses or water bodies will be hand strung across the ice surface where required.

Paramount will not be building any permanent roads for access to the seismic program as this program is being conducted during frozen ground conditions and only existing crossings are being utilized.

3.3 OPERATIONS

This section addresses Section C-3 of the MVEIRB ToR:
Describe the operations in terms of normal activities and in terms of potential malfunctions and accidents.

Normally activities are conducted without incident. Paramount, and the industry in general, relies on thorough monitoring and effective surveillance of its assets and activities to detect developing problems early, to limit any potential damage, and deal with them promptly. The reader is encouraged to review Section H-2 Effects of Malfunctions, in conjunction with this section.

Generally, field activities include:

- surveying;
- clearing;
- timber salvage;
- access/site construction;
- surface reclamation; and
- temporary work camps.

All of these topics are described in detail in Section 3.2 above.

Industry specific field activity includes well drilling, well completion, well evaluations testing, well abandonment, pipeline/power-line construction, production facility construction, gathering of seismic data, and production operations. All involve workplace hazards. Normally activities are conducted without incident but conscious recognition of the hazards, potential malfunctions, and potential accidents has given rise to the development and implementation of the Emergency Response Plan complete with spill response guidelines. Its purpose is to assist field personnel to respond in a safe and timely manner to emergency situations that may affect the health and safety of the public, employees, facilities, and the environment. The ERP describes the procedures and methods that will be implemented in the event of an emergency such as a fire, or liquid spill. The ERP has been filed with the NEB and MVLWB.

Potential accidents include:

- personal injury;
- vehicle collision;
- well blowout;
- leaks of contaminants, flammable substances, or toxic substances; and
- fire.

The ERP filed with the NEB and MVLWB, will be the prime documents guiding the actions of field personnel in the event that an accident should occur.

3.3.1 Ground Disturbance

The construction, drilling, completion, and seismic data gathering activities all occur under frozen ground conditions and the ongoing environmental disturbance should be limited to surface clearing. However, the possibility of working over wet or thawing soils in the early spring does exist. In order to minimize terrain disturbance and soil structure damage in the event of wet or thawed soils, the following options are available:

- equipment travel may be suspended;
- rescheduling work for early morning or late evening;
- the use of low ground pressure equipment;
- activity alternatives may be utilized;

- consider employing low-impact procedures (such as low ground pressure equipment / vehicles); and
- consider, if feasible, postponing those activities that require heavy equipment until frozen soil conditions.

Contingency measures shall be considered once one of the following indicators occurs:

- excessive rutting;
- excessive wheelslip;
- excessive build-up of mud on tires and cleats;
- excessive formation of puddles; and
- tracking of mud down the road as vehicles leave the ROW.

(These measures will also be implemented if construction, maintenance, or production operations require immediate deployment of heavy machinery.)

The following contingency measures shall be employed progressively or individually as warranted if the above indicators or conditions occur and will be employed in consultation with DIAND representatives:

1. Limit equipment traffic to the evening or early morning when ground conditions are frozen or delay activities until soils dry out or refreeze.

2. Prevent standard rubber-tired traffic from driving on the ROW.

3. Install geotextiles, swamp mats, or corduroy constructed from non-merchantable timber; or employ frost inducement measures such as snow packing or ploughing to increase the load bearing capacity of wet / thawed ground.

4. Salvage any excess snow from the spoil side of the ROW and spread, as well as pack, the snow on the work side to avoid premature thawing of the upper soils.

5. Restrict operations and maintenance activities vehicle traffic to equipment with low ground pressure tires or wide pad tracks, where feasible.

Apart from light survey, light scouting, and emergency maintenance activities, the routine production operation is the only activity undertaken year round. It is confined to surveyed boundaries of leases and access routes. Normal activities include the routine monitoring of production equipment to assure safe and proper operation.

Under normal conditions, access to wells and satellites will be by ATVs in the summer and regular vehicles and/or snowmobiles in the winter. All production access routes utilize existing cutlines and flowline ROWs. Low-lying areas, which are sensitive to disturbance, to the extent that slash inventories allow, will have a corduroy road for ATV traffic during unfrozen conditions. The corduroy will prevent chronic disturbance to the ROW in these areas. It should be noted that ATV traffic does leave some marks on the environment, as the tire tracks remain visible for considerable periods of time following use. The Cameron Hills climate is one that does not lead to rapid regeneration.

ATVs will be used during the frost-free period to travel to the leases. The small drainages, not crossed by bridges, will be forded. In the event that the ATVs get stuck or that the disturbance track expands to greater than about 2 m in width, a temporary log bridge may be placed over the crossing that could be removed easily at the end of the project, or gravel may be deposited into the crossing to create a stable ford.

For heavy equipment crossings during the winter, ice bridges will be installed as required along the access routes.

3.3.2 Ground and Water Contamination

Under normal conditions production chemicals and produced fluids are completely contained. The risk of a breach of the containment system is real. To minimize the incidents of liquid contamination of the ground and water, tanks have secondary containment and production equipment is housed in buildings providing liquid spill containment pans. Corrosion inhibition is actively employed to minimize the risk of a pipeline break. The quick detection of a pipeline break is facilitated through the use of automatic high/low pressure shutdowns. Buildings housing production equipment are also fitted with flammable gas and toxic gas detection capable of automatically isolating and shutting down the enclosed equipment.

Where a ready source of ignition is available, the enclosed production equipment is fitted with fire detection capable of automatically isolating and shutting down the enclosed equipment.

Early detection of leaks and other malfunctions is considered a key element in limiting the extent of an undesirable event. Remote gas well sites are monitored by telemetry so that all critical operating parameters are monitored and automatically alarmed at the manned central battery. Operators will attend the central battery site continually providing continual inspection of the central facility and telemetered wellsite data. The importance of facility surveillance is emphasized as a production operator's and supervisor's responsibility. The Environmental Protection Plan Manual (EPPM) emphasizes surveillance of ROWs and equipment as part of preventive measures. The EPPM specifically identifies the following routine inspections for operators and supervisors:

- pipeline patrol;
- noise;
- revegetation;
- unauthorized access;
- pits and sumps;
- camp waste storage;
- terrain stability;
- natural drainage have not been impaired;
- warning signs;
- road culverts;
- access;
- wildlife activity;
- trenchline subsidence;
- borrow pits;
- berms at facilities;
- revegetation success;
- air emissions during testing; and
- storage tanks.

3.3.3 Air Contamination

Under normal conditions emissions to the air are low level and will be within limits established for like activities. (Emissions to the atmosphere are described in detail in Section 7.2.) Under extreme conditions, like a pipeline break, the release of toxic and flammable gas could develop in a relatively confined area for a short period of time around the source of the leak. The fact that equipment and flowlines are equipped to automatically detect such events and shutdown, limits the release volume. The Cameron Hills area is very sparsely populated so the risk to the public is deemed minimal. Natural dispersion will quickly dilute dangerous accumulations of toxic and flammable gas to harmless levels.

Close surveillance of the ROWs and facilities assures that as problems develop they are detected early and that they are dealt with.

3.4 WASTE MANAGEMENT

This section addresses Section C-4 of the MVEIRB ToR:
Give a description of the existing and proposed waste management plans.

3.4.1 General

General waste handling and disposal procedures are outlined below:

1. It will be prohibited to deposit any deleterious materials on the ice or in the water of a watercourse or water body.

2. Litter and debris will be stored in covered bins for disposal off-wellsite at an approved landfill location.

3. All combustible garbage will be burned in a diesel-fired incinerator on-site, while metal, plastics and other wastes will be contained in bins for removal to appropriate disposal locations. Metal, plastic, wood planks, etc. will be contained in garbage bins and removed to an approved landfill.

4. Secured storage containers for fuels, filters used motor oil and special handling wastes will be placed away from low-lying areas and appropriate containment measures such as catch trays and berms will be used as necessary.

5. Oily wastes will be transported to an approved recycling or disposal facility.

6. All construction debris (e.g., welding rods, oil cans, etc.) and other refuse will be collected and disposed of at an approved facility.

Waste originating from specific activities will be handled as detailed below.

3.4.2 Drilling Fluid and Waste Disposal

1. Above ground tanks will be used to contain drilling fluids. At the end of each well water will be stripped from the drilling fluid for re-use at the next location. Drill cuttings will be transported to the remote pits for disposal.

2. Paramount is proposing to use only a fresh water, environmentally friendly Gel/Chem mud system. Drill cuttings will be sampled and analyzed to ensure that they do not contain elements that exceed regulatory parameters or guidelines. Upon completion of the drilling program, water will be stripped from the drilling muds for injection into water disposal wells. The drilling waste disposal location will be restored in a manner suitable to DIAND in accordance with the Alberta Energy and Utilities Board's Drilling Waste Management Guide G-50. The mix, bury and cover method will be used, whereby the excavated spoil from the pit or borrow site will be mixed with drill cuttings, followed by replacement or capping of the previously stripped organic/topsoil cover.

3. Cement returns will be segregated from the drilling waste and will be buried at the remote disposal site below a minimum of 1 m of cover.

4. Excess water will be sampled and analyzed on-site to confirm it is non-toxic and conforms to regulatory requirements. Produced water and other liquids resulting from testing, will be tanked and analyzed to determine disposal options.

5. Produced fluids from testing will likely be hauled to the central battery for handling with all the other produced fluids, or will be hauled to a custom processor in Alberta.

3.4.3 Camps and Camp Sumps

The onsite facilities will consist of accommodation trailers, generators, fuel storage, sewage disposal sumps and garbage incinerators. Small, open camp sumps will be dug at the proposed temporary campsites, pending suitable soil conditions. Sewage and grey water will be stored in the camp sumps and treated with lime, as required.

All domestic combustible garbage will be burned in a diesel-fired incinerator on-site. Non-combustible materials will be contained in garbage bins and removed to an approved landfill.

All garbage will be collected and stored properly, to not attract nuisance animals.

During camp occupation, good housekeeping practices will be enforced.

Following camp closure the sewage sumps will be properly treated with lime, backfilled and compacted and all equipment, garbage, wastes and structures will be removed from the site.

3.5 WATER USE

> This section addresses Section C-5 of the MVEIRB ToR:
> Provide a water budget for access and lease construction as well as drilling operations. Identify potential water sources.

Statistics from the 2002/2003 season are as follows:

- approximately 90 km of road was opened (40 km for drilling / service rig access and 50 km for production access);
- six new wellsites were built and 3 existing ones were opened;
- water usage was 27,132 m^3 over a 90 day period; and
- approximately 70% of the water was used on roads, 25% on wellsites and 5% on drilling, 0% on camps, service rigs and pipelining.

3.5.1 Current Year to 2014 Forecasted Water Consumption

Based on last season's, 2002/3, water consumption, the following conclusions are drawn:

- Water on 90 km of roads = 18,992 m^3
  - Heavy equipment roads 40 km (293 m^3/km)
  - Lighter equipment roads 50 km (146 m^3/km)

- Water to build 9 wellsites 6,783 m^3
  - 754 m^3 per wellsite
- Water to drill 6 wells 1,357 m^3
  - 226 m^3 per well or 13 days at 17 m^3/day

(It should be noted that the past season was quite typical with respect to natural snow inventories and cold weather temperatures. Future seasons may require greater water consumption to allow for snow making at water crossings, or for well site preparation. The use of last seasons rates of water consumption should provide a reasonable forecast of what could be expected in the long-term, and is not worst case.)

Using these rates of consumption, and considering one possible access and drilling scenario, the future ice road and site construction water consumption is forecast as presented in Table 3.5-1 below.

Table 3.5-1 Water Consumption Forecast for Access Construction

Season Ending in Year	Length of Road for Heavy Access (km)	Water Use for Heavy Access (m^3/km)	Length of Road for Operations Access (km)	Number of Wells	Water Use for Operations Access (m^3/km)	New Wellsites (@ 754 m^3/ wellsite)	Drilling Water (@ 226 m^3/ well)	Total Water Used (m^3)
2004	80	23,440	19	10	2,774	7,540	2,260	36,014
2005	100	29,300	17	8	2,482	6,032	1,808	39,622
2006	100	29,300	14	5	2,044	3,770	1,130	36,244
2007	105	30,765	16	5	2,336	3,770	1,130	38,001
2008	110	32,230	18	5	2,628	3,770	1,130	39,758
2009	115	33,695	19	5	2,774	3,770	1,130	41,369
2010	120	35,160	20	5	2,920	3,770	1,130	42,980
2011	125	36,625	21	5	3,066	3,770	1,130	44,591
2012	130	38,090	22	5	3,212	3,770	1,130	46,202
2013	135	39,555	23	5	3,358	3,770	1,130	47,813
2014 +	135	39,555	23	0	3,358	0	0	42,913

The only use of water in the production operation is potentially as amine make up water, if fuel sweetening is required. The daily volume will be limited to 0.070 m^3/d.

Potable water for construction personnel accommodations is sourced from Hay River Community so is not included here.

All other water consumption is centered around the operation of the production camp and plant and equipment maintenance which is viewed as insignificant so is not tabulated here.

3.5.2 Potential Water Sources

The character of four lakes has been investigated in detail and all have been identified as a potential water source (see Table 7.4-5).

An existing water well is located in section 11 60° 10'N, 117° 30'W which could be used in the event that the lake is not sufficient to supply the necessary volume of water.

Process make up water will be sourced from the potable water well currently operating on the battery site, as the water source for the permanent camp.

3.6 ABANDONMENT AND RESTORATION

> This section addresses Section C-6 of the MVEIRB ToR:
> Describe your plans for abandonment and restoration, including the well sites, sumps, and access roads, battery sites, etc. Include any plans for long-term monitoring.

3.6.1 General

By scheduling development activities during the winter months and employing minimal disturbance construction techniques, it is anticipated that several of the potential impacts commonly associated with programs of this nature will be mitigated. Consequently, reclamation requirements at the sites, access routes and along ROWs will be minimal.

Once the decision to abandon a site is made:

1. All equipment, materials and other debris will be removed and transported out of the area (e.g., to a point near Indian Cabins, Alberta).

2. All sites associated with the project will be stabilized and reclaimed to a condition that will mitigate residual impacts, promote revegetation and not impair pre-disturbance land use activities.

3. Wetlands will be restored to approximate their pre-construction profile.

4. Revegetation will be primarily through natural encroachment by native vegetation on the ROWs.

5. On level and gently sloping terrain, and where available, slash will be rolled back to minimize erosion and encourage natural revegetation from the soil seed bank and adjacent areas. The rollback, combined with cleat imprints from heavy equipment, will provide a rough micro-topography that helps plant re-establishment by creating "safe-sites," and increases plant biodiversity by producing a variety of microclimate habitats. Larger diameter slash will be placed near riparian areas and treed buffer strips to improve wildlife habitat and provide movement corridors.

3.6.2 Pits and Drilling Waste Disposal

The drilling waste pits will be restored in a manner suitable to DIAND. Paramount is proposing to use the standard mix, bury and cover method, whereby the excavated spoil from the pit will be mixed with drill cuttings, followed by placement or capping with the previously stripped organic/topsoil cover.

The pit edges will be overlapped during backfill operations to mitigate the possibility of post-abandonment subsidence of the fill material. Before backfilling, any snow cover on the pit surface and salvaged material piles will be removed to the extent feasible, as snow sandwiched between fill lifts or entrained in fill material may promote subsidence during thaw periods. To further mitigate post-abandonment subsidence, backfill material will be compacted during each lift placement and a cap will be created over the pit (i.e., 1 to 1.5 m in height) to compensate for any settling and to divert surface water away from the site. Following backfill operations, the pit locations will be re-contoured as necessary to promote site stability, which will include rolling back any salvaged slash or other organic debris.

3.6.3 Borrow Pits

Any borrow pits used for access construction will be re-contoured and/or terraced as necessary to promote site stability and all cuts and fills will be back sloped to a slope ratio of not less than 3:1, or as required in Land Use or Quarry Permits. Final reclamation will include rolling back any salvaged slash or other organic debris.

3.6.4 Revegetation

Revegetation through natural encroachment is preferred. Reclamation and flora regeneration on the access routes, pits and sumps, borrow pits, wellsites, facility sites and along ROWs will be enhanced by the seeds and other propagules contained in the natural seed bank (upper portion of the soil profile), as well as through natural colonization and encroachment from adjacent, undisturbed plant communities. It has been the practice to seed disturbed sites to promote or accelerate revegetation efforts. However, seeds from species that are both endemic to the project region and suitable for revegetation programs are seldom available in commercial quantities. Seed types that are currently available in sufficient quantities often consist of highly competitive agronomic species that are not indigenous to the area and may out-compete regenerating and re-colonizing native flora, especially in the early seral stages of secondary succession. Consequently, to maintain the ecological integrity of the project area, it is recommended that only disturbed sites that are susceptible to erosion be seeded. Peatland areas will not be seeded or fertilized. A monitoring program will be completed to determine the success of natural revegetation and erosion control. If necessary, seeding will be completed at that time.

3.6.5 Water Crossings

Some drainages with well-defined banks (e.g., Cameron River) will be crossed by the proposed access routes and ROWs. Should the banks be inadvertently disturbed, they will be stabilized by seeding, or with rip-rap, as appropriate. The majority of drainage crossings proposed for this program have been used previously, and none show any negative sign of disturbance, other than reduced bank vegetation.

3.6.6 Spills

Should any accidental surface contamination occur (i.e., from spills) during any stage of the project, the affected location will be evaluated and appropriate remedial techniques will be implemented. The affected location will be restored in a manner suitable to DIAND and other relevant regulatory agencies.

3.6.7 Wellbore Abandonment

If a wellbore proves to be unsuccessful, or ceases to be viable, the well will be abandoned in accordance with the NEB requirements. In this event, the site will be reclaimed.

3.6.8 Camps

Campsite abandonment will include:

1. Removal of all equipment and trash.

2. Reclaim the sump using the conventional mix/bury/cover technique. The sump edges will be overlapped during backfill operations to mitigate the possibility of post-abandonment subsidence of the fill material. Before backfilling, any snow cover on the sump surface and salvaged material piles will be removed to the extent feasible, as snow sandwiched between fill lifts or entrained in fill material may promote subsidence during thaw periods. To further mitigate post-abandonment subsidence, backfill material will be compacted during each lift placement and a cap will be created over the sump (i.e., 1 to 1.5 m in height) to compensate for any settling and to divert surface water away from the site. Following backfill operations, the sump locations will be re-contoured as necessary to promote site stability, which will include rolling back any salvaged slash or other organic debris. The campsites will be assessed within one year after construction to determine if remedial seeding or other work is required to promote site stability and enhance local flora establishment.

3.6.9 Other

In the case of future abandonment, regulations at that time will be adhered to. Under current regulations, the pipelines will be disconnected from the facilities underground, purged with air and capped. The facilities will be removed, piles cut off 1 m below grade and the salvaged organic layer and slash spread back over the disturbed areas as appropriate. The all-season access road between the camp and the airstrip would be left in place for future use by others in fire fighting, prospecting, etc. The bridges would be dismantled and removed. The bridge piles would be left in place to minimize the potential for disturbance to the banks of the drainages.

3.6.10 Monitoring

It is Paramount's objective to abandon and reclaim each and every site so that ongoing monitoring of any condition is not required. This is however not realistic and Paramount accepts its obligation to monitor the effectiveness of abandonment and reclamation efforts for at least the one year after a site is reclaimed, and beyond the first year until satisfactory reclamation conditions prevail. If the site is stable, and revegetating satisfactorily, no further monitoring or activity will be undertaken. The site will be considered reclaimed. If however, one year after a site is initially abandoned, evidence of the need for further restoration work is required, a remediation plan will be developed for review and acceptance by the DIAND Resource Management Officer. That remedial plan may be limited to seeding bare or erosion prone areas.

3.7 OTHER

> This section addresses Section C-7 of the MVEIRB ToR:
> Include any other relevant proposed activities or development components.

Details and discussion of proposed activities and development components that are not specifically requested in the Term of Reference are provided in the foregoing.

The supplemental activities and development components are:

1. Construction of facility/satellite site.

2. Construction of remote pits.

3. Construction of access to and use of water source lakes.

4. Construction of temporary campsites.

5. Construction of borrow pits.

6. Construction of electrical power distribution system.

7. Construction of temporary winter airstrip.

8. Seismic lines.

9. Water use – domestic and process.

10. Abandonment and reclamation of pipelines, bridges and production facilities.

4. PROJECT ALTERNATIVES

This section addresses Section D of the MVEIRB ToR:
The DAR should discuss alternatives to the currently proposed development components, their environmental impacts, and their limitations. As a minimum the following alternatives should be considered:
- alternative waste management, such as sumpless drilling systems;
- directional drilling methods;
- alternative transport modes, such as the use of airships to move heavy equipment; and
- alternative scheduling, e.g., stretching the program over a longer period of time.

4.1.1 Alternative Waste Management

Wastes that are generated by Paramount typically vary between the various phases of the programs (e.g., drilling wastes would not be generated during seismic or production), with some wastes (e.g., used oil) being a product common to all phases.

As discussed in previous sections, Paramount proposes to continue with their proven waste management plans within the Cameron Hills, as per industry standards.

The ToR refers to sumpless drilling as an alternative waste management option that should be assessed. Paramount has chosen to use sumpless drilling techniques for the drilling operations at Cameron Hills. With this system drilling fluids are held in tanks rather than sumps. At the end of drilling operations, the water is stripped from the drilling fluid for re-use at the next location. The dewatered drill cuttings are then sampled and analyzed to determine suitability for disposal in remote pits. To date all cuttings have been suitable for mix/bury/cover disposal at remote pit sites. Cuttings from more than one location are disposed of in common disposal pits up to the limits of maximum elemental loading as specified in AEUB Guide G-50 –- Drilling Waste Management. In the event that analysis indicates that the cuttings are not suitable for mix/bury/cover the cuttings will be disposed of at licensed waste reclamation sites in Alberta. At the end of drilling operations the water is hauled to Alberta for injection into a licensed disposal well. Another option for the mud disposal would be land spreading while drilling (LWD), which entails spreading the muds onto the land, typically cultivated land, at a prescribed rate determined by the receiving soil analysis and drilling mud tests. However, due to the natural forest cover of the project area, this approach is not feasible within the Cameron Hills.

The sumpless drilling technology would require the water to be removed and disposed of through re-injection or other means, and the waste solids, which are relatively dry, to be collected and transported for final treatment and disposal. As such, a sump or pit is still required for drilling, as it relates to remote areas such as Cameron Hills. This is because there is no offsite waste facility nearby that would be economical for Paramount to use for final treatment and disposal of the waste solids. The use of a remote pit by Paramount is intended to concentrate the disturbance (e.g., pit construction) to a centralized location.

It is acknowledged by Paramount that operators on the north slope in Alaska and in the Beaufort, where mix/bury/cover techniques can't be used, drilling operations practice reduction and direct injection of the drilling fluids. These types of practices have their own set of risks, benefits, and the costs are prohibitivethat Paramount feels are not warranted for application in the Cameron Hills.

4.1.2 DirectionalAlternatives to Vertical Drilling

Directional drilling is typically utilized under the following scenarios:

- to achieve specific well bore angles within target zones (e.g., horizontal drilling) to maximize production, particularly with heavy oil;
- when the surface location is unacceptable from an environmental perspective and the new location is not over the target zone (i.e., can not be attained with a vertical bore); and/or
- when a single lease can support several wells that have bores that extend out to different bottom hole locations within a target zone.

Directional drilling has been used by Paramount but only when the surface location has been unacceptable from an environmental perspective and the new location is not over the target zone. To date horizontal drilling has not been identified as a requirement and the target zones have been too shallow and spaced too far apart to facilitate any type of common pad drilling.

4.1.3 Alternative Transport Modes

To date, there are no alternative methods to pipelines, to economically transport oil and gas from the point of recovery, to processing facilities and then to market.

Paramount continues to use existing disturbance corridors for the transport of vehicles and equipment into, and within, the project area. To minimize the potential for disturbance to the environment, the required access is reconditioned each winter to ensure that it can adequately support the loads (e.g., the drilling rig components) and provide safety for people using the access.

The ToR suggests the consideration of alternative transport modes, such as the use of airships to move heavy equipment. The airship technology does exist that could be used to transport the various rig components and related equipment. For example, CargoLifter, a German company with its North American headquarters in Raleigh, North Carolina has an airship designated the CL-75 that can lift almost 100 tons, and is approximately 67 m in diameter. Paramount has plans to use this airship to build a high-speed maglev transportation system in Pennsylvannia (Lawrence 2002). Paramount also has an airship called the CL-160 that is capable of hauling 175 tons. The ship is approximately 285 m long and 92 m high. As such, although the technology is available, Paramount feels that it is not practical to get an airship to the project area, get approval for and construct the support system required, and using it for a short-term (i.e., less than 4 month drilling period) period, once a year in the NT.

There are helicopters in the world that are capable of lifting large payloads. In particular, the Mi-26 (Aviastar 2003), a Russian made helicopter is capable of lifting a 20,000 kg payload, while the American made Chinook CH-47D, is capable of lifting approximately 10,000 kg. Based on a telescoping double drilling rig, the approximate weights of the rig components are: pumps 36,000 kg; rig trailer/telescopic double 76,000 kg; draw works 17,000 kg; doghouse/watertank/ tool crib 34,000 kg; light plant/change room/fueltank 42,000 kg; mudtank 30,000 kg; manager's shack 14,000 kg; and, pipe tables/miscellaneous loads 22,000 kg (C. Gowler, Precision Drilling, pers. comm. 2002). The helicopters could not lift all of the rig components.

Considering the above information, and the fact that an existing disturbance corridor is used seasonally to achieve access to the project area, Paramount feels that the transport systems in place for the project are the best, from both an economic and environmental standpoint.

4.1.4 Alternative Scheduling

The scheduling that Paramount has suggested for the project, has been determined by several factors, which include:

- Seasonal limitations – Access for exploration, drilling, evaluating and construction is only available during the winter season;
- Economics – Paramount has several properties that require expenditures and activity. A cost-benefit analysis is completed to determine where funds are needed to provide the best return for Paramount;
- Equipment availability – Paramount's experience has dictated the balance between the amount of drilling and evaluating that can be done in a given winter period, followed by the tie-in of viable wells, in the available period of frozen ground conditions within the project area. Also related to this, is the number of rigs that are available to do the drilling during any given winter;
- Data interpretation – Once a seismic program has been completed, it takes several months to compile, analyze and interpret the data, and then determine the appropriate locations for drilling;
- Drilling success – Paramount expects to achieve a success rate of approximately 66% on their drilling program in the Cameron Hills. When dry holes are drilled, this can change the plan and the schedule.

Paramount's goal is to develop the Cameron Hills SDL progressively. Through an iterative process, the field will be delineated and developed in a progressive, cost-effective and environmentally responsible manner. An alternative would have been to first, blanket the entire SDL with 3D seismic, and then start drilling the high potential locations followed by installation of the gathering system (assuming the sales pipeline from the H-03 battery to Bistcho was in place), as fast as equipment availability and safety allowed. However, Paramount does not have the resources to operate in this fashion, and further, does not feel that this approach is environmentally responsible.

Another scheduling alternative, as suggested in the ToR, would be to stretch the program over a longer period of time. Regardless of the time frame of the development, the overall disturbance footprint is predicted to be the same. Other factors that need to be considered, as they relate to the operational period, include the return on investment for Paramount and their shareholders, and the need to provide adequate supply volumes for the efficient operation of the system (e.g., pipelines, compressors, battery).

Another consideration, is that if the disturbance footprint is the same for the operation, a longer operational period would delay the initiation of reclamation (i.e., delay regeneration of habitat) and extend the time that wildlife were exposed to disturbances from the activity (i.e., humans and vehicles/equipment). Paramount feels that the schedule presented in this DAR provides a reasonable estimate of the timing and progression of activities. However, it must be recognized that the final schedule will be determined by the success and longevity of the wells, and results of future exploration, and even by advances in technology as it affects recovery.

4.1.5 Alternatives to the Selected Camp Sites

Temporary campsites are used to house personnel required to facilitate the road and lease construction, seismic, drilling, service rig, well evaluations and pipelining. The alternatives to using small camps would be to have fewer, but larger camps at, or near, central locations of the program that would likely require additional clearing of trees, and further travel distances for the crews. Vehicle traffic would be expected to increase with the latter option.

The temporary campsites at Cameron Hills are selected to provide the following:

- accommodations for crews;
- efficient utilization of existing clearings and/or old campsites;
- to minimize the impact on the environment by utilizing centralized components rather than building a campsite for each location which is customary; and

- to ensure campsites are located within a reasonable distance to the well and/or pipeline to provide timely travel for the personnel, concentrate human activity in the immediate project area, limit the disturbance to the regional wildlife, and to limit the amount of vehicular traffic on access roads.

Paramount proposes to utilize the minimum number of camps that maximizes the safety and efficiency of the program, and use existing clearings to the extent feasible. In this way the environmental protection and safety considerations can both be achieved.

4.1.6 Alternatives to Extracting Oil and Gas by Drilling

To date, there are no alternative methods to economically extract oil and gas at the depths of the reservoir at Cameron Hills (1,200 to 1,800 m).

4.1.7 Alternatives to the Selected Wellsite Size

The following are considered by Paramount when selecting the wellsite size and shape:

- H_2S content;
- drilling duration;
- rig size;
- tankage requirements (since onsite sumps are not used);
- type of solids removal equipment;
- fluid recycling processes employed;
- equipment requirements, placement and set-backs;
- the minimum clearing area required for safe and efficient operations; and
- consideration of topographical or site-specific habitat features.

NEB regulations call for a setback distance of at least 40 m between the well bore and the flare stack (Canada Oil and Gas Drilling Regulation Part IV 112(4)(d)).

With the above considerations in mind, Paramount has determined that to complete the drilling and evaluation project in a safe manner, and to comply with the appropriate regulations, a 110 m by 110 m (1.21 ha) lease will be required for each well.

4.1.8 Alternatives to Flaring During Well Evaluations

The current project involves the drilling, completion and evaluation of wells. At present, there are a number of options that have been considered for evaluating wells of this nature, such as flaring, venting, incineration, and in-line testing. Each of these options is suitable only under specific circumstances, as noted below.

4.1.8.1 Flaring

Flaring is the most commonly used method for safely conducting well evaluations. A temporary flare stack is erected at the wellsite, allowing for the gases produced during the test to be ignited and burned. The use of a flare during a well test will eliminate virtually all of the H_2S present in the produced gas (see a discussion on the efficiency of flares in the next section), and keeps the radiated heat at a safe level for workers and equipment at the wellsite. In addition, flaring virtually eliminates the direct emissions of methane to the atmosphere. This results in lower GHG emissions.

Paramount determined that a flare during the well evaluation would maximize the environmental protection (i.e., burning of the gas and optimal dispersion), while at the same time, allowing flexibility for varying flow rates during the test.

4.1.8.2 Venting

In situations where well gases contain little or no H_2S, venting of the gases to the atmosphere has been used as a means of conducting a well evaluation. However, venting does release flammable and potentially toxic gases to the atmosphere and produces more greenhouse gas (GHG) emissions than flaring, as methane is released to the atmosphere directly.

Paramount determined that it would be inappropriate to vent the gases directly to the atmosphere, so this option was not pursued.

4.1.8.3 Incineration

Another option is to use enclosed flares (often referred to as incinerators) to handle produced gases. These "incinerators" are comprised of a relatively short stack that is lined with a ceramic (refractory) material to protect the stack from the heat generated by the burning gases. Inside, at the bottom of the "incinerator" is a burner similar in design to the one at the top of the flare stack. Under certain operating conditions, incinerators can offer several advantages over standard flares. These include the fact that the flame is hidden from view, is protected from the wind, and burns low volumes of gas more efficiently (see the discussion in next section regarding the efficiencies of flares). However, "incinerators" have a limited range of gas flows that they can handle. This makes them less practical than flares for well evaluations, since it is necessary to have the flexibility to test over a range of flows. The incinerators tend to be much shorter than a flare stack, resulting in higher ground level concentrations, especially in hilly or mountainous terrain.

In addition, an incinerator will be much heavier and larger in diameter than a flare with the same capacity. This places an extra burden on getting an "incinerator" into a remote area for conducting a well evaluation. For these reasons, the use of "incinerators" are typically restricted to oil and gas batteries, dehydration facilities and plants where a relatively steady volume of gas is to be burned for long periods of time.

Due to the varying terrain conditions of Cameron Hills, the remote location, and tendency for incinerators to create higher ground level concentrations, this option was not pursued.

4.1.8.4 In-line Testing

During an in-line test of a well, the gas produced during the evaluation period is directed through an existing pipeline. This avoids the need to release the gas to the environment and recovers the gas produced during the evaluation. However, this type of evaluation is practical only in areas that have an existing pipeline network. As there are only a few pipelines within the project area, this option has limited viability but will be practiced where the receiving facility and pipeline are capable of receiving the "test" production. It should be noted that almost all wellbores need to be "cleaned up" before the produced fluids can be influent to a plant without upsetting it.

5. REGULATORY REGIME

5.1 CURRENT COMPONENTS

This section addresses Section E-1 of the MVEIRB ToR:
Provide a table summarizing relevant licences, permits or other authorizations required for the proposed development.

Table 5.1-1 outlines the current regulatory status for the Baseline Case.

Table 5.1-1 Permitted Activity Status as of June 2003

X = Activity Permitted Not Conducted
Y = Activity Conducted and Completed
Z = Activity Conducted and Ongoing
A = Applied For – In EA

Well	Access Road	Drilling	Pipeline	Fuel Line	Power Line	Prod	Seismic	Federal Surface Lease
A-05,60 10 117 30	Y	Y	Y			Z		X
A-52,60 20 117 30	Y	Y						Y. Site reclaimed
A-68,60 10 117 15	X							X
A-73,60 10 117 30	Y	Y	Y			Z		X
B-08,60 10 117 30	Y	Y	Y			Z		X
B-13,60 10 117 00	Y	Y						Y. Site reclaimed
B-25,60 10 117 30	Y	Y	X	X	X			X
C-19,60 10 117 30	Y	Y	X					X
C-50,60 10 117 30	Y	Y	Y			Z		X
C-74,60 10 117 15	Y	Y	Y	X	X	Z		
C-75 60 10 117 15	Y	Y	X	X	X			X
D-49,60 10 117 30	Y	Y	Y			X		
D-78,60 10 117 15	X	X	X	X	X			
F-03,60 10 117 15	X	X	X	X	X			
F-34,60 20 117 30	X	X						
F-38,60 10 117 30	A	A	A					
F-73,60 10 117 15	Y	Y	Y	X	Y	Z		
F-75,60 10 117 15	Y	Y	X	X	X			
G-21,60 20 117 30	Z	Z						X
G-48,60 10 117 30	A	A	A					
H-03,60 10 117 30	Y	Y	Y	X	Y			
H-58,60 10 117 30	Y	Y	Y			Z		
H-72,60 10 117 15	X	X	X	X	X			
I-10,60 10 117 30	Y	Y						X
I-16,60 10 117 30	Y	Y						X
I-73,60 10 117 15	Y	Y	X	X	X			
I-74,60 10 117 15	Y	Y	X					X
J-11,60 10 117 15	Y	Y						Y. Site reclaimed
J-37,60 10 117 30	Y	Y	Y			Z		X

Well	Access Road	Drilling	Pipeline	Fuel Line	Power Line	Prod	Seismic	Federal Surface Lease
J-62,60 10 117 15	Y	Y						X
J-76,60 10 117 00	Y	Y						Y. Site reclaimed
K-74,60 10 117 15	Y	Y	Y	X	X	Z		
L-44,60 10 117 30	Y	Y						X
L-46,60 10 117 30	A	A	A					
L-47,60 10 117 30	Y	Y	X					X
M-31,60 10 117 00	Y	Y						X
M-49,60 10 117 30	Y	Y	X					
M-73,60 10 117 15	Y	Y	Y	X	X			X
N-28,60 10 117 30	Y	Y	Y			Z		X
N-36,60 10 117 30	A	A	A					
P-57,60 10 117 30	A	A	A					
Bridges	Y/A					Z		
H-04 Satellite	Y					X		
H-03 Battery	Y					Z		
Airstrip	X					X		
Borrow Pits	Z					Z		
2 Temp Camps	Z					Z		
Y. 2D Seismic							Y	
Y. 3D 40km^2 (304 km)							Y	
3D 1062 km							533 km remaining	

5.2 FUTURE COMPONENTS

This section addresses Section E-2 of the MVEIRB ToR:
Provide a table summarizing relevant licences, permits or other authorizations you anticipate to require for the proposed development components.

Table 5.2-1 outlines the regulatory approvals required for the proposed future case.

Table 5.2-1 Regulatory Approvals Required for the Planned Development Case

Lead Authority for Approval	MVLWB		NEB					DIAND					DFO	Canadian Coast Guard
Project Components (including camps, borrow pits and waste pits)	**Land Use Permit**	**Water Licence**	**Well/ Geophysical Authorizations**	**Gathering System Construction and Operation Permit**	**Significant Discovery Licence**	**Commercial Discovery Declaration**	**Development Plan**	**Leave to Open**	**Benefit Plan for Exploration**	**Benefit Plan for Development Plan**	**Production Licence**	**Federal Lease**	**Section 35 (2) of Fisheries Act**	**Navigable Waters Permit**
45 wells Drilling, Completion, Evaluation, Facilities, Tie-in, Production	Required	Required	N/A	Required	Approved	Approved	Approved	Required	N/A	Approved	Approved	To be Determined	Required	Required
3 wells Drilling, Completion, Evaluation, Facilities, Tie-in, Production	Required	Required	N/A	Required	Approved	Required	Required	Required	Required	Required	Required	To be Determined	Required	Required
200 km 3D Seismic and/or reconnaissance 2D Seismic	Required	Not Required	Required	Not Required	Not Required	Not Required	Approved	Not Required	Approved	Approved	Not Required	Not Required	Not Required	Not Required

6. PUBLIC CONSULTATION

6.1 RECORDS

> This section addresses Section F-1 of the MVEIRB ToR:
> Provide minutes and a summary of consultation undertaken with the public, Aboriginal organizations, land owners, federal, territorial and municipal governments, and others. Include dates and participants.

Paramount has consulted on the Cameron Hills project extensively since May 2000 with:

- Public: including the two identified Cameron Hills trappers
- Aboriginal organizations: Deh Gah Got'ie First Nation, Fort Providence Metis, K'atlodeeche First Nation, Ka'a'gee Tu First Nation, West Point First Nation, Deh Cho First Nation
- Land owners: Government of Canada
- Federal, territorial and municipal governments: Indian and Northern Affairs Canada, Enterprise, Hay River and the Government of the Northwest Territories.

The consultation program has included open house meetings, local community meetings, local access to Paramount's northern Liaison representative, consultation via telephone, electronic and hard copy media, including distribution of a project update.

Paramount has explained the project, including drilling, completion, well evaluation, construction and operation of the gathering flowlines, the pipeline and the central battery, acquisition of seismic, timing of the project and environmental considerations. In addition, Paramount explained the importance to develop and produce the natural gas and oil from this area, the opportunity to develop additional gas and oil reserves in the area and the advantages to further develop and construct pipeline infrastructure in the NT and Alberta. Paramount encourages the attendees of the meetings to ask questions and to raise their concerns.

The consultation tables in Appendix I summarize the meetings, discussions, and communications that have taken place since May 2000. Paramount's minutes and/or meeting notes have not been included as these notes were taken for internal use only and may include people's opinions and business decisions that are not intended for the public domain.

6.2 ISSUES

This section addresses Section F-2 of the MVEIRB ToR: Identify the issues raised, how they were resolved and what issues remain unresolved.

Paramount eagerly accepts the opportunity to provide the local communities their first impression of the oil and gas industry. Paramount seeks to minimize public fear of the industry that arises from the public being unfamiliar with its practices. Paramount has used a multitude of media in an effort to reach the people with the primary purpose of introducing the people to the industry, and establishing comfortable, at ease, lines of communication. In this effort Paramount has become aware of the communities' concerns and has addressed them as follows:

6.2.1 Local Business and Employment Opportunities

Local businesses desire to promote their capabilities (general construction, trucking, pipeline construction, welding, etc.). Community members were searching for jobs. Paramount outlined the construction jobs that arise from exploration and development activities and described the qualifications required.

For phases of construction requiring primary contractors, the successful companies names and phone numbers were initially published in the Project Update, and distributed to the public allowing the local services easy access to apply for work. The selected primary contractors are required in their bid documents to outline their hiring strategy for locals and their contribution to the community. Paramount representatives provided their contact information. Qualified people have the opportunity to apply for jobs at the project. Paramount currently employs three junior production operators and will continue to recruit locally.

6.2.2 Boosting Long-Term Local Economy

To assist in sales, shopkeepers expressed the need for growth in the community. In response, Paramount confirms that there are currently six permanent jobs at the project, with one half currently filled by NT personnel. Facility maintenance contracts, trucking and day-to-day subsistence goods and services, and a wide variety of other goods and services will be required from the local economy.

6.2.3 Generic Questions Were Asked About The Construction Of Water Crossings

The various crossing techniques, i.e., open cut, flumed, aerial and horizontally drilled, were described to outline the pros and cons of each method. The local communities' reliance on fishing in lakes downstream of the development area lead Paramount to implement a very secure crossing technique using double walled pipeline at the aerial crossings of the Cameron River and its major tributary. Paramount is serious about environmental protection.

6.2.3.1 Protection of the Environment During Pipeline Construction and Battery Operations

Paramount outlined the construction plan and minimum ROW clearance, minimal construction disturbance time and oilfield construction safety. Paramount explained the operating parameters for the central battery including automatic shut-downs, emergency response plan and operating guidelines. Paramount also referred to the extensive environmental monitoring and conservation program.

6.2.4 Creation of Long-Term Jobs Rather than Short-Term Jobs

Paramount distributed information outlining the proposed short-term jobs, the skill requirement and job duration. Paramount discussed the long-term jobs available at the central battery, required experience levels and opportunities that will be made available to northerners. Paramount suggested that job opportunities occur that are not directly tied to the project such as an increase in use of motel, restaurant and airlines services. Further development in the area will increase the potential for additional long-term jobs.

6.2.5 Minimize Trapping Disturbance

All pipeline routes were and will be selected after consideration of local residents and the area trappers. Construction will be completed in a timely manner to reduce the amount of direct disturbance time. Wildlife pathways will remain open during and after the construction program. All crews will respect traditional areas. Trappers will be contacted by Paramount prior to construction activity and provided an updated project schedule.

6.2.6 Produced Water

Produced water will be disposed of through deep well injection into a formation already containing salt water. It is not released to the watershed.

6.2.7 Contamination Entering the Cameron River and then Tathlina and Kakisa Lakes

To address this concern Paramount has used double walled pipe at the Cameron River Crossings that are suspended from bridges. Automatic shut off valves are installed at either end of the aerial crossing. Paramount has also installed supplemental erosion control measures along the ROWs adjacent to water crossings. The aerial crossing the Cameron River was conceived after much discussion with the community and brain storming. It is believed that the aerial crossing is the least intrusive and provides the best chance of leak detection and control.

6.2.8 Increased Access to the Cameron Hills Plateau by Hunters

Paramount uses a winter road that is monitored on a continual basis when open. There is no evidence that there is increased access by others for the purpose of hunting. The project development activities are conducted outside the open hunting season so is not relevant to non aboriginal hunters.

6.2.9 The Project Could Affect Animal Behavior in the Area

Paramount has conducted studies to assess wildlife activity in the area. Paramount's local community liaison is in contact with RWED personnel to offer assistance with their caribou studies in the area. Paramount has instituted the reporting of all wildlife, except ravens, by all personnel. Sightings of all varieties of big game, fur bearers, and birds has not indicated a decline in populations.

6.2.10 All Local Communities Have Said They Would Like to See More Employment from this Project

Paramount has spent considerable time and effort in assessing available services and individuals from each local community and has promoted many training initiatives through its prime and sub contractors. Wherever possible, Paramount has provided opportunities for local community members and services to receive employment on the project provided they are competitive and capable. Where possible, Paramount has also attempted to spread out the work so that all of the local communities receive some of the benefit. Our focus is to provide as much benefit to the North as reasonable through our projects in the area. This message has been communicated on a regular basis too all communities near the project area.

6.2.11 Westpoint First Nation Has Expressed Concern that the Wages Are Too Low for Some of the Jobs

Paramount has explained that the wages offered are competitive with that paid to others doing the same job in the same environment. On a strict comparison, it should be noted that the workers in the NT are sometimes paid a little more due to a higher minimum wage in the NT.

6.2.12 All Local Aboriginal Communities Have Said They Would Like to Know What Paramount's Plans Are for the Upcoming Year Before the Actual Applications are Sent Out

Paramount has complied with this concern in three basic ways. The first is that Paramount has a community liaison representative that keeps in contact with all of the band offices and communities on a regular basis to let them know what Paramount's proposed activities are and what will be applied for in the near future. The second method is the regular issue of the project update. The project update is issued to not only all of the communities and regulators but also any interested party that has requested a copy. This update outlines proposed project components, components that will be applied for through the MVLWB, and the types of services and labor that will be required for each phase of operation. The third method of communication is through open house meetings and corresponding workshops. Over the last number of years, Paramount has held an open house in Hay River which is widely advertised, and open to all interested parties. The open house has been followed up by a community workshop that all of the aboriginal communities and any of their alliance companies are invited to. This daylong meeting has been successful in creating a better working relationship with all aboriginal communities. These open house meetings and community workshops are held in the summer, after the winter work is completed, and before new work commences.

6.2.13 Expectations from Local Communities to Hire Alliance Companies are Not Being Met

The aboriginal communities have tried to establish business alliances with other established companies and services in some form. These alliance arrangements vary from; a simple agreement providing a percentage of the profit being paid to the community to, an actual ownership by the community in the new "alliance" company. Paramount has made it clear to all communities that Paramount will support a competitive and competent alliance that provides a community with real long-term benefits. The mere existence of an alliance does not provide any assurance of contract award. Training and capacity building for the community is of high importance and is a primary issue for Paramount.

6.2.14 General Issues With Communities

The issues listed above are the larger specific issues that Paramount has addressed through its business operations and project design.

With expectations from five aboriginal communities, the town of Hay River and the hamlet of Enterprise, concerns regarding employment and benefit to individual communities will be pervasive. These concerns are handled on an ongoing basis, with continued relationship building through previously mentioned initiatives.

6.2.15 Issues That Remain Unresolved Between Paramount and the Local Communities

6.2.15.1 Wildlife Harvesting Compensation Plan

The mediator retained by INAC and GNWT has informed Paramount that the communities have requested that the finalization of the plan be put on hold.

6.2.15.2 Benefit Plan

Kakisa has requested that Paramount enter into negotiations on a separate benefit plan with a scope indicative of land claims and outside of the regulatory process. Paramount has been discussing and will continue to discuss this expectation with Kakisa, the Deh Cho First Nation, GNWT, and INAC.

7. EFFECTS ON THE ENVIRONMENT

This section addresses Section G of the MVEIRB ToR:

The DAR should examine ecosystem components and analyze how they will be impacted by all development components combined in space and over time, rather than presenting individual components and their impacts. In assessing effects on the environment the DAR will take into account section 4.1, and it will:

a) Identify the valued components that may be affected. Baseline as well as current conditions should be reported.

b) Identify the other past, present and reasonably foreseeable human activities and developments that may affect the same valued components.

c) Predict the combined impact of the proposed development in combination with the past, present and reasonably foreseeable future activities and developments in (b) on the valued components identified in (a).

d) Describe ways to avoid, mitigate or manage those impacts.

7.1 INTRODUCTION

For the update of the cumulative impact assessment for the Cameron Hills Project, the document Addressing Cumulative Environmental Effects in Environmental Assessment under the Mackenzie Valley Resource Management Act (Interim Guide, September 2000), was reviewed for direction. Further, we considered previously completed cumulative effects assessments in conjunction with different development cases, as discussed in detail below, to address the MVEIRB Terms of Reference (ToR) using the following:

> *"Throughout this Environmental Assessment, the Review Board defines cumulative effects as the effects of the proposed development in combination with effects from past, present or reasonably foreseeable developments. The MVRMA defines "impact on the environment" to include effects on wildlife harvesting and any effect on social and cultural environment or heritage resources. In addition to bio physical parameters this assessment will examine the potential impacts of the development on the economic, social and cultural well being of affected communities."*

7.1.1 Cumulative Environmental Effects Assessment Approach

Cumulative effects are changes in the landscape composition and processes as a result of past, present and future developments. Cumulative effects assessment can differ from a project-specific environmental assessment by considering larger study areas, longer time frames and the effects of other developments, currently operating or that will be operating in the foreseeable future, within that study area. There is no standard accepted method for conducting a cumulative effects assessment given the complexity of this task. Thus, methods and approaches must reflect the objectives and the issues of the project(s) development. The main limitations of cumulative effects assessment are:

- a lack of specific spatial information;
- difficulty in quantifying environmental change;
- difficulty in predicting synergistic effects;
- availability of realistic site specific information on present and future developments; and
- difficulty in defining resource use and ecological thresholds.

When assessing cumulative effects, one must consider the differences between project specific assessments and regional planning initiatives. Regional planning initiatives are generally conducted by governmental or multi-agency resource planners to consider the effects of all past, present and reasonably foreseeable future disturbances over a large geographic area and long time frames. The studies are used to develop management objectives, policies, criteria, and with the help of inclusive models can help to understand ecological thresholds and develop best management practices. There is no such information currently available for the region of the NT that contains the Cameron Hills. Therefore, ecological thresholds are addressed in general terms in the assessment of six descriptive impact ratings (i.e., direction, magnitude, geographic extent, duration, reversibility, and frequency; described in more detail in Impact Description Criteria (see 7.1.1.4.1). This system was defined based on available literature (Suter 1993) and professional judgment. For example, Suter et al. (1995) has identified that the 20% rule for severity of effects from contamination is applicable by analogy to areal scales of ecological effects. Thus, an impact of greater than 20% change in the measurement endpoint is rated as a high magnitude.

A Landscape Cumulative Effects Simulator (ALCES) is one such model that is used for regional planning purposes. There was no support for the use of the ALCES model for this project during meetings and/or discussions with regulatory agencies. Paramount and Golder agree due to the following limitations. This model tracks natural processes in conjunction with several land use practices on a given landscape and can be run over a long time frame (e.g., 100 years). It is a spatially stratified model that uses spatial information from a landscape, but is not spatially-explicit. Although this model was assessed for use in this CEA, it was rejected for the following reasons. Firstly, not all components of the environment are considered in the ALCES model. For example, specific effects typically required for water, cultural and historical resources, and health and social indicators are not addressed in detail, and the air quality component of ALCES is very general, at best. Secondly, the model does not have a spatially-explicit component, and therefore, would not allow for analysis of specific effects on terrestrial resources due to incremental changes through the different development cases. Thirdly, the ALCES model is a strategic model used for regional planning, and not well-suited for assessments of single industry, small scale projects. The energy sector will be the only land use footprint that would be applicable, because Paramount is the only company with rights to operations within the terrestrial study area. Fourthly, several of the parameters required to run the model would require assumptions, which would lead to decreased confidence in the output.

Conversely, project specific cumulative effects assessments evaluate the proposed project in the context of other existing and likely disturbance sources. Site-specific information is usually readily available for the proponent with the proposed application; however, it is not readily available for other proponents operating within the same area or for foreseeable projects into the future. Since Paramount is the only operator in the Cameron Hills and has a general knowledge as to the maximum extent of their operations within the Cameron Hills, the most appropriate approach to undertake a cumulative effects assessment is to use spatially-based model approaches where information is available and appropriate for each environmental discipline. Although the future wellsites are located to the best of Paramount's knowledge, uncertainties with respect to drilling success may affect final location of subsequent wellsites.

The overall approach and methods for defining the following criteria are discussed for each discipline:

- spatial/temporal scope;
- Valued Ecosystem Component (VEC) selection;
- assessment approaches for each case described above; and
- development of case conditions, as follows:
    - Environmental Setting
    - Baseline Case
    - Application Case
    - Planned Development Case (maximum extent of operations at 2013)

- cumulative effects assessment
- far future case (discipline-specific based on the receptor).

7.1.1.1 Spatial Boundaries

The location of the project is shown in Figure 7.1-1. The Cumulative Effects Study Areas (CESAs) selected for use in this DAR are shown in Figure 7.1-2, and discussed in detail, including the rationale for selection, under the appropriate sections to follow. These areas were selected based on boundaries considered to encompass the various activities within the Significant Discovery Licence Area (SDL), and the potential effects to VECs, as requested by the Board in Section 4.1.1 of the ToR. Study area size was also a factor. Too small an area may not encompass all of the potential effects, while too large a study area would diminish the relative effects of the project to an insignificant number. Further, the selected areas were considered appropriate in size to capture all the potential impacts that could result from the project, as well as related future developments within the SDL. An Aquatics Study Areas was selected to assess all potential effects on aquatic ecosystems; a Terrestrial Study Area was selected to assess all potential effects on terrestrial ecosystems; and a Socio-Economic Study Area was selected to assess social and economic effects on communities. As appropriate, discussions for specific impacts (e.g., spills) have a narrower or smaller assessment area within the general CESA.

The rationale for component CESA selection is discussed below.

7.1.1.1.1 Aquatics

- the maximum extent of potentially effected watersheds; and
- extended from drainages that originate within the SDL, to the nearest large receiver waterbody; Tathlina Lake to the north, the Hay River to the east; and Johnson Lake to the south.

7.1.1.1.2 Terrestrial (Soil, Terrain, Wildlife and Vegetation)

- the home range size of one female woodland caribou (i.e., 70,000 ha from Stuart Smith et al. 1997) (woodland caribou are the valued ecosystem component that may be affected to the maximum extent from project disturbances); and

- natural features including drainages, contour lines and lake boundaries.

7.1.1.1.3 Air

- study area should be sufficiently large to capture any measurable change in air quality due to emissions from the project and includes all of the Cameron Hills SDL;
- defines the area over which the graphical results of the air quality modeling are to be presented; and
- defines the area in which the majority, if not all, of air quality effects are expected to occur.

7.1.1.1.4 Socio-Economic

- boundary based on potentially affected communities of Enterprise, Hay River, the Hay River Dene Reserve, Kakisa and Fort Providence. These are settlements within a 150 km radius of the project, with populations whose members both potentially use the project area for traditional activity and may be in a position to benefit from economic impacts of the project.

7.1.1.2 Temporal Boundaries

The temporal boundaries for the assessment are limited by only considering existing, man-made disturbances that have been approved, and those projects that could potentially occur in the foreseeable future. Further, the Board requested that Paramount begin quantitative analysis at the time as close to pre-development conditions as feasible, but no later than the beginning of Paramount's activities in the Cameron Hills area (Section 4.1.2 of the ToR). Paramount's first activities in the Cameron Hills were the drilling of M-31 (spud date of March 8, 1979). However, activities (i.e., access construction, seismic exploration and drilling – A-05 spud date of January 28, 1968) by other companies occurred prior to this. Therefore, to address the ToR, Paramount used the following temporal boundaries or development cases for consideration for this assessment:

- Environmental Setting – defined as the land base prior to development; this is assumed to be circa 1960, in the case of direct effects, the development footprints will be "lifted off" the current environment. Recognizing the data limitations related to this approach, professional judgement has been used for discussions about the environmental setting at that time;

- Baseline Case – includes all existing and approved developments at June of 2003; sets the baseline against which incremental effects of proposed and future activities will be assessed (Figure 7.1-3);
- Application Case – proposed Paramount developments for 2003/2004; i.e., the subject of this application, which includes 5 wells and approximately 15 km of flowline (Figure 7.1-4);
- Planned Development Case – maximum extent of Paramount's operations at 2013 including operations up to 2023; presents a forecast of a potential level of development of up to 48 wells and associated flowlines and facilities over the next 10 years (Figure 7.1-5); and
- Far Future Case – assumes full reclamation of disturbances in order to assess the vegetation composition and wildlife habitat at 2073.

7.1.1.3 Valued Ecosystem Component Selection

As it is not practical to study all ecosystem components within an area, those representative of public and scientific values are typically chosen for management purposes. Components selected in this fashion are referred to as Management Indicator Species (MIS) (Salwasser and Unkel 1981), Valued Ecosystem Components (VECs) (Sadar 1994), Key Indicator Resources (KIRs) and other terms. For example, indicator species are used as an index to measure attributes for other species too difficult to measure (Caro and O'Doherty 1998).

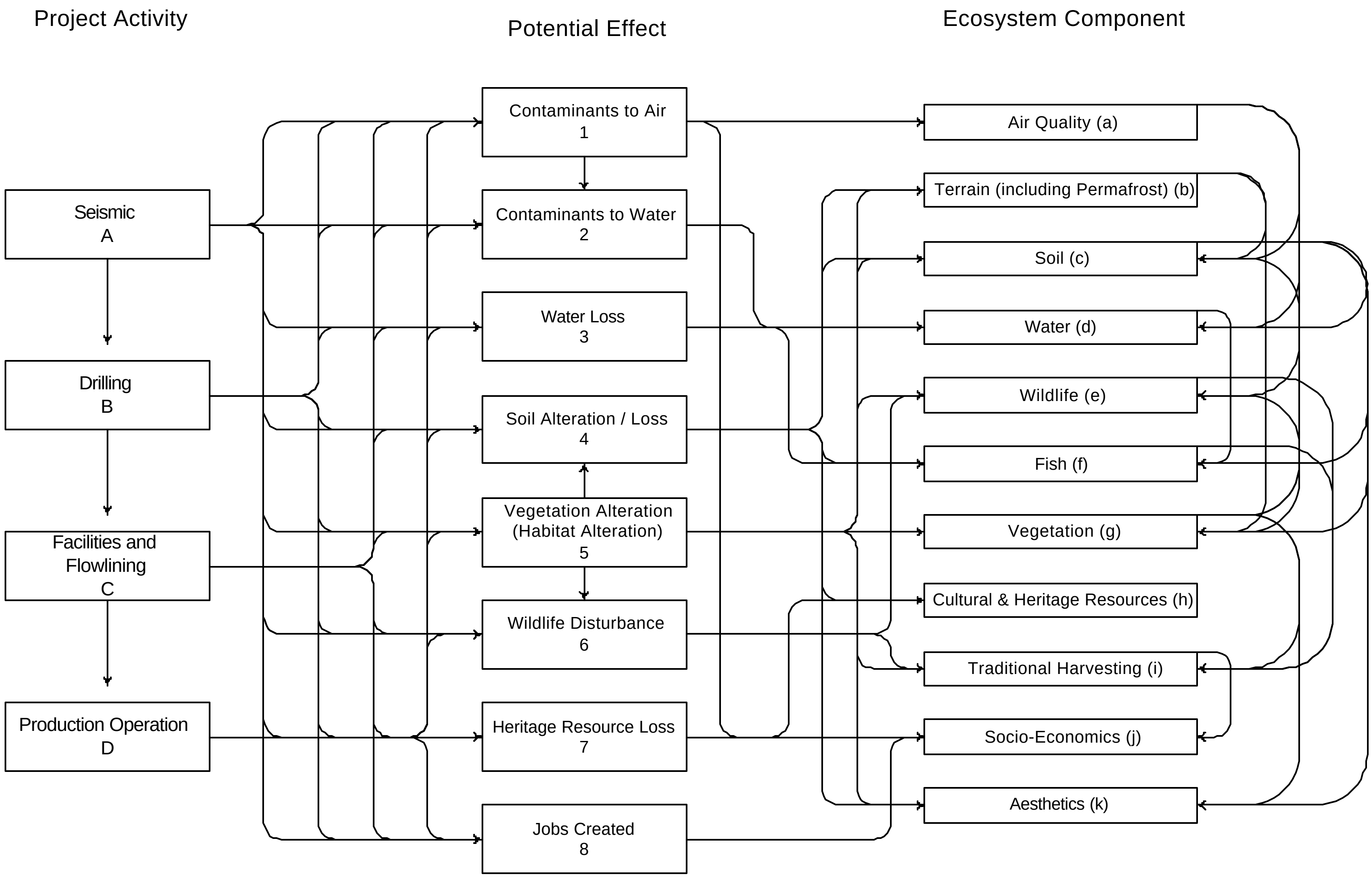
For the purposes of the Cameron Hills Cumulative Effects Assessment, indicator components are termed Valued Ecosystem Components (VECs). The EIA discipline leads evaluated information obtained from traditional knowledge, community consultation, past environmental assessments, requests in the MVEIRB ToR, and scientific and professional knowledge to determine appropriate VECs for this project. The disciplines and the VECs selected are presented below. The rationale for use of these VECs is provided under the following discipline specific sections.

- Air – SO_2 , NO_2, emissions from flaring and greenhouse gases
- Terrain – permafrost and landforms
- Soils – soil disturbance and erosion potential
- Wildlife – moose, caribou, marten, forest songbirds
- Vegetation – vegetation community composition (uplands, wetlands, riparian areas) and fragmentation parameters
- Surface Water – water bodies, watercourses (Cameron River); water quality
- Groundwater – groundwater quantity and quality
- Fish – fish habitat and fish abundance
- Cultural and Heritage Resources – individual resources
- Traditional Harvesting – number of moose and caribou harvested and furbearers trapped
- Health, Social and Economic Factors – depends on assessment of potential impacts, variables include use of social services, alcohol and drug use and teen pregnancy, NT economy and community economy

7.1.1.4 Linkage Analysis

The following linkage diagram shows the anticipated effects and pathways from project components including: seismic, drilling, flowlining and operations and their associated effects (i.e., air and water contamination, changes in water volume, soil and vegetation disturbance/alteration, wildlife disturbance, heritage resource loss, job creation) on the receptor (i.e., air quality, terrain/permafrost/soils, surface water, wildlife, fish, vegetation, cultural and heritage resources, traditional harvesting, socio-economics and aesthetics). The linkages between project development and operations and the receptors is discussed below. Specific linkages are discussed for each receptor in the following sections.

Linkages Between Project Components and Environmental Receptors



Seismic

Typically, access and 2-D seismic are the first activities within an Exploration Lease, consisting of long lines that cross the area of interest. In the Cameron Hills, Paramount uses vibroseis (i.e., large trucks with plates that vibrate the ground) as an energy source. This requires the trees be cut down on a right-of-way (ROW) that was approximately 6 to 8 m wide. Following this, there may be exploration wells drilled, depending on the findings of the seismic. If results are promising, the next step would be completion of 3-D seismic to provide Paramount with a better "picture" of the underlying geology and formations, so that precise drilling locations can be determined. The 3-D seismic requires that source lines (where the vibroseis trucks travel) and receiver lines (where recording lines are laid out to collect the data) be cut in a criss-cross pattern, with lines approximately 300-400 m apart, depending on the program parameters. Generally, source lines are cleared to 6 m wide, while receiver lines are cleared to 4 m wide. Receiver lines are narrower because smaller trucks are used to carry the receiving cables and geophones. Other associated activity at this stage would include a camp for the workers, and potentially some water for limited road construction and camp use. Due to the poor access and the presence of muskeg, all of this exploration work is done during the winter, under frozen ground conditions. Vegetated buffers are typically left between the cutlines and larger watercourses, such as the Cameron River, and snow bridges are used to cross smaller drainages.

Drilling

The drilling that follows the exploration is generally done to define the resource, which eventually allows Paramount to efficiently extract the resource. Access for drilling is achieved by using existing roads, cutlines and seismic lines to the maximum extent. Depending on the terrain, some new access may be cut to allow the larger trucks and their heavy loads to travel safely. In addition, a lease (usually 110 m by 110 m) is cleared, and centered on a seismic line, over a location that has been determined by Paramount, as being over the down-hole target or subsurface structure. If the surface location is not acceptable due to environmental concerns, the lease may be offset, and directional drilling may be used. Paramount uses non-toxic materials to drill their wells, reuses the fluids to the maximum extent, tests their solids before burying them in a pit, and trucking out the remaining solids. Camps are required for the crews, and usually, sites that were used during the seismic program are reused if appropriate (i.e., not long driving distances). Water source lakes are used to build the winter access, as better trails are required to support the heavier loads, for makeup water for drilling, and camp use.

Pipeline and Production Operations

Once the reserves of oil and/or gas have been proven, and Paramount is confident that there is enough product to economically support facilities, a gathering system and a pipeline, as required, these project components are planned, designed, permitted, and then constructed. For the gathering system, pipeline is buried in trenches, which is routed on existing cutlines to the extent practical. During the production operation phase, the wells and gathering system, and facilities are operating, with issues related to water use, access to the wells, air emissions and disturbance from light and noise. During this phase there is typically no new clearing required, and flowlines and unused access ROWs are allowed to naturally revegetate. In the spring to fall period ATVs are sometimes used during inspections, to access the wells. Where wet areas (e.g., bogs, drainages) are crossed without bridges, there can be disturbance to the wet areas. In general, oil wells require more frequent inspections due the mechanical nature of the pumps.

The linkages between the potential effect and the ecosystem, and amongst the ecosystem components are discussed in the discipline sections.

7.1.1.5 Impact Assessment Methodology

The following section describes the methodology used to assess potential effects of the project on the environmental resources in the area. Project specific assessments have considered potential impacts to the environment before implementation of mitigative measures. This cumulative effects assessment will consider residual impacts (impacts remaining after mitigation) in terms of a number of criteria. These criteria are described in detail in the Impact Description Criteria below. An environmental consequence is determined for each component based on summation of the numerical scores assigned for each impact parameter. The environmental consequence assessment is described in more detail under Environmental Consequence below. Specific impacts, mitigative measures, residual impacts, and a summary of the environmental consequences are detailed in each of the following component sections .

7.1.1.5.1 Impact Description Criteria

Potential residual impacts are considered in terms of the following criteria: direction, magnitude, geographic extent, duration, reversibility, and frequency (including seasonal effects). Each of these criteria is given a weighting as described in Section 7.1.1.5.3.

Direction of an impact may be positive, neutral, or negative with respect to the key issue (e.g., a habitat gain would be classed as positive whereas a habitat loss would be considered negative).

Magnitude is a measure of the degree of change in a measurement or analysis endpoint (e.g., the concentration of a metal in water compared to the water quality guideline value for the metal) and is classified as negligible, low, moderate or high. The categorization of the impact magnitude (i.e., high, moderate, low or negligible) is based on a set of criteria, ecological concepts and professional judgement pertinent to each of the discipline areas analyzed. Negligible means no measurable effect. Low, is <10% change in the measurement endpoint. Moderate, is 10 to 20% change in the measurement endpoint. High, is >20% change in the measurement endpoint.

Geographic extent refers to the area affected by the impact and is classified as local, regional, or beyond regional. It is recognized that a method of defining impacts within a regional area in terms of the percentage of a certain vegetative or wildlife habitat unit is influenced by the size of study area. As such, quantitative value of impacts must be tempered with an overall qualitative approach that considers the impacts of disturbance on overall viability and diversity of ecological units. Local is considered to be within the lease boundary and/or ROW. Regional is considered to be within the CESA as outlined in Figure 7.1-2. Beyond regional, means the effect extends beyond the regional area.

Duration refers to the length of time over which an environmental impact occurs. It considers the actual length of the period over which the effect of the impact occurs. Immediate term is <30 days, short-term is <1 year, medium-term is 1-20 years (proposed life of the project) and long-term is >20 years (e.g., persists beyond the life of the project).

Reversibility is an indicator of the potential for recovery of the ecological end point from the impact. In some cases, reversibility is closely tied to duration (e.g., in the case of temporary loss of habitat). In other cases, the effect may extend well beyond the end of the period of the original impact (e.g., a chemical spill might result in longer term effects on plant health).

Frequency describes how often the effect occurs within a given time period and is classified as low, medium or high in occurrence. Low means once; medium means occurs intermittently and high means continuously. Discussions on seasonal considerations are made when they are important in the evaluation of the impact.

7.1.1.5.2 Impact Probability

Impact probability refers to the likelihood that an impact will occur if the project is to proceed. In this assessment, potential impacts due to project developments are considered, mitigation is applied and a prediction of residual impacts is made. These residual impacts are assumed to occur for each of the assessment cases. The residual impacts are then measured against the criteria outlined above. An assessment of impact probability will be discussed for those residual impacts that are expected to have a moderate or high environmental consequence.

7.1.1.5.3 Environmental Consequence

Environmental consequence is an overall attribute associated with an impact and is a function of direction, magnitude, duration, frequency, geographic extent and reversibility. Table 7.1-1 outlines the screening system used to determine an environmental consequence for residual impacts. The screening system uses a numerical score for each of the parameters considered in evaluating an impact. The total is then used as a guide to assign environmental consequence of residual impact. Professional judgement has been used, as appropriate, to determine the associated ranking of the environmental consequences. This quantitative assessment system is intended to be used as a guide to facilitate the final assessment step; it is not intended to provide a definitive value.

Table 7.1-1 Screening System for Environmental Consequences

Magnitude (Severity)	Duration	Frequency	Geographic Extent	Reversibility
negligible (0)	immediate (0)	low (0)	local (0)	yes (-3)
low (+5)	short-term (+1)	medium (+1)	regional (+1)	no (+3)
moderate (+10)	medium-term (+2)	high (+2)	beyond regional (+2)	
high (+15)	long-term (+3)			

The total of all of the parameters listed above are then used as a guide to assign environmental consequence of residual impacts as follows:

- negligible 0 to 5
- low 6 to 10
- moderate 11 to 15
- high greater than 15

7.2 AIR

This section addresses Section G-1 of the MVEIRB ToR: Include all emission sources. The DAR should address short and long-term effects and also include any changes in the operations that have occurred since the last EA, e.g., the use of sour gas for compressors.

7.2.1 Introduction

The air quality assessment of the Paramount Cameron Hills Extension provides a complete air quality impact analysis of the proposed modifications to the Cameron Hills Project and identifies the potential effects of emissions associated with the proposed project. Information is provided on historic and current air quality associated with the existing and approved Cameron Hills development as well as the changes expected to result from the planned development at Cameron Hills. The focus of this air quality assessment is on determining changes to the composition of the air and comparing the results with NT standards or existing regulations and guidelines from other Canadian jurisdictions.

7.2.2 Environmental Setting

7.2.2.1 Air Quality Environmental Setting

The Environmental Setting has been described as the conditions prior to industrial development in the region and corresponds to the expected conditions in 1960. While there is no ambient monitoring data available for this region in 1960, it is reasonable to assume that the levels were low due to the absence of industrial activities. The earliest monitoring data that is readily available for the NT was collected by Dome Petroleum Ltd. in the vicinity of Inuvik and Richards Island in 1972 and 1973 (F.F. Slaney 1973a,). This monitoring indicated that the background-levels of SO_2 and NO_2 were low at that time. These findings for SO_2 are consistent with more recent observations make by the Government of the Northwest Territories in Fort Liard (GNWT 2002a).

7.2.2.2 Regional Climate and Meteorology

The climate of a region is the characterization of long-term averages of parameters such as temperature and precipitation. These are important to provide a sense of the expected conditions over time, as well as possible changes that may be occurring. In contrast, the regional meteorology describes the variability in wind, temperature, precipitation and turbulence necessary to understand the local dispersion patterns and conditions.

The climate characteristics for the project area were derived from data recorded at Fort Smith (1943 to 1990), Fort Liard (1973 to 1997), Fort Simpson (1943 to 1993) and Fort Nelson (1937 to 1993). These stations are operated by the Meteorological Service of Canada (MSC). The Fort Smith station is located approximately 250 km east of the project area, and provides more than 50 years of data. This station provides all of the necessary observations required for dispersion modelling, and a data set covering the period from January 1, 1998 through December 31, 2002 was obtained for use in the air quality assessment of the Cameron Hills Extension. While the Fort Liard and Fort Simpson stations are slightly closer to the project area and provided extensive data, they were considered to be less representative of the meteorological conditions at the Cameron Hills site due to their vicinity to the Rocky Mountains and the Mackenzie River, respectively. The MSC station in Fort Nelson also provides all of the meteorological variables necessary for the dispersion modelling, and has data retrieval rates that are high. Since this station is located near to the Rocky Mountains, it was not considered ideal as a source of meteorological data used in the dispersion modelling for this assessment.

7.2.2.2.1 Regional Climate

The Cameron Hills development area is located in an area with a Sub-Arctic climate, comprised of short warm summers and long cold winters. The baseline climate characteristics, including precipitation and air temperatures for the project area were derived from climate data recorded from the Meteorological Services of Canada stations at Fort Smith (1943 to 1990), Fort Liard (1973 to 1997), Fort Simpson (1943 to 1993) and Fort Nelson (1937 to 1993).

Table 7.2-1 summarizes the monthly temperature normals for the selected climate stations. The winters in the project area can be characterized by frigid and stable air masses originating from Arctic regions. Summers are short and cool and are dominated by large-scale weather systems, which produce both unstable and stable conditions. At Fort Smith, January is the coldest month, where the mean temperature is -25°C, and the minimum temperature is -31°C. At Fort Nelson, mean monthly temperatures range from -22°C (January) to 17°C (July). Both Fort Liard and Fort Simpson show air temperature characteristics similar to Fort Smith and Fort Nelson.

Table 7.2-1 Temperatures at Fort Smith, Fort Liard, Fort Simpson and Fort Nelson

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Smith (1943 to 1993)												
Minimum (°C)	-31	-27	-21	-8	1	7	10	8	2	-4	-17	-26
Mean (°C)	-25	-21	-14	-1	8	14	16	14	8	0	-13	-22
Maximum (°C)	-20	-15	-7	5	15	21	23	21	13	5	-9	-17
Fort Liard (1973 to 1993)												
Minimum (°C)	-26	-23	-17	-5	3	9	11	9	4	-4	-18	-24
Mean (°C)	-22	-18	-10	2	10	15	17	15	10	-1	-14	-20
Maximum (°C)	-18	-13	-4	8	16	22	23	21	15	5	-11	-17
Fort Simpson (1943 to 1993)												
Minimum(°C)	-31	-28	-21	-8	2	8	10	8	2	-5	-21	-29
Mean (°C)	-26	-22	-14	-1	9	15	17	14	7	-2	-17	-24
Maximum (°C)	-22	-16	-7	5	15	21	23	21	13	2	-12	-20
Fort Nelson (1937 to 1993)												
Minimum(°C)	-26	-22	-15	-4	3	8	10	9	3	-4	-18	-24
Mean (°C)	-22	-16	-9	2	10	15	17	15	9	1	-13	-20
Maximum (°C)	-18	-11	-2	8	16	21	23	21	15	6	-9	-16

Source: Environment Canada. 1993. Canadian Climate Normals (1961-1990), Yukon and the Northwest Territories. Publication of the Canadian Climate Program.

While climate normals provide good representations of the expected temperatures, they do not provide any information regarding the trends in regional temperatures. The estimated trends in observed temperatures since 1960 has been derived from the past 50 years of daily observations at Fort Nelson, Fort Simpson, Hay River, High Level and Fort Liard by Environment Canada. The 50 years of data at each station were combined using the following methods:

- Annual average temperatures were taken directly from the average daily temperatures provided by Environment Canada.
- Annual minimum temperatures were considered to be the lowest minimum monthly temperature in each year. The minimum monthly temperature was calculated as the average of daily minimum temperatures for that month.
- Annual maximum temperatures were considered to be the highest maximum monthly temperature in each year. The maximum monthly temperature was calculated as the average of daily maximum temperatures for that month.

The annual average temperatures from each of the stations were averaged to create annual temperatures for the region. Overall, the average annual temperatures for the area appear to have increased by 1.6°C since 1960, the maximum temperature has increased by 0.9°C and the minimum temperature has increased by 3.4°C. While it is possible to make observations regarding the overall trends, these values remain small compared to the year-to-year fluctuations as illustrated in Figure 7.2-1.

Table 7.2-2 summarizes the monthly precipitation (rainfall and snowfall) data from the regional climate stations. The water equivalents of snowfall at each station can be approximated by multiplying the reported snowfall depths (in cm) by a factor of 0.1. The total precipitation values were estimated by adding the rainfall and snowfall water equivalents. As the factor for converting snowfall to water equivalents will vary depending on snowpack, as it does at Fort Smith, the numbers presented in Table 7.2-2 may not add up exactly. The Fort Smith station averages 230.9 mm of rainfall and 153.7 cm of snowfall annually. Average annual rainfall at the Fort Liard station is 290.5 mm and average annual snowfall is 141.1 cm. At Fort Simpson station, annual rainfall is 191.9 mm and snowfall is 162.8 cm. Fort Nelson has an average annual rainfall amount of 305.7 mm and an annual average snowfall amount of 191.2 cm. Snowfall undercatch would result in underestimates (70% to 90%) of the true amounts (Metcalfe et al. 1994).

Table 7.2-2 Precipitation at Fort Smith, Fort Liard, Fort Simpson and Fort Nelson

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Fort Smith (1943 to 1990)													
Rainfall (mm)	0.0	0.0	0.1	3.6	25.2	45.0	56.8	48.9	37.7	12.2	1.0	0.4	230.9
Snowfall (cm)	25.7	18.9	17.3	11.8	4.4	0.3	0.0	0.2	1.0	17.5	31.9	24.7	153.7
Precipitation (mm)	19.9	14.3	13.9	13.5	29.2	45.3	56.8	49.1	38.5	28.1	25.2	19.2	352.9
Fort Liard (1973 to 1997)													
Rainfall (mm)	0.0	0.0	0.0	6.1	39.6	49.4	87.3	60.3	39.3	8.3	0.2	0.0	290.5
Snowfall (cm)	19.0	16.7	18.2	17.9	3.9	0.0	0.0	0.3	3.5	20.7	23.0	17.9	141.1
Precipitation (mm)	19.0	16.7	18.2	24.0	43.5	49.4	87.3	60.6	42.8	29.0	23.1	17.9	431.5
Fort Simpson (1943 to 1993)													
Rainfall (mm)	0.0	0.0	0.1	3.1	21.5	38.6	47.8	43.7	24.8	11.8	0.5	0.0	191.9
Snowfall (cm)	21.4	20.0	18.6	14.5	7.2	0.0	0.0	0.5	5.7	26.2	27.3	21.4	162.8
Precipitation (mm)	21.4	20.0	18.7	17.6	28.7	38.6	47.8	44.2	30.5	38.0	27.8	21.4	354.7
Fort Nelson (1937 to 1993)													
Rainfall (mm)	0.3	0.2	0.3	5.2	41.1	64.2	83.7	63.1	38.4	8.0	1.0	0.2	305.7
Snowfall (cm)	29.7	21.8	24.9	19.5	7.7	0.1	0.0	0.2	5.0	25.7	29.6	27.0	191.2
Precipitation (mm)	21.8	16.2	17.2	20.2	47.7	64.3	83.7	63.3	43.1	30.8	21.5	18.7	448.5

Source: Environment Canada. 1993. Canadian Climate Normals (1961-1990), Yukon and the Northwest Territories. Publication of the Canadian Climate Program.

As noted with the observations of temperatures, normals do not provide any indication of the trends or variability of precipitation over time. The trends in observed precipitation since 1960 has been derived from 50 years of daily observations at Fort Nelson, Fort Simpson, Hay River, High Level and Fort Liard. The daily precipitation data for these stations were summed for each year to yield annual precipitation values. The annual precipitation values from each of the stations were averaged to create an annual average for the region. Overall, the data suggests a decline in the total precipitation as well as a decline in the snowfall, while rainfall numbers appear to be on the increase. Figure 7.2-2 provides a summary of the annual precipitation observations in the region, highlighting the large year-to-year fluctuations that are seen.

7.2.2.2.2 Regional Meteorology

The local meteorology at the Cameron Hills site dictates the transport and dispersion of atmospheric emissions. For the assessment of the Cameron Hills Extension, five years of meteorological data from Fort Smith, NT (January 1, 1998 to December 31, 2002) were used in the assessment to provide a realistic representation of meteorological conditions near the project site. The meteorological data set was purchased, complete, from SDA Weather Services in Winnipeg and includes the following meteorological parameters:

- hourly wind speed and direction;
- hourly temperature;
- hourly stability class; and
- hourly mixing height.

Summaries of these meteorological parameters are provided in the following sections.

7.2.2.2.3 Wind Speed and Direction

The dispersion and transport of atmospheric emissions are driven primarily by the wind. A windrose is often used to present both wind speed and wind direction information using a 16-point compass. The windrose consists of bars whose length indicates the frequency of winds blowing from a given direction. The bars are also broken into sections, each of which defines a speed range. A longer section indicates that winds blow more frequently at a given speed for that compass direction. Figure 7.2-3 provides a windrose for observations at Fort Smith from 1998 through 2002. While the predominant wind is from the south-southeast; the higher wind speeds occur more frequently from the northwest.

7.2.2.2.4 Temperature

A summary of the monthly surface temperatures observed between 1998 and 2002 at Fort Smith is presented in Table 7.2-3. The temperatures at Fort Smith range from -41.7 to 31.7ºC during the year with an annual average of -0.8°C.

Table 7.2-3 Observed Monthly Temperature at Fort Smith

Month	Observed Temperature (°C)		
	Minimum	Average	Maximum
January	-41.7	-20.9	2.8
February	-38.9	-14.8	6.7
March	-34.5	-10.4	11.7
April	-27.8	-0.4	20.6
May	-21.7	6.9	27.8
June	-2.3	14.6	29.5
July	1.7	17.1	31.7
August	-1.1	14.3	31.7
September	-8.3	8.0	24.5
October	-18.9	-0.1	15.6
November	-26.7	-7.5	6.7
December	-40.6	-17.3	7.8
Year	**-41.7**	**-0.8**	**31.7**

7.2.2.2.5 Atmospheric Stability

One generalized scheme to classify atmospheric stability was developed by Pasquill and Gifford (Pasquill 1961) referred to as Pasquill-Gifford or PG stability classes. The classification scheme is comprised of the following six categories: Classes A, B and C (Unstable); Class D (Neutral); and Classes E and F (Stable). These stability classes are used in air dispersion modelling, in conjunction with other meteorological parameters, to determine how air emissions are dispersed. A description of these categories is provided below:

- Unstable conditions are primarily associated with daytime heating conditions, which result in enhanced turbulence levels (i.e., convection) and enhanced dispersion of airborne emissions.
- Neutral conditions are associated with moderate to high wind speeds or overcast conditions, which temper the amount of radiation cooling and heating. Dispersion under neutral conditions is affected more by mechanical turbulence (wind speed) than by surface heating or cooling.
- Stable conditions often occur as a result of night time cooling. This results in suppressed turbulence levels and weaker dispersion of airborne emissions.

Figure 7.2-4 summarizes the frequency of hourly stability class values that were determined for Fort Smith from observed data using the Turner method (Turner 1964). Unstable conditions occurred about 23% of the time, neutral conditions occurred 41% of the time, and stable conditions accounted for the remaining 36% of the observations throughout the 5 year period.

7.2.2.2.6 Atmospheric Mixing Heights

The atmospheric mixing height is the depth of the surface layer in which the majority of dispersion will occur. The depth of this well-mixed layer is a function of surface heating and wind turbulence. Low mixing heights provide little vertical room for dispersion and can result in elevated concentrations at ground-level. Mixing heights in the SDA Weather Service data were determined from surface and upper level winds and temperatures using the Holzworth method (Holzworth 1972). A study of mixing heights in North America done by SENES (1996) determined an average minimum mixing height of 95 m for Fort Smith. All hourly mixing heights in the data set less than 95 m were adjusted to 95 m.

Figure 7.2-5 provides a monthly summary of mixing heights in the Fort Smith data. The lowest average mixing height of 796 m above ground occurs in January, while the highest average of about 1,780 m above ground occurs in June.

7.2.3 Assessment Methodology

This section of the report introduces the reader to the approach used to assess the potential air quality impacts associated with Cameron Hills Extension. It includes a discussion of the emission scenarios evaluated, the study area considered and the modelling approach used to predict ground-level concentrations. Finally, a review is provided of the applicable ambient air quality criteria against which the effects due to the Cameron Hills Extension will be evaluated.

7.2.3.1 Assessment Cases

The evaluation of potential air quality impacts associated with the Cameron Hills Extension has included consideration of three distinct assessment scenarios:

- The **Baseline** Case includes an assessment of the air quality impacts from the existing and approved emission sources within the Cameron Hills development. Although the Baseline Case sources have been approved, all of them may not be built, as all of the wells that are approved to be drilled may not produce. However, all of the wells and sources at the battery that are approved have been included to ensure the assessment of the Baseline Case conditions is complete.

- The **Application** Case includes an assessment of the air quality impacts from the existing and approved emission sources in combination with the emissions from the Cameron Hills Extension Project. This scenario represents the ambient concentrations that will occur should all of the approved sources plus the 5 new gas wells become operational.

- The **Planned Development** Case will include an evaluation of the Cameron Hills development when emissions are at a maximum. This case will consider the combined effect of air emissions from the existing and approved emission sources, the Cameron Hills Extension Project, all proposed wells and the fully developed facility in the Cameron Hills SDL.

In addition to the three assessment cases described above, the air quality evaluation has included a discussion of the Environmental Setting (Section 7.2.2), which defines the conditions prior to development in this area (circa 1960). Finally, the air quality assessment includes a separate evaluation of the potential air quality effects during well testing and is presented in Appendix IV.

7.2.3.2 Air Quality Study Area

In completing the air quality assessment of the Cameron Hills Extension, an air quality study area was chosen that is sufficiently large to capture any measurable change in air quality due to emission from the project, as well as enclosing all of the Cameron Hills SDL. The air quality study area for the Cameron Hills Extension Project is defined by a 52 by 51 km area shown in Figure 7.2-6. The air quality study area defines the area over which the graphic results of the air quality modelling are to be presented. The study area also defines the area in which the majority, if not all, of air quality effects are expected to occur.

The potential effects of the emissions from Cameron Hills on the quality of air in communities surrounding the project is also an important issue and has been considered as part of the air quality assessment. Specifically, the air quality assessment has evaluated possible effects of emissions from Cameron Hills on air quality at the six community receptors listed in Table 7.2-4.

Table 7.2-4 Communities Included in the Air Quality Study

Community	Distance [km][(a)]	Direction[(a)]
Enterprise, NT	95	NE
Hay River, NT	131	NE
Indian Cabins, AB	33	SE
Kakiska, NT	100	N
Steen River, AB	50	SSE
Trout Lake, NT	212	WNW

(a) Distance and directions presented in the table are relative to the central battery.

7.2.3.3 Valued Ecosystem Components or Key Indicators

Air quality assessments and air quality do not lend itself to evaluation using the concepts of valued ecosystem components (VECs) since it is the quality of the air that is valuable. Therefore, we use a more relevant approach that relies on "key indicators", which will be used to assess the possible effects of the Cameron Hills Extension Project on air quality. The key indicators used in the air quality assessment include the following:

- ambient concentrations of sulphur dioxide (SO_2); and
- ambient concentrations of nitrogen dioxide (NO_2).

While the air quality assessment will focus on evaluating possible impacts due to changes in the airborne concentrations of SO_2 and NO_2, consideration will also be given to other air issues that have been identified by regulators and stakeholders. Specifically, the assessment will also discuss the potential effects of the Cameron Hills Extension Project with respect to the following:

- hydrogen sulphide (H_2S);
- fine particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$); and
- the deposition of acid forming compounds.

Finally, the air quality assessment will undertake to quantify the emissions of a group of compounds collectively referred to as greenhouse gases (GHGs). These primarily include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

7.2.3.4 Air Modelling Approach

7.2.3.4.1 Air Dispersion Model Selection

The air quality assessment of the Cameron Hills Extension Project makes extensive use of air dispersion models to evaluate potential air quality effects due to emissions from the Cameron Hills Project. Air dispersion models are predictive tools that use available information regarding the facility emissions and the meteorological conditions to estimate possible ground-level concentrations. The use of dispersion models is appropriate for assessing air quality effects as the model can evaluate the effect of emissions from facilities that are yet to be built, and are effective tools for assessing alternative designs that can mitigate possible effects before they occur. The selection of a dispersion model to be used as part of the air quality assessment should be able to satisfy the following key conditions:

- evaluate the various source types present in the region;
- predict the necessary ground-level concentrations;
- have a technical basis that is scientifically sound and is in keeping with the current understanding of the dispersion processes in the atmosphere; and
- be consistent with the draft NT Code of Practice (RWED 2002a) as well as the Alberta Modelling Guidelines (AENV 2000) that are referred to in the draft code.

The Industrial Source Complex (ISC3) dispersion model has been selected to assess the air emissions from the Cameron Hills Extension Project. The ISC3 dispersion model is recommended for use in the Northwest Territories, Alberta and by the U.S. EPA for evaluating atmospheric releases from a wide variety of source types and situations. The model has been accepted for use in many Canadian jurisdictions, including the Northwest Territories, British Columbia and Alberta. The ISC3 model can simulate dispersion of emissions from multiple sources by using real meteorological data from nearby stations, allowing for the predictions of both the likely short- and long-term air concentrations of sulphur dioxide (SO_2) due to emissions from the Cameron Hills development.

The oxides of nitrogen (NO_X) that are emitted from the project are a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2). However, the emissions of NO are unstable and can react in the atmosphere to form NO_2. Since the ambient air quality criteria are based on the NO_2 concentrations, estimating the fraction of the NO that has transformed into NO_2 is important, and requires additional modelling capabilities. One widely accepted approach for calculating this reaction is the Ozone Limiting Method (OLM). The OLM is based on the assumption that approximately 10% of the NO_X emissions will be released in the form of NO_2, while the balance of the emissions are in the form of NO. Based on the work of Cole and Summerhays (1979), the NO emissions are assumed to react rapidly with ambient levels of ozone (O_3) to form additional NO_2 in the atmosphere. The equation for the Ozone Limiting Method is as follows:

$$[NO_2] = [O_3] + 0.1 \times [NO_X]$$

where:

$[NO_2]$	=	the nitrogen dioxide concentration [ppm]
$[O_3]$	=	the ambient ozone concentration [ppm]
$[NO_X]$	=	the concentration of oxides of nitrogen [ppm]

Therefore, the maximum ground-level NO_2 concentrations that are likely due to emissions from the Cameron Hills Extension Project were determined using the ISC3-OLM model. The ISC3-OLM model is a modified version of the original ISC3 model developed by the U.S. EPA and incorporating the Ozone Limiting Formula. In addition, the ISC3-OLM has been used previously at Cameron Hills in direct response to feedback from Environment Canada personnel regarding the modelling of NO_2 concentrations. The ISC3-OLM model was run using a uniform background ozone concentration of 50 ppb applied to combined plumes (as per the Alberta Environment modelling guidelines [AENV 2000]).

7.2.3.4.2 Modelled Receptors and Terrain

Since air dispersion models only calculate concentrations at defined locations (referred to as receptors), care must be taken to carefully choose appropriate receptor locations. In addition, it is essential that sufficient receptors be included to describe the terrain features in the vicinity of the project as such features can have important effects on the predicted dispersion. In assessing the emissions from the Cameron Hills Extension Project, the following modelling receptors were used:

- a 4 by 4 km area centred on the central battery was covered with a uniform grid of receptors spaced at 250 m intervals;
- a 10 by 10 km area centred on the central battery was covered with a uniform grid of receptors spaced at 500 m intervals;
- an area 600 by 600 m in size, centred at each well and satellite were covered by receptors spaced at 100 m intervals;
- the entire Cameron Hills SDL (enclosed in an area 26 by 40 km in size) was covered with receptors spaced at 1 km intervals; and
- a uniform grid of receptors spaced at 2 km intervals over the remainder of the 52 by 51 km air quality study area described in Section 7.2.3.2.

Each of these modelled receptors included elevations obtained from digital terrain models for the Cameron Hills area. In addition to the receptors described above, the dispersion model predictions were also made at seven community receptors described in Section 7.2.3.2.

7.2.3.4.3 Modelling Meteorology

The meteorology at Cameron Hills will dictate the transport and dispersion of atmospheric emissions, as well as the resulting ground-level concentrations. For the air quality assessment of the project, five years of meteorological data from Fort Smith, NT (January 1, 1998 to December 31, 2002) were used. Fort Smith is located approximately 250 km east of the Cameron Hills, and is considered to provide the most representative data for use in the dispersion modelling. The meteorological data set used in the air quality assessment was purchased, complete, from SDA Weather Services in Winnipeg, and includes hourly observations of wind speed, wind direction, temperature, atmospheric stability class and mixing heights all derived using Environment Canada protocols. A review of the meteorological conditions observed at Fort Smith has been provided in the Environmental Setting (Section 7.2.2).

7.2.3.5 Air Quality Criteria

7.2.3.5.1 Criteria for Ambient Air Quality

Air emissions can have a direct and indirect effect on humans, animals, vegetation, soil, water and materials. For these reasons, air quality criteria have been established by regulators to set the maximum ambient air concentrations. The most relevant air quality criteria for assessing emissions from the Cameron Hills Extension Project are the NT Ambient Air Standards, which were most recently updated at the end of 2002. However, NT standards were not available for all parameters. In these cases, the federal ambient air quality objectives were used. Table 7.2-5 summarizes the NT air quality standards as well as available federal criteria for sulphur dioxide (SO_2), nitrogen dioxide (NO_2), hydrogen sulphide (H_2S) and fine particulate matter or $PM_{2.5}$ (this refers to particles that are nominally smaller than 2.5 microns [µm] in diameter).

Table 7.2-5 Applicable Air Quality Criteria

Parameter	NT Standards[(a)]	Canada-Wide Standards[(b)]	Federal Air Quality Objectives[(c)]		
			Desirable	Acceptable	Tolerable
SO_2 [µg/m³]					
1-hour	450	—[(d)]	450	900	—
24-hour	150	—	150	300	800
annual	30	—	30	60	—
NO_2 [µg/m³]					
1-hour	—	—	—	400	1,000
24-hour	—	—	—	200	300
annual	—	—	60	100	—
H_2S [µg/m³]					
1-hour	—	—	—	15	—
24-hour	—	—	—	5	—
$PM_{2.5}$ [µg/m³]					
24-hour[(e)]	30	30	—	—	—

(a) Source: RWED 2002b.
(b) Source: CCME 2000.
(c) Source: Environment Canada 1981.
(d) "—" = Not applicable.
(e) Compliance is based on the 98th percentile values.

7.2.3.5.2 Deposition Criteria

The deposition of acid forming compounds has been a concern in Europe and North America for a number of years. Initially, the focus was placed on limiting the emissions of sulphur dioxide from large industrial sources. However, the current understanding of acid deposition has expanded the evaluation to include the deposition of sulphur and nitrogen compounds that can result in long-term accumulations that have been associated with the acidification of soil and water. Evaluation of acid deposition has shifted from a purely source-based approach to one that considers the sensitivity of the affected ecosystem in combination with the emissions.

The system developed in Europe used a loading approach, which combines acid deposition expressed as potential acid input (PAI) and ecosystem sensitivities. The concepts of critical loads, target loads, and monitoring loads have been defined as follows:

- The critical load is defined as being the highest load that will not cause chemical changes leading to long-term harmful effects on the most sensitive ecological systems.
- The target load is defined as the maximum level of atmospheric deposition that provides long-term protection from adverse ecological consequences, and is practically and politically achievable.
- The monitoring load is the level of deposition predicted or estimated by a dispersion model that will trigger monitoring and/or research action.

Alberta is the first jurisdiction in Canada to adopt the critical loading system based on PAI. The basis for the recommendation was the belief that sensitive soils in Alberta would be no more sensitive to acid deposition than are the soils in Europe. The Target Loading subgroup of the Clean Air Strategic Alliance in Alberta (CASA) has set out critical loads of 0.25 keq/ha/yr for highly sensitive soils, 0.5 keq/ha/yr for moderately sensitive soils, and 1.0 keq/ha/yr for soils with low sensitivity (CASA 1999). The system used in Alberta includes consideration of the wet (i.e., by precipitation) and dry (i.e., directly falling on a surface) deposition of sulphur and nitrogen.

7.2.3.6 Impact Classification Criteria

The assessment of impacts due to emissions from the Cameron Hills Extension Project involves the evaluation of residual air quality effects, classified to determine environmental consequence.

The residual effects are described in terms of direction, magnitude, duration, frequency, geographic extent and reversibility, which can be combined to yield an overall environmental consequence. Table 7.2-6 outlines how these descriptors are applied for air quality.

In addition to these six descriptors, the project Terms of Reference also refer to a "probability" descriptor. Since the air quality assessment includes dispersion models to predict likely ground-level concentrations, this descriptor is comparable to the "frequency".

Magnitude, which is a measure of the degree of change, has been classified as negligible, low, moderate or high. For the air quality assessment, the magnitude was classified as "negligible" if there was no predicted increase as a result of the project emissions. A "low" magnitude was assigned when an increase was predicted, however the maximum value remains below the relevant criteria. A "moderate" magnitude was assigned when the maximum concentrations exceed the most stringent criteria but fall below the acceptable limits. Moderate magnitudes were only applied for the annual NO_2 predictions. A "high" magnitude was assigned when the maximum concentrations were predicted to exceed the NT standards or the federal acceptable objectives. In the case of Potential Acid Input (PAI) the magnitude was classified using the monitoring and critical loads established by CASA for sensitive ecosystems in Alberta. A moderate rating will be assigned if the maximum PAI exceeds the monitoring load, while a high magnitude will be assigned if the maximum PAI exceeds the critical load. The classification scheme for magnitude is outlined in Table 7.2-7.

Table 7.2-6 Impact Description Criteria for Air Quality

Direction	Magnitude	Duration	Frequency	Geographic Extent	Reversibility
▪ **negative** if the air concentrations increase due to the project ▪ **positive** if the air concentrations decrease due to the project	▪ **negligible** (+0) no predicted increase in concentrations due to project ▪ **low** (+5) there is a predicted increase in concentrations but maximums below criteria ▪ **moderate** (+10) a predicted increase in concentrations, with maximums between the desirable and acceptable criteria ▪ **high** (+15) there is a predicted increase in concentrations, and maximums are above the NT standard or the acceptable federal objective ▪ see Table 7.2-7	▪ **immediate-term** (+0) less than 30 days ▪ **short-term** (+1) less than 1 year ▪ **medium-term** (+2) between 1 and 20 years ▪ **long-term** (+3) greater than 20 years.	▪ **low** (+0) if the effect occurs only once ▪ **medium** (+1) if effect occurs intermittently ▪ **high** (+2) if the effect occurs continuously	▪ **local** (+0) the effect is restricted to the Cameron Hills SDL ▪ **regional** (+1) the effects extend beyond the SDL but remain with the air study area ▪ **beyond regional** (+2) the effect extends beyond the air quality study area	▪ **reversible** (-3) the effect is reversible shortly after the activity or project ceases ▪ **not reversible** (+3) the effect extends beyond when the activity or project ceases

Table 7.2-7 Magnitude Classifications for Air Quality

Parameter	Magnitude if Maximum is:			
	Negligible (0)	**Low (+5)**	**Moderate (+10)**	**High (+15)**
maximum 1-hour SO_2 [μg/m³]	no increase	< 450	—	> 450
maximum 24-hour SO_2 [μg/m³]	no increase	< 150	—	> 150
maximum annual SO_2 [μg/m³]	no increase	< 30	—	> 30
maximum 1-hour NO_2 [μg/m³]	no increase	< 400	—	> 400
maximum 24-hour NO_2 [μg/m³]	no increase	< 200	—	> 200
maximum annual NO_2 [μg/m³]	no increase	< 60	< 100	> 100
maximum 1-hour H_2S [μg/m³]	no increase	< 15	—	> 15
maximum 24-hour $PM_{2.5}$ [μg/m³]	no increase	< 30	—	> 30
PAI [keq/ha/yr]	no increase	< 0.17	< 0.25	> 0.25

"—" indicates not applicable

7.2.4 Baseline Case Air Quality Assessment

The Baseline Case includes an assessment of the air quality impacts from the existing and approved emission sources within the Cameron Hills development. Although the Baseline Case sources have been approved, all of them may not be built, as all of the wells that are approved to be drilled may not produce. However, all of the wells and sources at the battery that are approved have been included to ensure the assessment of the Baseline Case conditions is complete.

7.2.4.1 Baseline Case Emissions

In the Baseline Case, the sources of emissions include equipment at well sites, the test satellite and the main facility, or battery. The Baseline Case emissions, which have been summarized in Table 7.2-8, include all of the existing and approved sources used in the dispersion modelling. For the purposes of this assessment, the Baseline Case emissions are the emissions that would result from the fully approved capacities of these sources. Detailed listings of the assumptions and information used to calculate the emissions, determine stack parameters and the gas compositions used are presented in Appendix III.

Table 7.2-8 Baseline Case Emissions of SO_2 and NO_X

Source	Number of Sources	Emissions [t/d][a]	
		SO_2	NO_X
Oil Wells			
using produced gas as fuel	17	0.239	0.012
using sweet gas as fuel	1	0.005	0.001
Gas Wells			
using well gas as fuel	14	0.478	0.018
using propane as fuel	0	—	—
Satellites			
stand-alone satellite	1	0.039	0.001
combined satellite and oil well	0	—	—
combined satellite and gas well	0	—	—
Facilities			
central battery	1	0.393	0.142
Project Total	**34**	**1.154**	**0.174**

(a) Emissions are listed in units of tonnes per day and are provided per emission type (e.g., gas well using produced gas)

One of the air quality issues identified in the project Terms of Reference was a characterization of potential greenhouse gas (GHG) emissions. Table 7.2-9 summarizes the Baseline Case emissions of GHGs from the existing and approved sources at the Cameron Hills development.

Table 7.2-9 Baseline Case Greenhouse Gas Emissions

Source	Number of Sources	Emissions [kt/yr][a]			
		CO_2	CH_4	N_2O	ECO_2[b]
Oil Wells	18	2.399	0.023	0.001	3.168
Gas Wells	14	7.565	0.010	0.000	7.835
Satellites	1	0.596	0.001	0.000	0.614
Central Battery	1	5.663	0.031	0.001	6.685
Fugitive Emissions	—[c]	—	—	—	—
Project Total	**34**	**16.224**	**0.066**	**0.002**	**18.301**

(a) Emissions are listed in units of kilotonnes per year, and are provided per emission type (e.g., per gas well).

(b) Equivalent CO_2 (ECO_2) emissions were calculated using greenhouse potentials of 1 for CO_2, 21 for CH_4 and 310 for N_2O per Olsen (2002).

(c) Data currently not available.

7.2.4.2 Baseline Case Predictions

7.2.4.2.1 Sulphur Dioxide (SO_2)

The predicted Baseline Case concentrations of SO_2 resulting from emissions associated with existing and approved sources were estimated using the ISC3 dispersion model and five years of hourly meteorology from the MSC station in Fort Smith. Table 7.2-10 summarizes the maximum predicted ground-level SO_2 concentrations within the study area as well as at six communities in the vicinity of the project. All of the maximum 1-hour, 24-hour and annual predictions are below the respective NT standards of 450, 150 and 30 µg/m³.

Table 7.2-10 Baseline Case SO_2 Predictions

Parameter	Averaging Period		
	1-Hour	**24-Hour**	**Annual**
Regional Predictions			
maximum SO_2 [µg/m³]	444	148	20
distance to the maximum SO_2[(a)] [km]	0.2	1.8	0.5
direction to the maximum SO_2[(a)]	ESE	ENE	NW
Community Predictions			
Steen River, AB	8.4	0.8	0.0
Indian Cabins, AB	9.4	1.2	0.0
Kakiska, NT	7.4	0.5	0.0
Hay River, NT	3.0	0.2	0.0
Enterprise, NT	2.4	0.2	0.0
Trout Lake, NT	4.8	0.3	0.0
NT standard for SO_2 [µg/m³]	**450**	**150**	**30**

(a) Distance and directions presented in the table are relative to the central battery.

Graphical representations of the maximum Baseline Case 1-hour, 24-hour and annual SO_2 predictions are presented in Figures 7.2-7, 7.2-8 and 7.2-9 respectively.

7.2.4.2.2 Nitrogen Dioxide (NO_2)

The maximum 1-hour, 24-hour and annual ground-level NO_2 concentrations resulting from the emissions associated with existing and approved sources area were predicted using the ISC3-OLM dispersion model and five years of meteorological data from the MSC station in Fort Smith. The model results summarized in Table 7.2-11 confirm that the maximum Baseline Case

1-hour, 24-hour and annual NO_2 predictions are below the federal acceptable NO_2 objectives of 400, 200 and 100 µg/m³, respectively.

Graphical representations of the maximum Baseline Case 1-hour, 24-hour and annual NO_2 concentrations within the study area are presented in Figures 7.2-10, 7.2-11 and 7.2-12, respectively. Since the predicted NO_2 concentrations are so low, the NO_2 isopleths do not show any contour lines.

Table 7.2-11 Baseline Case NO_2 Predictions

Parameter	Averaging Period		
	1-Hour	**24-Hour**	**Annual**
Regional Predictions			
maximum NO_2 [µg/m³]	100	28	3
distance to the maximum NO_2[a] [km]	1.8	0.4	0.5
direction to the maximum NO_2[a]	NE	NW	NNW
Community Predictions			
Steen River, AB	1.5	0.1	0.0
Indian Cabins, AB	2.3	0.2	0.0
Kakiska, NT	1.0	0.1	0.0
Hay River, NT	0.4	0.0	0.0
Enterprise, NT	0.5	0.0	0.0
Trout Lake, NT	0.7	0.0	0.0
Federal objective for NO_2 [µg/m³]	**400**	**200**	**100**

[a] Distance and directions presented in the table are relative to the central battery.

7.2.4.2.3 Other Air Quality Parameters

As part of the consultation process for the Cameron Hills Extension Project, the following three potential air quality issues were also identified:

- emissions of hydrogen sulphide (H_2S);
- emissions of fine particulate matter, specifically $PM_{2.5}$; and
- the potential for acid deposition.

While these issues are important to both stakeholders and regulators, they are relatively minor for the Cameron Hills Extension Project due to its small size and the mitigation measures built into the overall project design.

The majority of the well and produced gas that contains hydrogen sulphide (H_2S) is gathered and transmitted to a facility in Alberta. Of the small volume used as fuel, nearly all of this is burned in engines, heaters and turbines that are effective at converting all of the H_2S present into sulphur dioxide (SO_2). The small volumes of gas produced by the pneumatic pumps are either flared or are vented into the methanol tanks. Flaring will convert virtually all of the H_2S present into SO_2, while the H_2S that is vented to the methanol tanks gets absorbed and is injected into the produced fluids.

It is expected that less than 0.0023 t/d of H_2S emissions —this is equivalent to 2% of the sulphur flared — will occur on a daily basis from all of the existing and approved sources at Cameron Hills. This emission value is approximately 1.1% of the Baseline Case SO_2 emissions from flaring. By applying this relationship to the maximum 1-hour SO_2 prediction of 444 µg/m³ (Table 7.2-10), a maximum 1-hour H_2S value of 4.8 µg/m³ would result. This maximum 1-hour H_2S value would occur if the maximum 1-hour SO_2 prediction of 444 µg/m³ was directly a result of a single flare. This value is less than 35% of the federal acceptable objective of 15 µg/m³.

Fine particles, especially those small enough to enter deeply into the respiratory tract (nominally smaller than 2.5 µg/m³ in diameter and referred to as $PM_{2.5}$), have been associated with potential health effects when present in sufficient quantities. These fine particles can either be emitted directly from combustion sources (primary particles) or can form in the atmosphere as a result of chemical transformations (secondary aerosols). However, the Cameron Hills Extension Project is designed to burn a combination of well and produced gas. The use of gas as a fuel will minimize the primary particulate emissions. In fact, the primary particulate emissions from the existing and approved sources at Cameron Hills are estimated to be approximately 0.007 t/d. Therefore the maximum 24-hour primary $PM_{2.5}$ concentrations from the existing and approved activities are expected to be low and well below the NT standard of 30 µg/m³. As for secondary aerosols, these are more commonly associated with relatively industrialized areas where there are numerous sources of NO_X and SO_2 emissions. For example, the maximum predicted 24-hour secondary aerosol concentrations at communities in north eastern Alberta were approximately 8 µg/m³. However, this area also has more than 580 t/d of combined SO_2 and NO_X emissions (CNRL 2003). In contrast, the combined NO_X and SO_2 emissions from the existing and approved sources in the Cameron Hills area are less than 2 t/d. Therefore, the secondary aerosols concentrations are expected to be too small to measure.

To assess the potential for acid deposition, the "critical load" system developed in Europe and adopted for use in Alberta will be used. The potential for the project to contribute to acid deposition can be evaluated by comparing the Baseline Case emissions to the emissions from other industrial projects. Table 7.2-12 compares the overall emissions of acid forming compounds in the Baseline Case with the emissions from the De Beers Snap Lake Diamond Project (De Beers 2002). The maximum level of acidifying emissions from Cameron Hills would be approximately 30% of the emissions from the De Beers development.

Table 7.2-12 Comparison of Baseline Case Acid Forming Emissions

Descriptions	De Beers Snap Lake Diamond Project [(a)]	Cameron Hills Project Baseline Case
SO_2 emissions [t/d]	0.17	1.15
NO_X emissions [t/d]	5.68	0.17
Acid forming compounds [t/d][(b)]	4.15	1.27

(a) Source: De Beers 2002.

(b) Acid forming compounds are the sum of the SO_2 and 70% of the NO_X emissions. This accounts for the slightly lower acid forming potential of NO_X emissions.

Given that the acidifying emissions from Cameron Hills are lower than from Snap Lake, it is also reasonable to assume that the PAI levels resulting from the Baseline Case emissions would be lower than those predicted in the De Beers EIA. It is also reasonable to infer that the areas with elevated PAI levels (i.e., above 0.17 keq/ha/yr) at Cameron Hills would be smaller than at Snap Lake and that they would be restricted to an area that would lie fully within the Cameron Hills SDL. It should also be noted that the emission sources at Cameron Hills are distant from each other. In contrast, sources at Snap Lake are located close together, resulting in a concentrated area of elevated acid deposition in the mine site. Since the Cameron Hills sources are dispersed, it is likely that deposition rates of acid forming compounds will be lower than those predicted at Snap Lake.

7.2.4.3 Baseline Case Mitigation

The existing and approved sources at Cameron Hills were designed to ensure compliance with relevant NT standards and federal objectives using a number of mechanisms, including:

- avoid venting any gas to the atmosphere that contains hydrogen sulphide (H_2S);

- well and produced gases are used as fuel to minimize GHG emissions, where possible;
- virtually all of the well and produced gas that is used as fuel is burnt in engines, compressors or turbines that effectively convert all of the H_2S present into SO_2;
- use of propane at the gas well G-48 and sweet fuel at the oil well D-78 to ensure that predicted SO_2 concentrations are less than the NT standards; and
- stack heights are of a sufficient height to ensure that predicted SO_2 concentrations are less than the NT standards.

7.2.4.4 Baseline Case Impact Assessment

Despite the mitigation incorporated into the design of the existing and approved components of the Cameron Hills development, the project activities will result in an increase in air emissions and a resulting increase in ambient concentrations. The residual air quality impacts associated with the existing and approved operations have been classified using the criteria described in Section 7.2.3.6. These parameters were then combined to yield the overall environmental consequence values listed in Table 7.2-13.

Of the nine air quality indicators evaluated, three were classified as having a “low” environmental consequence and six were classified as having a “negligible” environmental consequence.

Table 7.2-13 Baseline Case Classification of Air Quality Impacts

Parameter	Direction	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Environmental Consequence
1-hour SO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour SO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Annual SO_2	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)
1-hour NO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour NO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Annual NO_2	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)
1-hour H_2S	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour $PM_{2.5}$	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Acid Deposition	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)

Note: The magnitude is based on changes relative to the Environmental Setting.

7.2.5 Application Case Air Quality Assessment

The Application Case includes an assessment of the air quality impacts from the existing and approved emission sources in combination with the emissions from the Cameron Hills Extension Project. This scenario represents the ambient concentrations that will occur should all of the approved and the 5 new gas wells become operational.

7.2.5.1 Application Case Emissions

In the Application Case, the sources of emissions include the equipment at the 5 proposed wells included in the Cameron Hills Extension Project, in addition to the approved equipment at well sites, the test satellite and the main facility. The Application Case emissions are summarized in Table 7.2-14. Detailed listings of the assumptions and information used to calculate the emissions, determine stack parameters and the gas compositions used are presented in Appendix III.

Table 7.2-14 Application Case Emissions of SO_2 and NO_X

Source	Number of Sources	Emissions [t/d][(a)]	
		SO_2	NO_X
Oil Wells			
using produced gas as fuel	17	0.239	0.012
using sweet gas as fuel	1	0.005	0.001
Gas Wells			
using well gas as fuel	18	0.631	0.023
using propane as fuel	1	0.008	0.002
Satellites			
stand-alone satellite	1	0.039	0.001
combined satellite and oil well	0	—	—
combined satellite and gas well	0	—	—
Facilities			
central battery	1	0.393	0.142
Project Total	**39**	**1.315**	**0.181**

(a) Emissions are listed in units of tonnes per day and are provided per emission type (e.g., gas well using produced gas)

One of the air quality issues identified in the Project Terms of Reference was a characterization of the potential greenhouse gas (GHG) emissions. Table 7.2-15 summarizes the Application Case emissions of GHGs from the proposed, as well as the existing and approved sources at the Cameron Hills development.

Table 7.2-15 Application Case Greenhouse Gas Emissions

Source	Number of Sources	Emissions [kt/yr][a]			
		CO_2	CH_4	N_2O	ECO_2[b]
Oil Wells	18	2.399	0.023	0.001	3.168
Gas Wells	19	10.274	0.014	0.000	10.646
Satellites	1	0.596	0.001	0.000	0.614
Central Battery	1	5.663	0.031	0.001	6.685
Fugitive Emissions	—[c]	—	—	—	—
Project Total	**39**	**18.932**	**0.069**	**0.002**	**21.112**

(a) Emissions are listed in units of kilotonnes per year and are provided per emission type (e.g., per gas well).

(b) Equivalent CO_2 (ECO_2) emissions were calculated using greenhouse potentials of 1 for CO_2, 21 for CH_4 and 310 for N_2O per Olsen (2002).

(c) Data currently not available.

7.2.5.2 Application Case Predictions

7.2.5.2.1 Sulphur Dioxide (SO_2)

The predicted Application Case concentrations of SO_2 were estimated using the ISC3 dispersion model and five years of hourly meteorology from the MSC station in Fort Smith. Table 7.2-16 summarizes the maximum predicted ground-level SO_2 concentrations within the study area as well as at six communities in the vicinity of the project. All of the maximum 1-hour, 24-hour and annual predictions are below the respective NT standards of 450, 150 and 30 µg/m³.

Graphical representations of the maximum Application Case 1-hour, 24-hour and annual SO_2 predictions are presented in Figures 7.2-13, 7.2-14 and 7.2-15 respectively.

Table 7.2-16 Application Case SO_2 Predictions

Parameter	Averaging Period		
	1-Hour	24-Hour	Annual
Regional Predictions			
maximum SO_2 [µg/m³]	444	148	20
distance to the maximum SO_2[(a)] [km]	0.2	1.8	0.5
direction to the maximum SO_2[(a)]	ESE	ENE	NW
Community Predictions			
Steen River, AB	8.7	0.9	0.0
Indian Cabins, AB	11.2	1.4	0.0
Kakiska, NT	8.7	0.6	0.0
Hay River, NT	3.6	0.2	0.0
Enterprise, NT	3.4	0.2	0.0
Trout Lake, NT	5.7	0.3	0.0
NT standard for SO_2 [µg/m³]	**450**	**150**	**30**

(a) Distance and directions presented in the table are relative to the central battery.

7.2.5.2.2 Nitrogen Dioxide (NO_2)

The maximum 1-hour, 24-hour and annual ground-level NO_2 concentrations resulting from the emissions associated with applied for development in combination with emissions from the existing and approved sources area were predicted using the ISC3-OLM dispersion model and five years of meteorological data from the MSC station in Fort Smith. The model results summarized in Table 7.2-17 confirm that the maximum Application Case 1-hour, 24-hour and annual NO_2 predictions are below the federal acceptable NO_2 objectives of 400, 200 and 100 µg/m³, respectively.

Graphical representations of the maximum Application Case 1-hour, 24-hour and annual NO_2 concentrations within the study area are presented in Figures 7.2-16, 7.2-17 and 7.2-18, respectively. Since the predicted NO_2 concentrations are so low, the NO_2 isopleths do not show any contour lines.

Table 7.2-17 Application Case NO_2 Predictions

Parameter	Averaging Period		
	1-Hour	24-Hour	Annual
Regional Predictions			
maximum NO_2 [µg/m³]	106	43	3
distance to the maximum NO_2[(a)] [km]	12.3	12.3	0.5
direction to the maximum NO_2[(a)]	NW	NW	NNW
Community Predictions			
Steen River, AB	1.5	0.1	0.0
Indian Cabins, AB	2.4	0.3	0.0
Kakiska, NT	1.1	0.1	0.0
Hay River, NT	0.4	0.0	0.0
Enterprise, NT	0.5	0.0	0.0
Trout Lake, NT	0.8	0.0	0.0
Federal objective for NO_2 [µg/m³]	**400**	**200**	**100**

(a) Distance and directions presented in the table are relative to the central battery.

7.2.5.2.3 Other Air Quality Parameters

In the Application Case, the majority of the well and produced gas that contains hydrogen sulphide (H_2S) is gathered and transmitted to a facility in Alberta. The small volume used as fuel are burned in engines, heaters and turbines that are effective at converting all of the H_2S present into sulphur dioxide (SO_2). The small volumes of gas produced by the pneumatic pumps are either flared or are vented into the methanol tanks. Flaring will convert virtually all of the H_2S present into SO_2, while the H_2S that is vented to the methanol tanks gets absorbed and is injected into the produced fluid. As a result, it is expected that less than 0.0028 t/d of H_2S emissions — this is equivalent to 2% of the sulphur flared — will occur on a daily basis from all of the sources in the Application Case. This emission value is approximately 1.1% of the Application Case SO_2 emissions from flaring. By applying this relationship to the maximum 1-hour SO_2 prediction of 444 µg/m³ (Table 7.2-16), a maximum 1-hour H_2S value of 4.8 µg/m³ would result. This maximum 1-hour H_2S value would occur if the maximum 1-hour SO_2 prediction of 444 µg/m³ was directly a result of a single flare. This value is less than 35% of the federal acceptable objective of 15 µg/m³.

As in the Baseline Case, the design of the Cameron Hills Extension Project will minimize primary particulate emissions. In fact, primary particulate emissions from the Application Case sources are estimated to be approximately 0.0076 t/d. Therefore, the maximum 24-hour primary

$PM_{2.5}$ concentrations from the existing and approved activities are expected to be low and well below the NT standard of 30 µg/m³. As for secondary aerosols, the maximum predicted 24-hour secondary aerosol concentrations at communities in north eastern Alberta were approximately 8 µg/m³. However, this area also has more than 580 t/d of combined SO_2 and NO_X emissions (CNRL 2003). In contrast, the combined NO_X and SO_2 emissions from the existing and approved sources and the Cameron Hills Extension Project in the Cameron Hills area are less than 2 t/d. Therefore, the secondary aerosols concentrations are expected to be too small to measure.

The potential for the Cameron Hills Extension Project to contribute to acid deposition can be evaluated by comparing the Application Case emissions to the emissions from the De Beers Snap Lake Diamond Project (De Beers 2002). Table 7.2-18 compares the overall emissions of acid forming compounds in the Application Case with the emissions reported in the De Beers EIA. The maximum level of acidifying emissions from the Cameron Hills would be less than 35 % of the emissions from the De Beers development.

Table 7.2-18 Comparison of Application Case Acid Forming Emissions

Descriptions	De Beers Snap Lake Diamond Project [a]	Cameron Hills Project Application Case
SO_2 emissions [t/d]	0.17	1.32
NO_X emissions [t/d]	5.68	0.18
Acid forming compounds [t/d][b]	4.15	1.45

(a) Source: De Beers 2002.

(b) Acid forming compounds are the sum of the SO_2 and 70% of the NO_X emissions. This accounts for the slightly lower acid forming potential of NO_X emissions.

Given that the acidifying emissions from Cameron Hills are lower than from Snap Lake, it is also reasonable to assume that the PAI levels resulting from the Application Case emissions would be lower than those predicted in the De Beers EIA. It is also reasonable to infer that the areas with elevated PAI levels (ie., above 0.17 keq/ha/yr) at Cameron Hills would be smaller than at Snap Lake and that they would be restricted to an area that would lie fully within the Cameron Hills SDL. It should also be noted that the emission sources at Cameron Hills are distant from each other. In contrast, sources at Snap Lake are located close together, resulting in a concentrated area of elevated acid deposition in the mine site. Since the Cameron Hills sources are dispersed, it is likely that deposition rates of acid forming compounds will be lower than those predicted at Snap Lake.

7.2.5.3 Application Case Mitigation

As was the case with the existing and approved sources at Cameron Hills, the proposed wells and associated equipment will be designed to ensure compliance with relevant NT standards and federal objectives. This will be accomplished using the following measures:

- avoid venting any gas to the atmosphere that contains hydrogen sulphide (H_2S);
- well and produced gases are used as fuel to minimize GHG emissions, where possible;
- virtually all of the well and produced gas that is used as fuel is burnt in engines, compressors or turbines that effectively convert all of the H_2S present into SO_2;
- use of propane at the gas well G-48 and sweet fuel at the oil well D-78 to ensure that predicted SO_2 concentrations are less than the NT standards; and
- stack heights are of a sufficient height to ensure that predicted SO_2 concentrations are less than the NT standards.

7.2.5.4 Application Case Impact Assessment

Despite the mitigation incorporated into the design of the Cameron Hills Extension Project, the project activities will result in an increase in air emissions and a resulting increase in ambient concentrations relative to the pre-development conditions (i.e., the Environmental Setting). The residual air quality impacts associated with the Application Case operations have been classified using the criteria described in Section 7.2.3.6. These parameters were then combined to yield the overall environmental consequence values listed in Table 7.2-19.

Of the nine air quality indicators evaluated for the Application Case, three were classified as having a “low” environmental consequence and six were classified as having a “negligible” environmental consequence, the same classification results as for the Baseline Case.

Table 7.2-19 Application Case Classification of Air Quality Impacts

Parameter	Direction	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Environmental Consequence
1-hour SO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour SO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Annual SO_2	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)
1-hour NO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour NO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Annual NO_2	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)
1-hour H_2S	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour $PM_{2.5}$	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Acid Deposition	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)

Note: The magnitude is based on changes relative to the Environmental Setting.

7.2.6 Planned Development Case Air Quality Assessment

The Planned Development Case will include an evaluation of the Cameron Hills development when emissions are at a maximum. This case will consider the combined effect of air emissions from the existing and approved emission sources, the Cameron Hills Extension Project, all proposed wells and the fully developed facility in the Cameron Hills SDL.

7.2.6.1 Planned Development Case Emissions

In the Planned Development Case the sources of emissions include the existing and approved emission sources, the Cameron Hills Extension Project, all of the proposed wells and the fully developed facility. For the purposes of this assessment, the Planned Development Case emissions are the emissions that would result from the full capacities of these sources. This scenario represents the worst case NO_X emissions at Cameron Hills, as it includes the largest amount of equipment that is expected to be installed in the SDL.

With respect to SO_2 emissions, Paramount is proposing to implement a number of mitigation measures to ensure that the maximum ground-level SO_2 concentrations as a result of the Planned Development Case sources are below the NT standards. These mitigation measures include:

- raising stack heights;
- reducing the flow rate through a down hole choke;
- using propane as fuel at the wells;
- using sweet gas as fuel at the wells; and
- using sweet fuel at the battery as fuel.

The SO_2 dispersion modelling was completed with several of the mitigation measures listed above implemented to demonstrate that Paramount can meet the NT standards for the Planned Development Case for Cameron Hills, as Paramount is committed to meeting the standards.

It should be noted the increased stack heights used in the Planned Development Case SO_2 dispersion modelling were not increased in the Planned Development Case NO_X dispersion modelling. The stack heights of the sources added in the Planned Development Case were left at the minimum height for the NO_X dispersion modelling, which ensures the NO_2 predictions presented are conservative.

The emissions associated with the Planned Development Case are summarized in Table 7.2-20, and detailed in Appendix III.

Table 7.2-20 Planned Development Case Emissions of SO_2 and NO_X

Source	Number of Sources	Emissions [t/d][a]	
		SO_2	NO_X
Oil Wells			
using produced gas as fuel	35	0.493	0.024
using sweet gas as fuel	6	0.028	0.004
Gas Wells			
using well gas as fuel	37	1.359	0.047
using propane as fuel	2	0.017	0.003
Satellites			
stand-alone satellite	1	0.039	0.001
combined satellite and oil well	2	0.105	0.004
combined satellite and gas well	3	0.231	0.008
Facilities			
central battery	1	0.027	0.326
Project Total	**87**	**2.298**	**0.417**

(a) Emissions are listed in units of tonnes per day and are provided per emission type (e.g., gas well using produced gas)

Table 7.2-21 summarizes the emissions of GHGs from the sources included in the Planned Development Case.

Table 7.2-21 Planned Development Case Greenhouse Gas Emissions

Source	Number of Sources	Emissions [kt/yr][a]			
		CO_2	CH_4	N_2O	ECO_2[b]
Oil Wells	41	5.46	0.05	0.00	7.22
Gas Wells	39	21.08	0.03	0.00	21.85
Satellites[c]	6	5.46	0.01	0.00	5.71
Central Battery	1	10.42	0.07	0.00	12.83
Fugitive Emissions	—	—	—	—	—
Project Total	**87**	**42.432**	**0.160**	**0.006**	**47.608**

(a) Emissions are listed in units of kilotonnes per year, and are provided per emission type (e.g., per gas well).

(b) Equivalent CO_2 (ECO_2) emissions were calculated using greenhouse potentials of 1 for CO_2, 21 for CH_4 and 310 for N_2O per Olsen (2002).

(c) Two of the satellites include the emissions from an oil well located at a satellite and three of the satellites include the emissions from a gas well at a satellite.

(d) Data currently not available.

7.2.6.2 Planned Development Case Predictions

7.2.6.2.1 Sulphur Dioxide (SO_2)

The predicted Planned Development Case concentrations of SO_2 were estimated using the ISC3 dispersion model and five years of hourly meteorology from the MSC station in Fort Smith. Table 7.2-22 summarizes the maximum predicted ground-level SO_2 concentrations associated with the Planned Developed Case with mitigation measures implemented.

Table 7.2-22 Planned Development Case SO_2 Predictions

Parameter	Averaging Period		
	1-Hour	24-Hour	Annual
Regional Predictions			
maximum SO_2 [µg/m³]	448.4	149.5	20.4
distance to the maximum SO_2[a] [km]	11.8	4.6	9.3
direction to the maximum SO_2[a]	NW	NNW	N
Community Predictions			
Steen River, AB	15.0	1.3	0.0
Indian Cabins, AB	17.1	1.7	0.1
Kakiska, NT	18.3	1.2	0.0
Hay River, NT	8.6	0.5	0.0
Enterprise, NT	8.5	0.4	0.0
Trout Lake, NT	11.4	0.5	0.0
NT standard for SO_2 [µg/m³]	**450**	**150**	**30**

(a) Distance and directions presented in the table are relative to the central battery.

Graphical representation of the 1-hour, 24-hour and annual SO_2 predictions for the Planned Development Case with mitigation measures implemented are provided in Figure 7.2-19, 7.2-20 and 7.2-21.

7.2.6.2.2 Nitrogen Dioxide (NO_2)

The maximum 1-hour, 24-hour and annual ground-level NO_2 concentrations resulting from the emissions associated with Planned Development Case emissions were predicted using the ISC3-OLM dispersion model and five years of meteorological data from the MSC station in Fort Smith. The modelling results are summarized in Table 7.2-23. The maximum 1-hour, 24-hour and annual NO_2 predictions are below the federal acceptable NO_2 objectives of 400, 200 and 100 µg/m³, respectively.

Table 7.2-23 Planned Development Case NO_2 Predictions

Parameter	Averaging Period		
	1-Hour	**24-Hour**	**Annual**
Regional Predictions			
maximum NO_2 [µg/m³]	116	69	8
distance to the maximum NO_2[(a)] [km]	1.8	0.4	0.6
direction to the maximum NO_2[(a)]	NE	ESE	NNW
Community Predictions			
Steen River, AB	3.6	0.3	0.0
Indian Cabins, AB	5.4	0.6	0.0
Kakiska, NT	2.7	0.2	0.0
Hay River, NT	1.0	0.1	0.0
Enterprise, NT	1.3	0.1	0.0
Trout Lake, NT	1.8	0.1	0.0
Federal objective for NO_2 [µg/m³]	**400**	**200**	**100**

(a) Distance and directions presented in the table are relative to the central battery.

Graphical representations of the predicted maximum 1-hour, 24-hour and annual NO_2 ground-level concentrations for the Planned Development Case are provided in Figures 7.2-22, 7.2-23 and 7.2-24 respectively.

7.2.6.2.3 Other Air Quality Parameters

In the Planned Development Case, the majority of the well and produced gas that contains hydrogen sulphide (H_2S) is gathered and transmitted to a facility in Alberta. The small volume used as fuel are burned in engines, heaters and turbines that are effective at converting all of the H_2S present into sulphur dioxide (SO_2). The small volumes of gas produced by the pneumatic pumps are either flared or are vented into the methanol tanks. Flaring will convert virtually all of the H_2S present into SO_2, while the H_2S that is vented to the methanol tanks gets absorbed and is injected into the produced fluid.

It is expected that in the Planned Development Case, less than 0.0067 t/d of H_2S emissions — this is equivalent to 2% of the sulphur flared — will occur on a daily basis from all of the sources. This emission value is approximately 1.1% of the Planned Development Case SO_2 emissions from flaring. By applying this relationship to the maximum 1-hour SO_2 prediction of 448 µg/m³ (Table 7.2-22), a maximum 1-hour H_2S value of 4.9 µg/m³ would result. This maximum 1-hour H_2S value would occur if the maximum 1-hour SO_2 prediction of 448 µg/m³ was directly a result of a single flare. This value is less than 35% of the federal acceptable objective of 15 µg/m³.

The design of the Cameron Hills Project will minimize primary particulate emissions. In fact, primary particulate emissions from the Planned Development Case sources are estimated to be less than 0.02 t/d. Therefore, maximum 24-hour primary $PM_{2.5}$ concentrations are expected to be low and well below the NT Standard of 30 µg/m³. As for secondary aerosols the maximum predicted 24-hour secondary aerosol concentrations at communities in north eastern Alberta were approximately 8 µg/m³. However, this area also has more than 580 t/d of combined SO_2 and NO_X emissions (CNRL 2003). In contrast, the combined NO_X and SO_2 emissions from the Planned Development Case are less than 3t/d. Therefore, the secondary aerosols concentrations are expected to be too small to measure.

The potential for the Cameron Hills Extension Project, to contribute to acid deposition can be evaluated by comparing the Planned Development Case emissions to the emissions from the De Beers Snap Lake Diamond Project (De Beers 2002). Table 7.2-24 compares the overall emissions of acid forming compounds in the Planned Development Case with the emissions reported in the De Beers EIA. The maximum level of acidifying emissions from the Cameron Hills would be approximately 65% of the emissions from the De Beers development.

Table 7.2-24 Comparison of Planned Development Case Acid Forming Emissions

Descriptions	De Beers Snap Lake Diamond Project [a]	Cameron Hills Project Planned Development Case
SO_2 emissions [t/d]	0.17	2.30
NO_X emissions [t/d]	5.68	0.42
Acid forming compounds [t/d][b]	4.15	2.59

[a] Source: De Beers 2002.

[b] Acid forming compounds are the sum of the SO_2 and 70% of the NO_X emissions. This accounts for the slightly lower acid forming potential of NO_X emissions.

Given that the acidifying emissions from Cameron Hills are lower than from Snap Lake, it is also reasonable to assume that the PAI levels resulting from the Planned Development Case emissions would be lower than those predicted in the De Beers EIA. It is also reasonable to infer that the areas with elevated PAI levels (i.e., above 0.17 keq/ha/yr) at Cameron Hills would be smaller than at Snap Lake and that they would be restricted to an area that would lie fully within the Cameron Hills SDL. It should also be noted that the emission sources at Cameron Hills are distant from each other. In contrast, sources at Snap Lake are located close together, resulting in a concentrated area of elevated acid deposition in the mine site. Since the Cameron Hills sources are dispersed, it is likely that deposition rates of acid forming compounds will be lower than those predicted at Snap Lake.

7.2.6.3 Planned Development Case Mitigation

Paramount will design the project to ensure compliance with relevant NT standards and federal objectives. This will be accomplished using the following mitigation measures:

- avoid venting any gas to the atmosphere that contains hydrogen sulphide (H_2S);
- well and produced gases are used as fuel to minimize GHG emissions, where possible;
- virtually all of the well and produced gas that is used as fuel is burnt in engines, compressors or turbines that effectively convert all of the H_2S present into SO_2;
- stack heights are of a sufficient height to ensure that predicted SO_2 concentrations are less than the NT standards;
- reducing the flow rate through a down hole choke;
- using propane as fuel at the wells;
- using sweet gas as fuel at the wells;

- using electrical power at oil wells and satellites; and
- using sweet fuel at the battery.

7.2.6.4 Planned Development Case Impact Assessment

The project as modelled in the Planned Development Case will result in an increase in air emissions and a resulting increase in ambient concentrations relative to the pre-development conditions (i.e., the Environmental Setting). The residual air quality impacts associated with the Planned Development Case have been classified using the criteria described in Section 7.2.3.6. These parameters were then combined to yield the overall environmental consequence values listed in Table 7.2-25.

Of the nine air quality indicators evaluated for the Planned Development Case, three were classified as having a "low" environmental consequence and six were classified as having a "negligible" environmental consequence.

Table 7.2-25 Planned Development Case Classification of Air Quality Impacts

Parameter	Direction	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Environmental Consequence
1-hour SO_2[(a)]	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour SO_2[(a)]	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Annual SO_2[(a)]	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)
1-hour NO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour NO_2	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Annual NO_2	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)
1-hour H_2S	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
24-hour $PM_{2.5}$	negative	low (+5)	medium-term (+2)	medium-term (+1)	local (0)	reversible (-3)	negligible (5)
Acid Deposition	negative	low (+5)	medium-term (+2)	high (+2)	local (0)	reversible (-3)	low (6)

Note: The magnitude is based on changes relative to the Environmental Setting.

(a) The environment consequence was determined based on the results of the Planned Development Case (mitigated fully developed) SO_2 predictions presented in Table 7.2-22.

7.3 SOIL AND TERRAIN

This section addresses Sections G-2 and G-3 of the MVEIRB ToR:
This section should include impacts on permafrost.

7.3.1 Environmental Setting

7.3.1.1 Physiography, Soil and Terrain

Because they are slow to change, the terrain and soil of the Cameron Hills in the Environmental Setting case is expected to be similar to that described in previous EIAs (Golder and Alpine 2001). The Cameron Hills physiographic region consists of an upland plateau, elevated above the Northern Alberta Lowlands along the south and east sides, and the Great Slave Plain along the north side. The plateau extends southerly into northern Alberta (Hardy BBT Limited 1991).

The plateau is elongated and irregular in outline, with its long axis trending nearly east-west. The north and east sides of the plateau are defined by escarpments and aprons which rise up at comparatively gentle to moderate slopes above the surrounding lowland. The plateau becomes less defined to the south and west, with increasing distance from its apex at the north-east corner, as both the surface elevation declines and the escarpment slopes flatten. Swamps and bogs occupy shallow, often elongated low and broad u-shaped swales, and sometimes connect with larger, more incised drainage channels (Golder 1999).

The Cameron River flows southwesterly from its headwaters near the plateau high point, and continues through the middle of the plateau within a relatively wide, subdued floodplain before turning north, where it forms a valley approximately 300 m deep. The terrain north of the river is rolling or undulating with comparatively steep slopes. The terrain south of the river is generally more subdued, and comprised of extensive lakes and lowlands.

Surface materials consist of bedrock, glacial drift, and postglacial sediment. The rock outcropping in the Cameron Hills area consists exclusively of undifferentiated shale, sandstone, and siltstone comprising the Fort St. John Group. Glacial deposits consist mostly of moraine (till) deposited during the Wisconsin advance. Two distinct surface forms comprising till, or till and bedrock have been delineated within the study area: ground moraine or ablation moraine that blankets or veneers the underlying bedrock surface; and streamlined or fluted till and bedrock. Post-glacial deposits include stream and river alluvial material, commonly in the form of fans, particularly along the plateau margins or as point-bars in the streams and the Cameron River. The abrupt plateau margins are often characterized by colluvial material as noted along the east and north edges (Morris 1970); likely a result of freeze and thaw processes operating within the uplands. Organic-rich and clayey lacustrine sediments characterize the extensive, often water-covered, low lying terrain within the Cameron Hills (Hardy BBT Ltd. 1991).

Previous soil surveys (Golder and Alpine 2001) characterized soils based on representative vegetation communities identified in the project area. Soils within wetland communities are generally Rego Gleysols (shallow peats), Organics, or if permafrost is present these soils are Organic Cryosols. Most of the peat accumulation is relatively shallow (less than 1 m) and is typically underlain by glaciolacustrine deposits (heavy clay). Upland soils vary, depending on the moisture regime and the forest humus layer present. In coniferous stands, soils are typically coarse textured Eutric Brunisols. In well drained aspen-pine stands, finer textured Eutric Brunisols are dominant. The texture of the soils was predominantly clay and fine sand, with the occurrence of stones generally beingless than 30%.

The soil and terrain classification in the Terrestrial Study Area (TSA) is illustrated in Figures 7.3-1 and 7.3-2 respectively.

7.3.1.2 Permafrost Potential

The occurrence of permafrost in the Cameron Hills is characterized as "discontinuous sporadic" which indicates that the permafrost underlies approximately 10% to 50% of the area (Wolfe 1998). The distribution and thickness of permafrost is affected by factors such as climate, topography, vegetative cover, winter snow accumulation, hydrological conditions, subsurface geology and ground disturbance. Once thawing has occurred, sensitivity of any site to disturbance may vary depending on ice content of the soil, soil type, drainage and vegetative cover. Permafrost in the project area is expected to be confined to thick, poorly drained, organic bogs and "speckled bog", generally indicative of degrading permafrost. Pipeline construction over the past two winters in the Cameron Hills shows that it is sometimes difficult to pinpoint exactly where permafrost exists within a landscape until it is disturbed. A section of permafrost can be encountered to the depth of the trench and ten metres away no permafrost is present. In most cases, sharp heaves usually indicate the presence of permafrost. Permafrost can also be variable in depth within an area.

Depressional topography, high moisture content, dense vegetation cover, and thickness of surface organic matter have a negative effect on soil temperature. Snow cover can also have an insulating effect (Tarnocai 1984). The role of snow in maintaining the high ground temperature is very important and ground snow cover control possibly provides a means of reducing ground temperatures (Judge 1973).

Based on the terrain mapping, and considering the permafrost areas reported during the permafrost monitoring program (Golder 2002a), the permafrost potential was mapped in the TSA (Figure 7.3-3). Bogs were rated as having a moderate potential for permafrost, moraine and fens were rated as having a low potential, and glaciofluvial/fluvial deposits were rated as having a negligible potential.

7.3.2 Methods

7.3.2.1 Spatial and Temporal Boundaries

The TSA boundary was determined in conjunction with the vegetation and wildlife disciplines to ensure that it was appropriate in size in an ecological context. In addition, the TSA boundary was selected to support a CEA of the soil and terrain impacts of all existing, approved and planned projects outlined for the various cases.

The temporal boundaries of the CEA are the timeframes for the various Development Cases discussed in Section 7.1.1.2.

7.3.2.2 Valued Ecosystem Components

The soil and terrain VECs were selected based on sensitivity to disturbance and/or overall ecological and social importance in the area, and the rationale for their selection is outlined in Table 7.3-1.

Table 7.3-1 Soil and Terrain Valued Ecosystem Components

EIA Component	VEC Selected	Rationale
Terrain	Area of disturbance Permafrost potential	Indicates total area affected TSA contains discontinuous permafrost once disturbed, permafrost terrain can melt and cause slumping and erosion
Soil	Area of disturbance Soil erosion	Indicates total area affected Once disturbed, soils can erode until revegetated

7.3.2.3 Potential Impacts to Soil and Terrain in the Terrestrial Study Area

Activities can result in the direct loss or alteration of soil units in the TSA. Surface soil will be salvaged for future reclamation operations when appropriate to meet the approval requirements. These disturbances will be progressively reclaimed, which minimizes impacts to soils. However, there is expected to be a net increase in surface disturbance associated with the project.

Terrain features can be altered in the TSA as a result of project activities. Topography, site elevation and drainage patterns can be altered at the local scale (e.g., within a lease). Because the topography of the TSA varies from level to rolling, localized cut and fill is expected to be necessary in constructing some facilities. Implementing progressive reclamation is expected to yield short- to moderate- term disturbances to terrain.

Soil erosion is a process involving soil movement from one area to another by wind and water. Soil erosion can result in alteration or loss of soil quality, a process that can subsequently affect vegetation growth. If activities in the TSA result in vegetation removal, thereby exposing the soil, the probability for erosion would likely increase. Mineral soils will be more at risk because they are on upland topography and can have sandy soil textures.

Erosion risk in the TSA is considered to be low when there is a vegetative cover. After disturbance, the risk of wind and water erosion will increase. The risk of wind erosion depends on soil texture, moisture and organic matter content, with sandy soils having a higher risk. Water erosion risk increases where slopes are present and fine-textured subsoils underly coarse-textured soils.

Field experience has shown that the fine textured soils which underlie the organic mat are highly susceptible to water erosion when the mat is removed. There are areas in the project area which are saturated with water and pipeline construction through these areas can trigger water movement down the pipeline ROW from undefined drainages, springs, and existing seismic lines. This can make it difficult to predict where to establish water control structures on the ROW. Construction of the ROW adjacent to an existing seismic line or winter road may result in water erosion problems. When the pipeline is constructed along existing disturbed areas additional water can easily find its way into the trench, potentially causing erosion. Existing diversion ditches constructed on seismic lines and winter roads can bring water into the pipeline trench.

7.3.2.3.1 Seismic

Winter seismic activities will have limited potential impacts to soil and terrain, due to frozen ground conditions and snow cover. Summer seismic activities are not planned, however if implemented, would be expected to have the potential to lead to direct loss or alteration of soil units, due to disturbance (e.g., admixing, rutting). Creation of seismic lines have the potential to alter local thermal regimes and alter permafrost areas. Because ground cover is not usually disturbed, there will be a low increase in erosion risk.

7.3.2.3.2 Drilling

Well pad construction has the potential to disturb soil and terrain resources, depending on local conditions and construction techniques. Where conducted, removal of organic material, leveling and pad development would be expected to alter soil and change local topography. Progressive reclamation would minimize disturbances as wells are decommissioned. If exposed areas of mineral soil result from the construction of a well pad, this would be expected to increase erosion risk. It should be noted that the risk of erosion is managed with diversion berms, silt fences, matting and reseeding.

7.3.2.3.3 Flow-lining

Flow-line construction is predicted to result in the direct loss or alteration of soil units and terrain. Cut and fill may be required during construction, thereby altering local topography. The linear nature of these developments and the disturbance to vegetation can increase erosion risk when located on slopes, and warrants appropriate mitigation measures that have proven to be effective. Where appropriate and feasible, separate handling of topsoil material will be required for use in reclamation. Prompt reclamation and revegetation of disturbed areas has proven effective in minimizing these potential impacts.

7.3.2.3.4 Facilities

Facility construction is predicted to result in the direct loss or alteration of soil units and terrain. Cut and fill may be required during construction, thereby altering local topography. Erosion risk may increase following construction as the vegetation and soil will be removed, but primarily where slopes are present. Separate handling and stockpiling of topsoil material will be required for use in reclamation. Prompt reclamation and revegetation of disturbed areas is expected to minimize these potential impacts.

7.3.2.3.5 Production

Production operations can impact soil character resulting from accidental spills, and the terrain soil can be affected in wet areas where summer access is achieved with ATVs. It is Paramount's first priority to prevent spills, which are otherwise mitigated through early detection and expeditious clean-up to ultimately yield negligible impacts to soil.

Wet areas, susceptible to disturbance are protected with the use of wide tires on ATVs, yielding low ground pressure, and plank bridges in extreme cases. The effects to soils in wet areas is typically localized rutting, admixing or increased silt release, depending on the type of wet area crossed.

Acidification of soils can occur when annual concentrations of SO_2 and NO_2 are sufficiently high that they result in the deposition of acid forming compounds to the soil. Such conditions are typically a concern in areas with extensive development and high industrial emissions that occur throughout the year. Given that the project has been designed to meet the NT Air Quality Standards, no residual impacts to soil resulting from air emissions are predicted.

7.3.2.4 Soil and Terrain Cumulative Effects Assessment Methods

7.3.2.4.1 Soil and Terrain Mapping

Soil and terrain mapping for the TSA were undertaken by converting Landsat vegetation classification to soil map units. This conversion was aided by utilizing surficial geology and soil information for the area (Golder 1999, Golder and Alpine 2001).

Terrain units for the TSA were derived by combining soil map units of similar genetic materials as shown in Table 7.3-2.

Table 7.3-2 Correlation of Soil Units to Terrain Units in Terrestrial Study Area

Soil Great Group	Terrain Unit
Eutric Brunisol (fine), Rego Gleysol	Moraine
Eutric Brunisol (coarse)	Glaciofluvial/fluvial
Organic	Fen
Organic Cryosol	Bog

Soil and terrain units directly affected by the various Development Cases were quantified by GIS analysis, using the following process:

- the GIS quantified areas of soil and terrain map units within the TSA for the Environmental Setting, Baseline, Application and Planned Development Cases;
- the cumulative soil and terrain disturbances were calculated for each Case; and
- impact ratings were determined based on the cumulative disturbance within the TSA.

The permafrost issues were quantitatively evaluated as follows:

- each terrain unit in the TSA was rated for permafrost potential;
- the cumulative area of terrain with a moderate permafrost potential (bogs) was calculated for each Case; and,
- impact ratings were determined based on the cumulative area of disturbance to moderate permafrost potential in the TSA for each Case.

The soil erosion issues were quantitatively evaluated as follows:

- organic soils (Organic, Organic Cryosol) were assumed to have a negligible soil erosion risk when disturbed;
- mineral soils (Eutric Brunisols, Rego Gleysols) were assumed to have increased erosion risk for the short-term when disturbed;
- impact ratings were determined based on cumulative area disturbance to mineral soils in the TSA for each Case.

7.3.3 Results

7.3.3.1 Impact Analysis

This section analyzes the cumulative effects of all Paramount's activities on soil and terrain for the Baseline Case, Application and Planned Development versus the Environmental Setting Case.

7.3.3.1.1 Disturbance of Soil and Terrain Units

A cumulative total of 2,093 ha (2.2 %) of the soil and terrain units in the TSA are predicted to be disturbed by Paramount's activities (Tables 7.3-3 and 7.3-4). The Baseline Case is responsible for the largest incremental disturbance (2.0%) relative to the Environmental Setting Case, with the Application Case and Planned Development Case, each contributing approximately 0.1%.

The largest cumulative disturbance for soils is to Rego Gleysols (788 ha, 0.8% TSA), while the primarily impacted terrain unit is moraine (900 ha, 0.9% TSA). With complete reclamation of all disturbed lands following final reclamation, there will be no net loss in soil and terrain units.

Table 7.3-3 Cumulative Loss/Alterations to Soil in the Terrestrial Study Area

Soil Great Groups	Environmental Setting		Baseline Case		Application Case		Planned Development Case	
	ha	% TSA	ha	% TSA	ha	% TSA	ha	% TSA
Eutric Brunisol (coarse)	19,847	20.7	386	0.4	389	0.4	432	0.4
Eutric Brunisol (fine)	7,061	7.3	106	0.1	107	0.1	112	0.1
Organic	6,501	6.8	133	0.1	135	0.1	143	0.2
Rego Gleysol	34,643	36.1	720	0.7	735	0.8	788	0.8
Organic Cryosol	21,996	22.9	510	0.5	517	0.5	554	0.6
Other (water, clouds, bare ground)	6,183	6.4	63	<0.1	63	<0.1	64	<0.1
Disturbed	0	0	1,918	2.0	1,946	2.0	2,093	2.2
Undisturbed	96,231	100	94,313	98.0	94,285	98.0	94,138	97.8

Table 7.3-4 Cumulative Loss/Alterations to Terrain Units in the Study Area

Terrain Units	Environmental Setting		Baseline Case		Application Case		Planned Development Case	
	ha	% TSA	ha	% TSA	ha	%TSA	ha	% TSA
Bog	21,996	22.9	510	0.5	517	0.6	554	0.6
Fen	6,501	6.8	133	0.1	135	0.1	143	0.2
Glaciofluvial / fluvial	19,847	20.7	386	0.4	389	0.4	432	0.5
Moraine	41,704	43.4	826	0.9	842	0.9	900	.9
Other (Clouds, water, bare ground)	6,183	6.4	63	<0.1	63	<0.1	64	<0.1
Disturbed	0	0	1,918	2.0	1,946	2.1	2,093	2.2
Undisturbed	96,231	100	94,313	98.0	94,285	98.0	94,138	97.8

The cumulative disturbance of terrain with a moderate permafrost potential is small (554 ha, 0.6% TSA) as shown in Table 7.3-5. The disturbance of soils rated with a low or negligible permafrost potential is not considered an issue for terrain stability.

Table 7.3-5 Cumulative Changes in Permafrost Potential in the Study Area

Permafrost Potential	Environmental Setting		Baseline Case		Application Case		Planned Development Case	
	ha	% TSA	ha	% TSA	ha	%TSA	ha	% TSA
Moderate	21,997	23.0	510	0.5	517	0.5	554	0.6
Low	48,010	49.9	956	1.0	974	1.0	1,040	1.1
Negligible	20,245	21.1	389	0.4	392	0.4	435	0.5
Other (clouds, water, bare ground	6,183	6.4	63	<0.1	63	<0.1	66	<0.1
Disturbed	0	0	1,918	2.0	1,946	2.0	2,093	2.2
Undisturbed	96,231	100	94,313	98.0	94,285	98.0	94,138	97.8

7.3.3.1.2 Residual Impact Classification

The environmental consequence of loss/alteration of soil and terrain units, soil erosion and permafrost potential is rated as negligible for all Cases (Table 7.3-6). This is due to the small cumulative soil and terrain disturbances from all Cases (maximum of 2,093 ha, only 2.2% of the TSA), and the adoption of progressive reclamation throughout the life of the project that is expected to return the disturbed areas to an equivalent capability. The negligible environmental consequence also assumes the implementation of planned mitigation outlined in Section 3.2.

The probability of occurrence of the impacts is rated as high for the Baseline Case, high for the Application Case, and moderate for the Planned Development Cases. The high probability of the Baseline and Application Cases is related to the fact that the disturbances are already present, or are planned to be completed in the winter of 2003/2004. The moderate probability for the Planned Case relates to the uncertainty of the final number and/or location of wells, and the subsequent gathering system routes.

Table 7.3-6 Residual Impact Classification for Soil and Terrain

Parameter	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Environmental Consequence
Baseline Case							
Soil disturbance	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Soil erosion risk	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Terrain disturbance	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Permafrost potential	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	negligible (+1)
Application Case							
Soil disturbance	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Soil erosion risk	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Terrain disturbance	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Permafrost potential	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	negligible (+1)
Planned Development Case							
Soil disturbance	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Soil erosion	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Terrain disturbance	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	low (+6)
Permafrost potential	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	low (0)	negligible (+1)

7.3.4 Summary

All impacts are predicted to be negligible for soil and terrain for the Development Cases evaluated for this report. The maximum disturbed area is 2,135 ha (2.2% of the TSA) for the Planned Development Case. Prompt reclamation using stockpiled topsoil and revegetation are the primary mitigations for soil and terrain impacts. It should be noted that the disturbance areas discussed in this section refer to the maximum cleared areas, and not all of these areas will be subjected to direct soil or terrain disturbance. For example, within a pipeline ROW, only the trench line (approximately 2 m wide) would be subjected to direct disturbance during installation of the pipeline, while the remainder of the ROW receives minimal to no disturbance to the soil. As such, this report represents the worst case scenario.

The impacts of the Baseline Case have a high probability since they already exist. The impacts predicted for the Application Case and the Planned Development Case are moderate, since there is uncertainty about the number and the timing of developments in the region.

For the Far Future scenario, the soil and terrain of the TSA is expected to remain similar to that described for the Environmental Setting Case. This judgment is based on the mitigation plans outlined by Paramount, and the limited disturbance area.

7.4 SURFACE WATER

This section addresses Section G-4 of the MVEIRB ToR:
This section should include impacts on surface and ground water, in terms of quantity and quality.

7.4.1 Introduction

The Aquatics Study Area (1,987 km^2) for the cumulative effects assessment includes the Cameron River watershed (1,387 km^2) that drains northward to Tathlina Lake and the watershed of a small unnamed creek (600 km^2), that drains south from Cameron Hills to Hay River (see Figure 7.1-2). Surface water quantity and quality are to a large extent controlled by hydrologic and hydraulic characteristics (such as flows in waterbodies in rivers and streams and water balances in lakes), which determine the assimilative capacity of the particular watercourse or waterbody for contaminants from natural and anthropogenic sources, as well as suitability of a particular water resource to support ecological functions. As used in this report, the term waterbody or waterbodies refers to various surface waterbodies in the project area including lakes, rivers, streams, creeks, and wetlands.

7.4.2 Environmental Setting

The Environmental Setting is defined as the pre-development surface water conditions, i.e., before oil and gas development began in 1960. In many cases, environmental data before this date is not available. In such cases, data from the Baseline Case is used and is considered to be representative of the Environmental Setting.

The Environmental Setting provides a basis for quantifying and comparing changes due to future development activities in the Aquatics Study Area.

7.4.2.1 General Surface Water Features

The Cameron River is the largest river and a major physical feature within the study area. The river originates in the northeast quadrant of the plateau, flows southwest through the middle before turning north to flow off of the hills and into Tathlina Lake. The upper and lower areas of the Cameron River watershed, which account for approximately 90% of the river's watershed area, are nearly level wetland areas, while the middle watershed area is steeper. South of the Cameron River, relief is minimal and numerous irregular shaped lakes are common. The lakes are often shallow and are typically interconnected by streams to form extensive wetlands.

An Unnamed Creek also provides surface drainage in the Aquatics Study Area (ASA), flowing to the south into the Hay River. The upper and lower areas of the Unnamed Creek watershed, which together account for about 80% of the creek's watershed area, are nearly level wetland areas, while the middle of this watershed area is steeper. The mean elevations of the Cameron River watershed and the Unnamed Creek watershed are approximately 670 m above sea level (masl) and 620 masl, respectively.

7.4.2.2 Climate

Climatic factors are important considerations for defining the surface water conditions, because climatic variables such as air temperature and precipitation significantly affect basin runoff characteristics and streamflows. Climatic variables that have been characterized include air temperature, precipitation and lake evaporation. Historical climatic records were obtained from the Atmospheric Monitoring Division of Environment Canada.

7.4.2.2.1 Air Temperature

The Cameron Hills development is located in an area with a Sub-arctic climate typified by short warm summers and long cold winters. Environment Canada long-term regional climate monitoring stations are located at the Hay River Airport, Fort Smith Airport, Fort Liard Airport, and Fort Simpson Airport as shown in Figure 7.4-1. The Fort Smith Airport climate station was chosen as the surrogate station for the hydrologic assessment for the following reasons:

- the Fort Smith Airport climate station is located approximately 250 km from the project area and provides more than 50 years of data;
- the Fort Liard Airport and Fort Simpson Airport climate stations are closer to the project; however the recorded data at these stations were considered to be less representative of the meteorological conditions at the Cameron Hills site due to the close vicinity of the climate stations to the Rocky Mountains; and
- the recorded air temperature data at Fort Smith Airport and Hay River Airport climate stations are similar, however, the Fort Smith Airport climate station provides a more complete set of climatic data.

Table 7.4-1 presents the statistics of the monthly air temperatures at the Fort Smith Airport climate station. The mean monthly temperature in January, which is the coldest month, is -25°C, while the daily minimum is -31°C and the daily maximum is -20°C. Average temperatures are at, or above, freezing from May through October.

Table 7.4-1 Recorded Air Temperatures at the Fort Smith Airport Climate Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Fort Smith Airport (normals), 203 masl													
Daily Minimum (°C)	-30.5	-27.4	-21.3	-7.9	1.4	7.4	9.8	7.8	2.3	-3.8	-16.9	-26.3	-8.8
Mean Monthly (°C)	-25.4	-21.2	-14.0	-1.4	8.1	14.0	16.3	14.3	7.6	0.4	-12.6	-21.7	-3.0
Daily Maximum (°C)	-20.3	-15.2	-6.9	5.0	14.7	20.6	22.7	20.7	12.9	4.5	-8.5	-17.2	2.7

7.4.2.2.2 Precipitation

Precipitation recorded at the Fort Smith Airport climate station is assumed to be representative of precipitation in the Aquatics Study Area. Though Cameron Hills area is expected to have higher precipitation than the recorded precipitation at the Fort Smith Airport climate station because it is approximately 400 to 500 m higher in elevation, the use of Fort Smith precipitation leads to a conservative estimate of precipitation for this assessment.

The Fort Smith Airport climate station averages 353 mm of precipitation annually (231 mm rainfall and 122 mm of snowfall). The maximum monthly precipitation occurs in July and the minimum precipitation occurs in February, March and April. Table 7.4-2 presents the monthly precipitation (rainfall and snowfall) statistics.

Table 7.4-2 Recorde d Precipitation at the Fort Smith Airport Climate Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Fort Smith Airport (1963 to 1990), 203 masl													
Rainfall (mm)	0.0	0.0	0.1	3.6	25.2	45	56.8	48.9	37.7	12.2	1.0	0.4	231.2
Snowfall (mm)	19.9	14.3	13.8	9.9	4.0	0.3	0.0	0.2	0.8	15.9	24.2	18.8	121.7
Precipitation (mm)	19.9	14.3	13.9	13.5	29.2	45.3	56.8	49.1	38.5	28.1	25.2	19.2	352.9

7.4.2.2.3 Lake Evaporation

There is limited long-term recorded evaporation data in the regional area. A few long-term climate stations such as Fort McMurray Airport climate station and Norman Wells climate station record the necessary climate data including air temperature, humidity and solar radiation to enable estimation of lake evaporation by modeling. An example of a lake evaporation model is the Morton's Complementary Relationship Lake Evaporation model (Morton et al. 1985).

Recent lake evaporation estimates for the ice-free season, which is typically from June to September, in Alberta and NT include a mean annual lake evaporation estimate of 275 mm at Lac de Gras NT (Golder 1996), 413 mm at Fort McMurray Airport climate station (Golder 2002b), 335 mm at Inuvik climate station and 417 mm at Norman Wells climate station (Golder 2002c). In comparison with annual precipitation on the order of 300 mm, these values are relatively high. Based on these regional lake evaporation rates, the annual lake evaporation rate for the shallow ponds in the Aquatics Study Area is assumed to be about 350 mm.

7.4.2.3 Stream Flows and Basin Water Yields

The significant water bodies in the Aquatics Study Area include the Cameron River, the Unnamed Creek (tributary to Hay River) and a number of lakes located in the flat upper watersheds (wetland area) of Cameron River and Unnamed Creek. Since there are no hydrometric gauging stations located in the Aquatics Study Area, an analysis of the regional recorded flows is required to estimate flows in the Cameron River and Unnamed Creek.

A regional analysis of mean annual flows was conducted based on stream flow records from the Environment Canada hydrometric stations located within 150 km of the Aquatics Study Area and having drainage areas of less than 4,500 km^2. The locations of the selected hydrometric stations are shown in Figure 7.4-1. Table 7.4-3 lists the selected Environment Canada hydrometric stations with their station names and numbers, coordinates, drainage areas, periods of record and annual water yields.

The table shows a wide variation in annual water yield varying from 60 to 216 mm. This wide variation is a reflection of the differences in the hydrological responses in these basins. For example, the watersheds of Steen River (2,610 km^2) and Whitesand River (3,410 km^2) are fairly comparable in drainage areas, but have contrasting annual water yields of 68.4 mm for Steen River and 216 mm for Whitesand River. An examination of their watershed characteristics show that the Steen River watershed is about 85% wetland area while the Whitesand River watershed is better drained with about 35% wetland areas.

Table 7.4-3 Summary of Regional Annual Water Yields for Selected Environment Canada Hydrometric Stations

Station Name	Distance from Study Area (km)	Station Number	Station Location		Drainage Area (km^2)	Period of Record	Estimated Annual Water Yield[a]	
			Latitude North	Longitude West			(m^3/s)	(mm)
Lutose Creek near Steen River	44.7	07OB006	59.41	117.28	292	1977 to 2001	0.55	59.9
Jackpine Creek at Wadlin Lake Road	145	07JD003	58.19	115.75	582	1971 to 2001	1.78	96.5
Sousa Creek near High Level	129	07OA001	58.59	118.49	819	1970 to 2001	1.61	62.0
Ponton River Above Boyer River	116	07JF003	58.46	116.26	2,440	1962 to 2001	10.34	134
Steen River near Steen River (Town)	32	07OB004	59.57	117.20	2,610	1974 to 2001	5.66	68.4
Whitesand River near AB/NT Boundary	79	07PA002	60.00	115.58	3,410	1986 to 1994	23.38	216
Buffalo River near AB/NT Boundary	138	07PC001	60.01	114.53	4,350	1987 to 1994	23.74	172

(a) assumed zero winter flows at stations with no monitoring data in the winter months.

The Cameron River and the Unnamed Creek watershed characteristics are similar to those of the Steen River watershed. This similarity provides a basis for deriving the basin annual water yield statistics for the Cameron River and the Unnamed Creek. Table 7.4-4 shows the derived annual water yields for the two watersheds for the 10-year wet, 100-year wet, 100-year dry, 10-year dry, and average hydrological conditions.

Table 7.4-4 Derived Annual Water Yields for Cameron River and Unnamed Creek

Station Name	Drainage Area (km^2)	Annual Water Yield (m^3/s)				
		100 year wet (167 mm)	10 year wet (119 mm)	Average (68 mm)	10 year dry (26 mm)	100 year dry (7 mm)
Steen River	2,610	13.8	9.8	5.4	2.12	0.57
Cameron River[(a)]	1,387	7.3	5.2	3.0	1.1	0.3
Unnamed Creek[(a)]	600	3.2	2.3	1.3	0.5	0.1

(a) annual water yields were derived based on a linear relationship between Steen River drainage area and water yield.

7.4.2.4 Water Source Lakes

There are four lakes in the study area that have been identified as potential water sources for road and wellsite construction, drilling process, and operation of wells. Because the lakes are unnamed they are called Lake 1, Lake 2, Lake 3 and Lake 4, and are shown in Figure 7.4-2.

Three of the proposed water source lakes are connected to the Cameron River:

- Lake 1 is connected by a small stream to two small, unnamed lakes to the north, and then ultimately connected to the Cameron River via a small stream. The distance from Lake 1 to the Cameron River is approximately 9.1 km.
- Lake 2 is connected to a small, unnamed lake 0.8 km to the north which has a stream exiting its northwest corner that is a small tributary to the Cameron River. The distance from Lake 2 to the Cameron River is approximately 4.0 km.
- Lake 4 has a stream that exits from the southern end, which leads into a tributary of the Cameron River. The distance from Lake 4 to the Cameron River is approximately 10.5 km.

Lake 3, which has been used previously as a water source by Paramount, is not connected to the Cameron River or any of its tributaries. It eventually drains to Johnson Lake, which is located in the Unnamed Creek watershed to the south. Available information on the lake parameters is provided in Table 7.4-5.

Based on discussions with DFO (Bruce Hanna, pers. comm.2002), an ice thickness of 1 m was determined to be applicable to lakes in the Cameron Hills. As such, Lakes 1, 3, and 4 can be used for water sources. Information on Lake 1 is provided below, to model the worst-case scenario where all water could be obtained from Lake 1. However, Paramount intends to use Lakes 1, 3, and 4 for water.

Table 7.4-5 Water Source Lakes

Water Source	Mean Depth (m)	Approximate Maximum Depth (m)	Surface Area (ha)	Total Storage (m^3)	Storage Under 1 m of Ice Cover (m^3)	Usable Storage Under 1 m of Ice Cover (m^3)[(a)]	Storage Under 2 m of Ice Cover (m^3)	Usable Storage Under 2 m of Ice Cover (m^3)[(a)]
Lake 1	1.33	3.0	874.9	11,662,250	4,632,793	231,640	1,328,000	66,400
Lake 2	0.60	1.0	7.2	43,000	538	27	0	0
Lake 3 (Previously Used by Paramount)	0.59	1.4	94.4	562,030	29,254	1,463	0[(b)]	0[(b)]
Lake 4	2.43	6.0	14.5	352,738	228,110	11,406	136,725	6,836

(a) 5% of existing storage as per DFO guidelines.

(b) Lake #3 was deemed to have no overwintering fish habitat as it was expected to freeze to the bottom, therefore the DFO water withdrawal volume restrictions were relaxed.

7.4.3 Lake 1 Water Balance

The main hydrologic parameters for the Lake 1 water balance based on the derived climatic and hydrologic conditions for the Aquatics Study Area are presented in Table 7.4-6.

Table 7.4-6 Main Hydrologic Parameters of Lake 1

Parameter	Value
mean lake water level	742 masl.
lake surface area	8.75 km^2
contributing drainage area	14.3 km^2
estimated mean annual precipitation onto the lake surface	353 mm (0.098 m^3/s)
estimated mean annual lake surface evaporation	350 mm (0.097 m^3/s)
estimated mean annual net lake surface evaporation	3 mm (0.0008 m^3/s)

assumed mean annual percolation loss to basal aquifer	0 mm (0 m^3/s)
estimated mean annual basin runoff inflow	68 mm (0.031 m^3/s)
estimated mean annual lake outflow	43 mm (0.030 m^3/s)

During the average hydrological conditions, estimated mean basin runoff inflow is 0.031 m^3/s, estimated net annual lake evaporation is 0.0008 m^3/s and mean lake outflow is estimated to be 0.030 m^3/s. It is expected that the lake will be replenished annually with runoff from snowmelt and rainfall.

7.4.3.1 Water Quality

No water quality data is available for the study area prior to the commencement of oil and gas development activities in the 1960s. Additionally, limited water quality data has been collected in the project area since this time. This section presents a summary of the available water quality data for the Cameron River. In addition, regional water quality data are summarized, in order to provide an indication of trends in key water quality parameters in regional waterbodies near the project area.

The only available site-specific water quality data were obtained during a fisheries assessment survey in 2000 (Western and Golder 2000). Standard water quality parameters (pH, temperature, conductivity and dissolved oxygen) were measured at 3 sites along the Cameron River measured on July 10, 2000. Water temperatures ranged from 16 to 17°C. The pH ranged from 8.0 to 8.1. Conductivity values ranged from 116 to 138 µS/cm and dissolved oxygen concentrations varied from 8.8 to 9.4 mg/L. These results fall within the range of water quality conditions for regional waterbodies (DIAND 2003). No other water quality data for the Cameron River or for lakes in the Aquatics Study Area are available.

More extensive regional water quality baseline data are available as a result of water quality sampling conducted by DIAND in a number of waterbodies to the north and west of the project area from the early 1980s to 2002 (DIAND 2003). The available water quality data (sampling conducted at a single station in the Kakisa River) are summarized here, in order to provide an indication of observed water quality conditions near the project area and to provide some context to predicted future impacts on water quality at the site. Table 7.4-7 presents a summary of the available water quality data for the Kakisa River (DIAND 2003).

Table 7.4-7 Water Quality Summary Statistics for Kakisa River at Highway 1 Bridge (1982-2002)[(a)]

Parameter	Units	Min	Max	Mean	Median	CCME Guidelines[(b)]	
						Drinking Water	Aquatic Life
General							
pH	pH units	6.95	8.37	8.02	8.09	(6.5-8.5)	6.5-9.0
Conductivity	µS/cm	2.5	401	244.35	250		
Turbidity	TCU	1.2	85	18.4	11.4	1(<5)	
Colour (CU)	mg/L	5	150	38.75	30	(<15)	
TSS	mg/L	3	184	23.5	15		
TDS Residue	mg/L	148	251	181.45	180	(<500)	
Hardness	mg/L	101	238	129.69	125		
Alkalinity	mg/L	81.5	185	110.01	109		
Major Ions							
Calcium	mg/L	26.9	75.3	38.73	36.7		
Chloride	mg/L	1	5.3	1.91	1.8	(<250)	
Magnesium	mg/L	6.8	12.1	8.06	7.9		
Potassium	mg/L	0.8	3.7	1.4	1.23		
Sodium	mg/L	3.3	7.55	4.69	4.57	(<200)	
Sulphate	mg/L	10	33	19.72	19	(<500)	
Nutrients							
Ammonia (N)	mg/L	0.002	0.077	0.023	0.02		5.38
Nitrate-Nitrite	mg/L	0.008	0.18	0.03	0.02		
Kjeldahl (N)	mg/L	0.27	0.78	0.426	0.37		
Total Phosphorous	mg/L	0.002	0.12	0.037	0.03		
Total Metals							
Arsenic	µg/L	0.3	7.4	1.164	1	25	5
Cadmium	µg/L	0.05	5	0.304	0.15	5	0.033
Chromium	µg/L	0.2	13.5	2.202	1.183	50	1
Colbalt	µg/L	0.1	1.9	0.609	0.5		
Copper	µg/L	0.3	30	3.025	2	(<1000)	2-4
Iron	µg/L	35	2,710	659.64	329	(<300)	300
Lead	µg/L	0.1	20	1.545	1	10	2-7
Manganese	µg/L	3.8	321	32.717	16		
Mercury	µg/L	0.01	1.4	0.151	0.03	1	0.1
Nickel	µg/L	1	50	3.947	2		25-150
Zinc	µg/L	0.5	63	11.711	6.333	(<5000)	30

(a) =Data from Water Resources Division, DIAND

(b) =Canadian Water Quality Guidelines for Drinking Water and the Protection of Aquatic Life (CCME, 1999)

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. Winnipeg, MB.

The pH ranged from 6.95 to 8.37 in the Kakisa River, with a mean value of 7.6 and 8.02. The conductivity varied from 2.5 to 401 µS/cm, with a mean value of 244 µS/cm. The values for hardness ranged from 101 to 238 mg/L, with a mean value of 130 mg/L.

Turbidity values at the sampled location ranged from 1.2 to 85 NTU. The mean turbidity level was 18.4 NTU, indicating that higher turbidity events occur infrequently, most likely during spring runoff and precipitation events. This same pattern can be noticed in the total suspended solids (TSS) data that shows a range of 3 to 184 mg/L, with a mean of 24 mg/L.

Phosphorus is a measure of the productivity within a given waterbody. The mean total phosphorus value was 37 µg/L. This falls within the eutrophic range that is defined as having average total phosphorus concentrations between 30 and 100 µg/L (Wetzel 1983).

Comparisons of measured metal concentrations at the sampling site with relevant CCME guidelines for the protection of aquatic life (CCME 1999) is not possible for a number of metals (cadmium, chromium, and mercury), because the reported analytical detection limits are higher than the guidelines for these metals. The copper concentrations ranged from 0.03 to 30 µg/L, with a mean value of 3 µg/L. The mean and maximum values of the samples exceed the CCME guideline of 2.9 µg/L based on a hardness of 130 mg/L.

Iron concentrations ranged in value from 35 to 2,710 µg/L, with a mean value of 660 µg/L. The mean values for this region exceed the CCME guideline of 300 µg/L, indicating that natural iron concentrations are above this guideline.

7.4.4 Assessment Approach

7.4.4.1 Valued Ecosystem Component Selection and Analysis

The scope of the surface water assessment is the evaluation of cumulative environmental impacts associated with activities undertaken as part of existing, approved and planned future developments in the Cameron Hills project area. To assess the effects of these activities on surface water, valued ecosystem components (VECs) have been identified, and measures to mitigate these effects have been considered. Indicators and parameters are then used to analyze the residual effects on the VECs and determine the environmental consequence.

7.4.4.1.1 Valued Ecosystem Components

The proposed developments will cause changes to the surface water conditions in the study area during the different phases of the development. Effects of the development on the surface water are related to the following VECs:

- hydrology (water quantity); and
- water quality.

These VECs will be used to systematically address the key issues, present the results of the impact analysis and assess the residual effects.

7.4.4.1.2 Indicators to Assess VECs

The following indicators will be used to characterize each VEC:

- change in flows in the receiving streams;
- change in lake water balance;
- changes in sediment yields in the receiving streams; and
- changes in concentrations of various water quality parameters.

7.4.4.1.3 Parameters for Characterizing Effects

A number of parameters measured in surface waters are typically used as indicators of surface water hydrology and quality. The following parameters are used to characterize changes in receiving water bodies:

- mean annual discharge for flows;
- mean water level for lake water balance;
- total suspended solids (TSS) and turbidity for sediment yield;
- routine parameters (pH, temperature, dissolved oxygen and conductivity);
- ions (hardness, alkalinity, calcium, magnesium, etc.);

- nutrients (different forms of phosphorus and nitrogen);
- metals (total and dissolved); and
- organic compounds (hydrocarbons, phenols, etc.).

Due to water quality data limitations, only qualitative assessments of potential changes to selected water quality parameters (i.e., TSS, turbidity, pH, metals, etc.) were conducted.

7.4.4.1.4 Temporal Parameters

The surface water cumulative effects assessment considers the following development cases:

- a pre-development Environmental Setting dating back to 1960;
- a Baseline Case that is comprised of existing and approved developments in the Aquatics Study Area as of June 2003;
- an Application Case which includes proposed Paramount developments for 2003/2004 (i.e., the subject of this application); and
- a Planned Development Case that includes potential developments in the Aquatics Study Area over the next 10 years and field operations to 2023.

7.4.4.1.5 Spatial Parameters

The Aquatics Study Area consists of the Cameron River watershed (1,387 km^2) and the watershed of a small unnamed creek (600 km^2) that drains to the Hay River south of Indian Cabins (Figure 7.1-2). All of the activities which may pose a potential source of impact to water quantity and quality would occur within these two watersheds. Because no other developments are currently known in the region surrounding this area, the cumulative effects assessment for water quantity and quality assumes that regional development would be limited to those currently proposed by Paramount.

7.4.4.1.6 Effects Analysis

The potential effects to the VECs are addressed by quantifying (and/or qualitatively assessing) the combined effects of the existing, approved and planned developments on the surface water conditions in the study area. The following approach was used:

- identify the potential effects to surface water from the development activities;
- identify mitigation measures to minimize effects;
- conduct a qualitative or quantitative analysis to assess residual effects;
- quantify or qualify the residual effects based on the analysis; and
- classify the cumulative effects to determine the environmental consequences.

7.4.4.2 Development Activities and Mitigation of Effects

The project developmental phases include seismic exploration, construction and drilling activities and pipeline installation in the winter during base waterbody flows and frozen ground and water conditions. Well and facility operations will require year-round access using all-terrain vehicles (ATVs) on seasonal access routes. Water withdrawal is also required from a regional lake throughout the construction, drilling and operations phases.

Potential impacts to surface water resulting from activities in the Cameron Hills may include:

- alteration to water quality from increased sediment loading;
- alteration to bed substrate, bank vegetation and top of bank;
- lake levels may be reduced due to drawdown for water use;
- alteration to water quality due to disturbance of bottom sediments in waterbodies
- potential bank and bed instability of the trenchline during operations;
- chronic disturbance to banks and bed during fording by ATVs during operations; and
- water contamination from wastes and spills.

7.4.4.2.1 Seismic Exploration

Seismic exploration requires the clearing of access routes and cutlines during the winter period only, leaving the surface vegetation (duff and low growing vegetation) intact. This activity generally occurs in a single season and, unless the cutlines are used for other developments (eg. access roads or pipeline ROWs), they are allowed to revegetate naturally. Vegetated buffers are maintained between the cleared lines and larger waterbodies such as the Cameron River and its major tributaries. However, during the spring melt period and during rainfall events potential impacts to surface water quality may result from increased surface erosion and increased sediment loading to waterbodies. Vehicle and equipment crossings have the potential to cause direct effects to waterbodies in the study area. The effects to the small waterbody crossings are expected to be minimal, because they are typically frozen to the bottom, and a snow bridge is used. Crossings of larger waterbodies will also use snow and ice bridges or existing bridges wherever feasible.

No source water is required for seismic exploration operations. The only effect seismic exploration has on surface water hydrology is related to the increased runoff potential in cleared areas as compared to forested areas. This effect will be minimized by leaving the ground vegetation intact.

7.4.4.2.2 Site Construction and Drilling

Clearing and construction of wellsites, facilities and access roads has the potential for increased sedimentation of surface waterbodies. This activity will occur during winter when most surface water will be frozen, and topsoil and ground cover vegetation will be relatively undisturbed. Temporary waterbody crossing by means of ice bridges will minimize potential erosion to stream bed and banks. Standard mitigative measures such as diversion ditches and berms, silt fence installation and revegetation will be implemented in areas of erosion potential.

Direct effects from drilling activities are not expected to impact surface water resources, as the footprint is small and leases are located at least 100 m from drainages and water bodies. Indirect impacts may occur with respect to access routes that cross waterbodies (see seismic activity description) and water withdrawal (see below) from water source lakes for use as a constituent of the drilling fluids.

Water will be withdrawn from the identified watersource lakes to aid the construction of a snow/ice surface layer for wellsites and winter access roads, to provide make-up water for well drilling fluid and for well control. The amount required could potentially affect the lake water balance and the outflows to Cameron River. Projected water use requirements for construction and drilling are detailed in Section 3.5.

A release or spill of drilling fluids can potentially contaminate surface waters, resulting in increases in the concentrations of various water quality parameters (e.g., organics, metals, etc.). To mitigate potential impacts, drilling wastes will be stored in on-site tanks, and waste volume will be minimized by re-using clear fluids. Drilling waste solids will be disposed of by mix-bury-cover method on-site or at remote pit locations to be determined by suitable soil and groundwater conditions.

7.4.4.2.3 Pipeline Construction

Pipeline and flowline construction requires clearing of ROWs and trenching and will occur in the winter months. The predominant effects to water quality are related to pipeline construction across waterbodies. Waterbody crossings will be located in areas with minimum topographic relief to minimize impacts to the banks. Small waterbodies that are frozen to the bottom and do not have sensitive fish habitat will be open cut. From a hydrological perspective, the cost-effective, open-cut trench technique construction method is considered appropriate for these small creek crossings. Should flow be present during the time of the crossing, an effective isolation method (e.g., dam and pump) or a trenchless technique (e.g., horizontal directional drill) would be used. Where permanent bridges (road or ATV) are installed, the flowlines will be attached to the bridge for an aerial crossing, to avoid disturbance to the bed and banks of the stream. These bridges are designed to withstand a 1:100 year flood event.

Primary impacts to the waterbodies crossed by the pipelines may include bed and bank (e.g., soil and vegetation) disturbances at the crossing location. Construction practices will include soil and substrate handling following the "first-out-last-in" rule. This construction practice ensures that the substrate material is replaced on the stream bed. Watercourse bed material will be replaced in such a manner as to ensure that the substrate replaced onto the trench will not dam water. There may be a small increase in waterbody TSS and turbidity due to bed material disturbance at trenched crossing locations during snowmelt, however, this event is expected to be within natural variations of a spring flush event as described in the Environmental Setting section above. Conventional sediment and erosion control practices will be implemented to mitigate potential sedimentation as a result of the pipeline installation.

Winter construction will mitigate erosion during wellsite and access road construction. In addition, topsoil and ground cover vegetation will be reasonably undisturbed mitigating runoff effects in the snowfree months.

Pipeline ROWs will follow existing or recently constructed access roads, where possible, to minimize the total cleared area and the number of waterbody crossing points.

7.4.4.2.4 Production Operations

Production operations will require access to the wellsites and facilities for maintenance and monitoring throughout the year. Access roads will be frozen down each winter season by the application of water to prevent damage to vegetation and soil. Water withdrawal during the operations phase will be limited to access road maintenance and potential amine make-up water if fuel sweetening is required. Projected water use requirements for operations are detailed in Section 3.5. These values are used to in the assessment of surface water impacts due to water withdrawal in the study area.

The primary potential impact to surface water during production operations is related to the physical disturbance to drainages caused by repetitive crossings by ATVs during the unfrozen period. During open water conditions, large waterbodies, such as the Cameron River and larger tributaries, will be crossed via permanent bridges and small waterbodies will be forded. It is predicted that there will be increased sediment disturbance and bank deterioration within waterbodies and small drainages (low-lying wetlands and depressions) which may result in increased TSS and sedimentation. Measures will be taken to reduce these impacts (e.g., bridge and plank installation) where appropriate and feasible. The continuous disturbance of bottom sediments also has the potential to result in increased mobilization of various sedimentary constituents, such as metals and PAHs, which are normally trapped within the sediment matrix. This may cause an increase in the water column concentrations of these parameters. These activities may affect the local area with impacts expected over the duration of operations.

Maintenance of wells and facilities requiring the access of heavy equipment will be scheduled during frozen ground conditions. However, emergency maintenance may be required during open water conditions. In such a case, suitable methods of access will be determined on an as-needed basis.

Well, facility, and pipeline operations are conducted to continuously monitor infrastructure conditions and to prevent accidents. However, in the case of an accidental spill or a pipeline break, surface water may be affected. Response mechanisms in such a case are outlined in the Emergency Response Plan for the Cameron Hills.

The operation of the battery, satellites, and wells will cause increased SO_2 and NOx emissions. However, these emissions are not large enough to result in increased acid deposition. The Air Quality section (Section 7.2) describes the potential project related effects of air emissions on acid deposition.

Production camp operates year-round for the term of the development. Potential impacts on water quality may occur as a result of discharges of domestic waste waters to waterbodies. To minimize potential impacts, camps will be located at least 100 m from waterbodies and waterbodies. All sewage and grey waters from the camps will be contained in sewage disposal sumps. Small, open camp sumps will be dug at the proposed temporary campsites, pending suitable soil conditions. Sewage and grey water will be stored in the camp sumps and treated with lime, as required.

Increased surface runoff and potential sediment input may be encountered at access route and pipeline drainage crossing locations throughout the production period, depending on high runoff events and heavy rains, residual vegetation/slash, slope, soil type. Appropriate mitigative measures, such as diversion ditches, diversion berms, silt fence, will be implemented as appropriate to minimize impacts to surface water.

7.4.4.3 Residual Effects Assessment Criteria

Taking into consideration implementation of the outlined mitigative measures, a classification of residual effects is provided to determine and assess any cumulative effects resulting from the development. Potential residual effects are considered in terms of the following criteria: direction, magnitude, geographic extent, duration, reversibility and frequency. Each of the criteria is given a weighting which is added to determine an Environmental Consequence. Details of this assessment methodology is outlined in Section 7.1.1.5 of this report.

The residual impacts to surface water hydrology are summarized in the Planned Development Case as the highest rate of water withdrawal occurs at this stage. Assessment of the Baseline and

Application Cases would be conducted if a moderate or high environmental consequence was determined at the Planned Development Case.

7.4.5 Cumulative Environmental Assessment

The following sections assess the cumulative environmental effects on surface water for the Baseline, Application, and Planned Development cases.

7.4.5.1 Baseline Case

The Baseline Case assessment evaluates the effects of existing and approved developments as of June 2003 on the surface water hydrology in the study area. Baseline Case land disturbance in the area totals approximately 1,918 ha. The existing and approved developments include 39 wellsites, and associated facilities, and approximately 214 km of linear clearing (access roads and pipeline ROWs), resulting in a total of 42 waterbody crossings (13 pipeline crossings and 29 road crossings).

The Baseline Case and the associated surface water impacts are described in previous Environmental Assessment reports (Western and Golder 2000, Golder and Alpine 2001, Paramount and Golder 2001b). These reports assessed individual components of the existing and approved developments. The findings of the assessments particular to each VEC are summarized below.

7.4.5.1.1 Residual Effects on Hydrology and Water Quality

Environmental Screening for the Cameron Drilling Project (Western and Golder 2000)
This report was prepared for the environmental screening of the Cameron Hills Drilling Project scheduled for the winter of 2000/2001. Paramount proposed to drill and complete up to nine wells to assess potential reserves of natural gas and oil in the Cameron Hills area of the NT.

An unnamed lake, located about 1.6 km west of one of the well pads, was identified as a potential source for water withdrawal for the drilling process. The maximum lake depth was measured to be 1.5 m and the mean lake depth was estimated to be 1m. Due to its shallow depth, the lake is expected to freeze in the event of extreme low winter temperatures.

A water demand of 12,000 m^3 was required from the lake during the winter months. The effect of water withdrawal from the lake was estimated to be a lowering of the lake water level by 2 cm. This effect was considered negligible. Moreover, it was anticipated that actual water usage would be less as water use would be staggered throughout the winter and any potential impact to the lake would be further reduced by recharge to the lake from groundwater and an adjacent bog. No residual impacts were predicted for water withdrawal.

Environmental Impact Assessment for the Cameron Hills Gathering System and Facilities Project (Golder and Alpine 2001)

An environmental assessment was conducted to identify the potential biophysical effects associated with the then proposed Cameron Hills Gathering System and Facilities. This development included winter access roads, gas and oil gathering flowlines, a fuel gas system, a satellite, a central battery, temporary construction camps, a permanent camp and operational roads to an airstrip, an airstrip, bridges, a water disposal system and an electrical distribution system.

The hydrologic assessment of the risk of pipeline exposure at water crossings due to scour was presented. This included defining the hydrologic design criteria, hydrologic analysis, hydraulic analysis and stream crossing design. Minimum specifications ranging from 1.5 to 2.5 m burial depth below the existing thalweg and sag-bend setback from stream banks ranging from minimum of 1 to 4 m were recommended for all the pipeline creek crossings. These specifications of sag-bend setbacks and burial depths were conservatively increased from calculated minimums. This approach minimized the risk of any potential pipeline exposure due to hydraulic forces, even during the design flood events. The only project activity identified as having a potential to cause residual impacts to water quality was pipeline failure (i.e., accidental spill) away from wellpad.

Environmental Impact Assessment in Response to the Terms of Reference for the Paramount Resources Ltd. Cameron Hills Drilling Project 2001 (Paramount and Golder 2001b)

This report was issued in response to an amendment to the final EA work plan and Terms of Reference by the Mackenzie Valley Environmental Impact Review Board (MVEIRB) for the completion of an environmental assessment which started as an environmental screening study (Western and Golder 2000). There was no hydrologic assessment presented in this report as no residual impacts were predicted in the screening study. Similarly, no residual impacts were predicted for water quality.

Environmental Impact Assessment for the Proposed Cameron Hills Access Project (Paramount and Golder 2001b)

Paramount proposed in 2001 to prepare (i.e., build snow/ice surface) and maintain the following: existing winter access to their existing well leases (including emergency escape routes), two temporary camps and an airstrip (collectively referred to as the Project), in the Cameron Hills region of the Northwest Territories (NT). An impact assessment of the proposed project showed no residual impacts to hydrology and water quality.

7.4.5.2 Application Case Assessment

The Application Case assessment evaluates the effects of proposed developments under the current application for 2003/2004. This includes the construction and drilling of five wells, access construction, flowline construction and six waterbody crossings (each is a common access and flowline ROW). These crossings are likely to be shallow drainage areas and wetlands that are expected to freeze to the bottom during the winter. The potential impacts to surface water would be related to water quality impacts due disturbances to substrate at the crossing site and potential sedimentation from erosion, and water quantity effects from water withdrawal for access construction and drilling.

The additional total disturbed land area is estimated to be 26 ha. The proposed developments under the current Application Case includes construction of an additional five wells, 15 km of winter access road with parallel pipeline ROWs, and a 6.6 km winter access road to the battery, resulting in six additional waterbody crossings.

7.4.5.3 Planned Development Case Assessment

The Planned Development Case assessment evaluates the effects of the maximum extent of developments in the Aquatics Study Area between winter of 2004/05 and 2013/14, including production operations up to 2023. Project phases of the Planned Development Case are similar to those for the Application Case in each year. It is proposed that during the 10-year period, the total disturbed land area will increase by approximately 147 ha. An additional 48 wells and 63 km of access roads and parallel pipelines will be constructed, resulting in 14 additional waterbody crossings.

7.4.5.3.1 Residual Effects on Hydrology

An assessment of the residual effects for the Planned Development Case involves an analysis of flows and sediment yields on the Cameron River and Unnamed Creek. The residual effects of developmental activities are predicted to result in negligible changes, as described below.

Annual Water Usage

Table 3.5-1 shows the projected annual water requirements from 2003 to 2023. The annual water demand will gradually increase from about 19,400 m^3/year in 2003 to a peak value of about 47,800 m^3/year in 2012 when the number of wells in operation is at a maximum. Beyond 2013, there are no new wells or access roads planned for construction and water demand from the water source lakes will be solely for maintaining the existing access roads. The projected water demand from 2013 to 2023 will be approximately constant at 42,900 m^3/year. The average water demand from 2003 to 2023 will be approximately 41,000 m^3/year.

Lake 1 has a useable storage of 66,400 m^3 (5% of available water under 2m of ice), as shown in Table 7.4-5. Water withdrawal from the lakes during the winter months will reduce the lake storage, which will be recharged each spring from snowmelt. The projected maximum annual water withdrawal of 47,813 m^3 relative to the Lake 1 storage, lake inflows and lake water level, represents:

- 0.4 % of the lake storage of 11.6 million m^3;
- 3.6 % of the 1.3 million m^3 of lake storage under an assumed 2 m of ice cover;
- 72 % of the DFO defined useable storage of 66,400 m^3 under an assumed 2 m of ice cover;
- 4.9 % of an estimated annual water yield of 972,400 m^3 (68 mm runoff) from the lake contributing drainage area of 14.3 km^2 for the average hydrological conditions;
- 12.9 % of an estimated annual water yield of 371,800 m^3 (26 mm runoff) from the lake contributing drainage area for the 10-year dry hydrological conditions; and

- a 5.5 mm drop in lake water level in addition to an estimated 69 mm drop in lake water level in the event of a 10-year dry hydrological condition.

Lake 1 is located in the Cameron River watershed. Therefore, water withdrawal from this lake will have no effect on the flows in the Unnamed Creek but will affect the lake outflows to the Cameron River. The projected maximum annual water withdrawal of 47,813 m^3 (0.0015 m^3/s) from Lake 1 will reduce the annual water yield of the Cameron River watershed by the same amount. This translates to a reduction of the Cameron River mean annual flow of 5.4 m^3/s by 0.0015 m^3/s (0.03% reduction). Therefore, changes to the Cameron River flows will be negligible.

These numbers show that the projected withdrawals will result in negligible changes to the lake water balance for the average hydrological conditions. It is expected that the lake will be replenished annually and a progressive reduction in water level will not occur. In the event of a 10-year dry hydrological condition, estimated changes to the lake water balance will be negligible.

Disturbed Areas

Development activities including seismic exploration, drilling activities, pipeline construction and production operations will increase the extent and size of cleared areas in the Aquatics Study Area. The cleared areas have the potential to yield higher runoffs and sediment yield to the receiving streams than forested areas. Table 7.4-8 shows the disturbed areas in the Cameron River watershed and the Aquatics Study Area.

Table 7.4-8 Disturbed Areas

Area	Environmental Setting Case	Baseline Case		Application Case		Planned Development Case	
	(km^2)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)
Disturbed Area	0	1.9		1.95		2.09	
Undisturbed Cameron River watershed[(a)]	1,387	1,385.1	99.863	1,385.05	99.859	1,384.91	99.849
Undisturbed Aquatics Study Area	1,987	1,985.1	99.904	1,985.05	99.902	1,984.91	99.895

(a) assumes all disturbances are in the Cameron River watershed

For the Planned Development Case, the percentage of disturbed area relative to the Cameron River watershed area is less than 0.2%, assuming all disturbed areas are in the Cameron River watershed (only a very small fraction of the disturbed area is in the Unnamed Creek watershed). The percentage reduction in undisturbed areas is very small and will result in negligible changes to the mean flows in the Cameron River and the Unnamed Creek. With effective mitigation and reclamation measures in place, changes in flows in the receiving streams are expected to be negligible.

The drainage area of Lake 1, which is 23 km^2 at the outlet, includes a lake area of 8.7 km^2 and a contributing drainage area of 14.3 km^2. There are no disturbed areas in Lake 1 watershed since there are no planned developmental activities in the lake watershed.

7.4.5.3.2 Residual Effects on Water Quality

The environmental consequences of seismic exploration, drilling and pipelines on water quality for the Planned Development Case are predicted to be negligible. Increased activities undertaken as part of this project have the potential to result in increased TSS and turbidity. However, as described above, the percentage reduction in undisturbed areas is very small and will result in negligible changes to the TSS concentrations in the Cameron River and the Unnamed Creek. It is expected that mitigation measures discussed above will minimize potential for residual impacts. Similarly, based on the mitigation measures employed during drilling and pipelines installation, residual impacts on water quality are predicted to be negligible. The predicted environmental consequence on water quality from increased site access and fording of waterbodies is predicted to have a low environmental consequence, principally because site access and fording will be on-going throughout the lifetime of the project (medium-term), with a high frequency of occurrence. Furthermore, site access will occur throughout the regional area of the project.

7.4.5.4 Ratings of Impacts and Environmental Consequences

Based on the effects assessment criteria, Table 7.4-9 presents a summary of the ratings of the impacts and environmental consequences on flows, sediment yields and lake water balance. Only the changes associated with the negative and neutral direction are considered in these rating tables. When all the predicted changes are neutral in direction, the effect classifications are provided in the tables, but no environmental consequence rating is provided.

Table 7.4-10 shows that the combined effects of the existing, approved and planned developments on flows, sediments yields and water levels in the receiving water bodies, including the Cameron River, Unnamed Creek and Lake 1, will have negligible environmental consequences.

Table 7.4-9 Classification of Residual Effects and Environmental Consequences to Hydrology

(a) Flows in Receiving Streams

Activity	Impact Classification						Environmental Consequence[b]
	Direction[a]	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	
Seismic	neutral	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	n/a
Drilling	neutral	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	n/a
Pipeline Construction	neutral	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	n/a
Operations	neutral	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	n/a
Water Withdrawal	negative	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	negligible (0)

[a] Note: Since surface water is a natural resource and has important value, a reduction is considered to be negative and an increase in water quantity is considered to be neutral. This neutral classification is to balance the considerations that an increase in water quantity is generally positive but too much of an increase could lead to negative effects on aquatic habitat and riparian vegetation in receiving streams.

[b] n/a = not applicable – environmental consequences not rated for neutral impacts.

(b) Sediment Yields to Receiving streams

Activity	Impact Classification						Environmental Consequence
	Direction	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	
Seismic	negative	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	negligible (0)
Drilling	negative	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	negligible (0)
Pipeline Construction	negative	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	negligible (0)
Operations	negative	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	negligible (0)
Water Withdrawal	neutral	negligible (0)	medium-term (+2)	medium (+1)	local (0)	reversible (-3)	n/a

(c) Lake 1 Water Balance

Activity	Impact Classification						Environmental Consequence
	Direction	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	
Seismic	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Drilling	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pipeline Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Production	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Water Withdrawal	negative	negligible (0)	medium-term (+2)	medium(+1)	local (0)	reversible (-3)	negligible (0)

Table 7.4-10 Classification of Residual Effects and Environmental Consequences on Water Quality

Activity	Direction	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Environmental Consequence
Seismic	negative	low (+5)	short-term (+1)	low (0)	local (0)	reversible (-3)	negligible (+3)
Drilling	negative	negligible (0)	short-term (+1)	low (0)	local (0)	reversible (-3)	negligible (0)
Pipeline	negative	low (+5)	short-term (+1)	low (0)	local (0)	reversible (-3)	negligible (+3)
Operations - Access	negative	low (+5)	medium-term (+2)	high (+2)	regional (+1)	reversible (-3)	low (+7)
- Water withdrawal	negative	low (+5)	medium-term (+2)	medium(+1)	local (0)	reversible (-3)	low (+5)

7.5 GROUNDWATER

This section addresses Section G-4 of the MVEIRB ToR:
This section should include impacts on surface and ground water, in terms of quantity and quality.

7.5.1 Environmental Setting

As there is limited information available for the shallow groundwater system in the Aquatics Study Area, it is assumed that the results of the investigations below represent the pre-disturbance setting.

A brief summary of the surface geology has been provided in the Environmental Screening Report for the Cameron Hills Drilling Project (Western and Golder 2000) and can be subdivided into the following main units:

- alluvial material;
- till;
- meltwater channel sands and gravel; and
- bedrock (Fort St. John Group – undifferentiated shales, sandstones and siltstones).

The underlying bedrock, which also outcrops in the Cameron Hills, is part of the Fort St. John Group and is comprised of undifferentiated shales, sandstones and siltstones. Glacial deposits overly the bedrock surface and are mostly comprised of clay and sandy clay till. These deposits were found to exceed 90 m in thickness during exploration drilling for the water well installed on March 25, 2002. The alluvial material is considered to have only a local extent and can be found along the plateau margins or as point-bars in the streams and the Cameron River. Meltwater channel sands and gravel are scattered throughout the uplands. The soil survey completed in July 2000 also noted glaciolacustrine deposits underlying peat accumulation.

In general, the majority of groundwater flow will occur in the coarse-grained sediments and rocks with the flow direction in the shallow system strongly influenced by topography. The till and fine-grained sediments and rock will tend to impede the flow of groundwater.

Groundwater quality information is only available from the groundwater well installed on March 25, 2002. This well was installed in a sand and gravel aquifer located between 108 and 115 m below ground. The water analysis shows the water has a total dissolved solids concentration of 1501 mg/L and is low in iron (0.01 mg/L) and chloride (1.56 mg/L).

7.5.2 Valued Ecosystem Components Selection

Groundwater quantity and quality were identified as VECs for the project. The assessment of potential cumulative impacts to groundwater involved an evaluation of the potential changes to groundwater quantity and groundwater quality as a result of the project and existing activities in the area. A number of existing and/or project activities were identified with respect to the potential effects of the project on groundwater resources and are described below.

7.5.3 Assessment of Impacts and Mitigation

7.5.4 Spatial Parameters

The aquatics study area consists of the Cameron River watershed north to Tathlina Lake (1,387 km^2) and the watershed of a small unnamed creek (600 km^2) that drains southeast to the Hay River south of Indian Cabins and small waterbodies in the southern portion of the SDL including the drainages to the south that flow into Johnson Lake in Alberta as shown in Figure 7.1-2. All of the activities which may pose a potential source of impact to groundwater resources would occur within these two watersheds. Because no other developments are currently known in the region surrounding this area, the cumulative effects assessment for hydrologic resources assumes that regional development would be limited to those currently proposed by Paramount.

7.5.5 Temporal Parameters

The groundwater assessment considers the following development cases:

- a predevelopment Environmental Setting dating back to 1960;

- a Baseline Case that is comprised of approved developments in the Aquatics Study Area as of June 2003;
- an Application Case which includes proposed Paramount developments for 2003/2004 (i.e., the subject of this application); and
- a Planned Development Case that includes potential developments in the Aquatics Study Area over the next ten years.

7.5.6 Residual Effects Assessment Criteria

The criteria used to assess residual effects pertaining to direction, magnitude, geographic extent, duration, reversibility, frequency and probability is described in Section 7.1.1.5.3 of this report.

7.5.7 Potential Impacts

The sources for potential cumulative impacts to groundwater quality are:

- pits and sumps;
- spills; and
- waste water disposal.

The sources for potential cumulative impacts to water quantity are related to water withdrawal. Specific issues relate to:

- the sustainable long-term yield of the aquifer versus the water volume requirements;
- the degree of hydraulic communication between the aquifer and nearby surface water bodies; and
- potential impact to water users within the likely influence of future groundwater abstraction.

7.5.7.1 Water Quality

7.5.7.1.1 Pits and Sumps

The camp sumps and drilling waste remote pits will be installed within low permeability sediments (silts and clays) to minimize the potential for vertical migration of pit or sump fluids to any shallow aquifers. If there is not adequate material on site, an artificial lining will be installed at the base of the pit. Due to the isolation of pits from the shallow groundwater system, the potential long-term impact to groundwater quality is considered negligible.

7.5.7.1.2 Spills and Leaks

Engineering measures for environmental protection will be included in the design of the site facilities. Chemicals will be handled and stored in accordance with legal and regulatory requirements. Should any accidental surface contamination occur (i.e. from spills) during the construction and drilling program, Paramount will implement the spill response plan and initiate the following steps to:

- determine the source of the impact and initiate mitigation measures to minimize or halt further impacts;
- define the magnitude and likely extents of the impact; and
- take appropriate actions involving remediation, risk assessment and/or risk management after consultation with regulatory authorities.

The affected location will be restored in a manner acceptable to the relevant regulatory agencies. These established good work practices will minimize the potential for significant impacts to the shallow groundwater quality.

7.5.7.1.3 Waste Water Disposal

The waste water disposal zone considered to date has been the Devonian Keg River carbonates which are at a depth of more than 1,500 m in the Cameron Hills area. This porous Keg River interval is capped by the Muskeg formation which is approximately 100 m thick and comprised largely of impermeable anhydrites. Any upward migration of injected fluids is extremely unlikely. Injected water would typically be produced from the Slave Point, Sulphur Point or Keg River formations.

7.5.7.2 Water Quantity

There are three shallow water wells that have been drilled for the project to date. The first well at H-03 was installed on March 15, 2002 at a depth of approximately 21 m. The yield for this well is 13 m^3/day. The second well at H-03 was installed on March 25, 2002 at a depth of 110 m. The recommended well yield for this well is 65 m^3/day. The third well is an old well for which drilling records are not available. It was drilled to supply drilling camp water and drilling fluid source, at section 11, 60° 10'N 117° 30'W.

Water wells could be used in the event that lake water is not sufficient to supply the volume of water necessary for operations. Water balance calculations presented in the Surface Water section (Section 7.4) of this report indicate that the lake is capable of supplying all of the routine water needs for this project. Potable water for construction personnel accommodations is sourced from the Hay River Community and is therefore not considered in this assessment.

The only predicted use of groundwater in the production operation is potentially as amine make-up water if fuel sweetening is required and for the 20 man permanent camp. The daily volume required for make-up water would be limited to 0.07 m^3/d. Process make-up water would be sourced from the potable water well currently operating on the battery site, as the water source for the permanent camp.

As most of the water requirements for this project are expected to be supplied by lake water, the impacts to groundwater quantity are expected to be negligible in magnitude, short-term duration, low frequency, local geographic extent, and reversible.

7.5.8 Classification of Impacts

A summary of the assessment of the cumulative impacts to the groundwater system is summarized in Table 7.5-1 below.

Table 7.5-1 Impact Classification

Issue	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Environmental Consequence
Water Quality						
Pits and Sumps	negligible (0)	short-term (+1)	low (0)	local (0)	reversible (-3)	negligible (0)
Spills	negligible (0)	short-term (+1)	low (0)	local (0)	reversible (-3)	negligible (0)
Water Disposal	negligible (0)	short-term (+1)	low (0)	local (0)	reversible (-3)	negligible (0)
Water Quantity						
Water Withdrawal	negligible (0)	short-term (+1)	low (0)	local (0)	reversible (-3)	negligible (0)

7.5.9 Summary of Impacts and Mitigation

The project activities will have a negligible impact in magnitude, direction, frequency and geographical extent on groundwater resources. The negligible rating of environmental consequence indicates the groundwater resources will not be impacted by the proposed project.

The project will take steps to mitigate the potential impacts associated with pits including location, low permeability sediments, or installation of a liner. Chemicals will be handled and stored in accordance with legal and regulatory requirements. Should a spill occur, Paramount will implement its spill response plan which involves an assessment of the spill, the identification and implementation of remedial measures to ensure the spill is contained and the site restored to a level acceptable to DIAND.

7.6 WILDLIFE

This section addresses Wildlife in Section G-5 of the MVEIRB ToR:
This section should deal with direct impacts on fish and wildlife, e.g., through short-term disturbance, interruptions of fish and wildlife movement, and changes to habitat. In particular, the DAR is to address changes in effective or critical habitat for boreal woodland caribou. Also, the DAR should identify any species protected by the Species At Risk Act and describe how potential impacts will be minimized.

This section deals with direct and indirect effects on wildlife as a result of the various Development Cases of the Paramount Cameron Hills project. The main issues that will be assessed, among others, include:

- direct habitat loss due to clearing;
- sensory disturbance potential;
- habitat fragmentation; and
- increased access and potential for increased predation/hunting/trapping.

This section will also discuss the following: the wildlife resources under the Environmental Setting (in general terms), discuss species protected by the Species at Risk Act (SARA), interruptions to wildlife movement, methods for conducting the CEA including modeling approaches, results for each assessment case as described in Section 7.1 and the residual impact classification for each wildlife VEC.

7.6.1 Environmental Setting

Characteristic wildlife of the region that contains the TSA include: moose, woodland caribou, wolf, black bear, red fox, marten, beaver, snowshoe hare, lynx, red squirrel, various mice and vole species, waterfowl, and boreal songbirds. The Cameron Hills represents a unique landform in the NT, with productive forested habitat located along their northern and eastern escarpments and limited quality habitat on the plateau of the hills. The plateau is characterized by black spruce bogs and black spruce upland sites interspersed with small areas of pine, aspen and white spruce stands. As such, the plateau is considered to be poor quality wildlife habitat. The following discusses occurrence and habitat preferences for the wildlife VECs which were selected based on criteria discussed in Section 7.6.3.1 below.

To provide a context of the Environmental Setting wildlife/habitat within the Cameron Hills and surrounding region in the 1960s historical data provided by Colosimo (1968) and Lines (1969) is presented. These authors conducted winter aerial surveys to determine population status of caribou and moose in Game Management Zone #6, Hay River District. Observations, including incidental observations on other wildlife species and habitat quality made in proximity of the TSA, are summarized in Table 7.6-1.

7.6.1.1 Woodland Caribou

Woodland caribou generally prefer mature or 'old growth' coniferous forests, closely associated with bogs, fens, lakes and streams, which contain high concentrations of terrestrial and arboreal lichens (RWED 2003b). Winter aerial ungulate surveys conducted during the late winters of 1968 and 1969, cumulatively observed only 2 sets of caribou tracks within the Cameron Hills survey plot (Colosimo 1968; Lines 1969).

During the winter caribou utilize uplands, bogs and south-facing slopes, where snow conditions allow access to their winter diet, consisting primarily of lichen (RWED 2003b). These findings are similar to those found in northeastern Alberta, where woodland caribou use pine and black spruce forests, as well as wooded fens and bogs as their main winter habitat (Dzus 2001; Bradshaw et al. 1995; Stuart-Smith et al. 1997). Suitable winter habitat within the Cameron Hills Project area is considered to be primarily along the southern slopes of the hills, in the vicinity the NT/AB border. Woodland caribou diet incorporates fresh green growth of flowering plants and grasses during the summer (RWED 2003b), which is primarily found in mature coniferous forests, and open fens and bogs (ASRD 2001; Bradshaw et al. 1995; Stuart-Smith et al. 1997).

Table 7.6-1 Summary of Aerial Surveys in Game Management Zone #6, Hay River District, 1968-1969.

Block	Location	Habitat	1968	1969
1 Swede Creek	NE of and at base of CH	Mainly open, with spruce in SE of plot	▪ 3 Caribou + many tracks. ▪ Many moose tracks	▪ 3 Caribou + tracks (suspect 6-8 animals). ▪ Many moose tracks in SE.
2 Big Creek	NE of Tathlina Lake, approximately 33 km north of the north edge of the Cameron Hills	Heavy spruce @ N and S ends. Pb and Spruce along creek. Open bog through centre.	▪ A lot of caribou tracks. ▪ 2 moose along creek.	▪ 5 moose ▪ numerous moose/caribou tracks.
3 Lady Evelyn	NE of Kakisa Lake, approximately 68 km north of the north edge of the Cameron Hills	Dense spruce and jackpine NW of Kakisa river.	▪ Moose/caribou tracks ▪ Lynx tracks in Spruce stand.	▪ Very few moose/caribou tracks. ▪ E/W running caribou crossing. ▪ 1 moose in East
4 S. Mills Lake	NW of Kakisa Lake, approximately 95 km NNW of the north edge of the Cameron Hills	Mixture of Sb, pine, open muskeg, and willow.	▪ 4 moose ▪ caribou tracks ▪ lynxtracks abundant in N.	▪ No caribou, but habitat is reasonable. ▪ 1 moose + moderate # of tracks.
5 Cameron Hills	From NT/AB border north through centre of hills to north rim.	Cover is thin. Area burnt over, willow regrowth along streams. Spruce and a lot of heavy willow along Cameron River.	▪ 1 set of moose tracks. ▪ Beaver lodges along Cameron River. ▪ Lynx, fox, tracks and many muskrat homes. ▪ "The area does not lend itself to good habitat for fur bearers." ▪ Many ptarmigan flocks found throughout plot.	▪ 1 moose ▪ a few moose/caribou tracks. ▪ lynx, wolverine and wolf tracks seen on high ground and barren area. ▪ approx. 36 beaver lodges / 100 mile², most along Cameron River and adjoining lakes.
6 Kakisa River	W end of Kakisa Lake, approximately 21 km NW of the northwest edge of the Cameron Hills.	Dense spruce and poplar along river.	▪ 6 moose within the timber along river. ▪ lots of caribou sign. ▪ Lynx, fox, tracks and many muskrat homes.	▪ 25 moose + numerous moose/caribou tracks. ▪ approx. 50 beaver lodges / 100 mile². ▪ "very good habitat for big game and most fur bearers."

Block	Location	Habitat	1968	1969
7 Foetus Lake	WSW of Kakisa Lake, approximately 60 km NNW of the northwest edge of the Cameron Hills.	Open, scrub spruce and jackpine over most of plot. Dense Pj stand at N end.	▪ 5 moose and 11 sets of tracks. ▪ No caribou sign ▪ "Plot very poor cover for fur bearers, although Lynx tracks were recorded."	▪ 3 moose + moderate # of moose tracks. ▪ no caribou tracks. ▪ group of 5 lynx seen together.
8 Silt Lake 9 Dogface Lake	50 km W of Cameron River gorge and adjacent to NT/AB border.	Many rolling hills with Spruce, Pj, Pb, Bw, and willow cover. Many lakes and streams.	▪ Good beaver habitat. ▪ 6 caribou off line. ▪ 1 wolverine ▪ moose, caribou, lynx, fox and wolf tracks. ▪ "Very good cover for fur bearers other than beaver"	▪ 13 moose + many moose/caribou tracks.
10 Redknife	Approx. 78 km NW of the northwest edge of the Cameron Hills.	Predominately Sb with some pine and open muskeg.	▪ moose/caribou tracks. ▪ some beaver/muskrat.	▪ 6 caribou observed, but it appears there are 2-3 herds of 10-15 animals. ▪ Moose tracks scarce. ▪ approx. 24 beaver lodges / 100 mile^2. ▪ otter trail

Gunn et al. (in prep.) have produced a draft caribou model within the Deh Cho Territory. High quality caribou habitat, which has high black spruce and lichen cover, is widespread across the Deh Cho Territory. The model suggests that the Cameron Hills is relatively good habitat compared to adjacent areas such as the lowlands surrounding Tathlina Lake. However, few caribou or caribou sign have been observed in the Cameron Hills. For example, Gunn et al. (in prep.) had only one sighting in the Cameron Hills area during field work to validate their model. As discussed above, aerial surveys found few caribou in the Cameron Hills relative to the surrounding low-lying areas (Colosimo 1968; Lines 1969). Although the Cameron Hills appears to have good quality caribou habitat, there are few caribou within the Cameron Hills.

Nonetheless, the Cameron Hills do have the potential to support caribou populations. The Cameron Hills is a known summering area for woodland caribou and may be used as a calving area (Gray and Panegyuk 1989); while the surrounding lowlands are reported to be a wintering area (Gray and Panegyuk 1989). A comparable summary of caribou habitat is also presented in the Deh Cho Atlas (Deh Cho Land Use Planning Committee 2003).

7.6.1.2 Moose

Preferred moose habitat consists of early successional areas created by flooding and/or fires, with rich deciduous shrub growth of willow, birch and alder. Within the TSA, the best moose habitat is associated with the Cameron River valley. During aerial surveys, a total of 1 moose and a few moose tracks were observed within the Cameron Hills survey plot (Colosimo 1968, Lines 1969).

Moose habitat in the Deh Cho Territory has been mapped for the Deh Cho Atlas (Deh Cho Planning Committee 2003). The majority of the Deh Cho Territory below tree line is reported to represent suitable moose habitat; fall or winter range occurs at the west end of Tathlina Lake and upstream on the Kakisa River, both of which are north of the TSA. However, there were few observations of moose or moose sign in the Cameron Hills, relative to surrounding lowland areas, as far back as the late 1960s (Colosimo 1968; Lines 1969). This is likely due to a lack of productive forage habitat within the Cameron Hills. Through community consultation, it has been suggested that most moose hunting in the area occurs in proximity to Tathlina Lake and Kakisa River.

7.6.1.3 Marten

Marten typically favour mature conifer forests, especially spruce and fir dominated stands (RWED 2003a). During aerial surveys, Lines (1969) indicated that “marten tracks appeared very numerous” within the Cameron Hills survey plot, despite Colosimo’s (1968) observation, one year earlier, that “the area does not lend itself to good habitat for fur-bearers.” Overall, the Cameron Hills is considered to be of poor habitat quality for fur-bearers and in particular marten, due to a lack of forested vegetation with high structural complexity.

7.6.1.4 Forest Songbirds

During previous field studies in the Cameron Hills (Western and Golder 2000, Golder and Alpine 2001), several bird species were recorded. Table 7.6-2 provides a list of species reported to occur in the vicinity of the project, and Table 7.6-3 lists these species as a function of the habitat type in which they were observed.

In general, forest songbird communities in the boreal forest become simpler, dominated by only a few species, as one moves farther to the north and west. For example, Machtans and Latour (2003) found that five species comprised 50 to 77% of all birds detected, and the ten most common comprised 79-95% of birds detected in any one of the six stand types that they sampled in the Liard River Valley, NT. Similar findings have been reported for Alberta (Schmiegelow et al. 1997), and in Saskatchewan (Hobson and Bayne 2000), albeit to a lesser extent. It is anticipated that bird communities in the TSA may be less diverse and simple, compared to the Liard River valley, due to a lack of vegetation community structure and diversity.

Table 7.6-2 Bird Species Recorded in the Cameron Hills Project Area

Common Name	Scientific Name	Common Name	Scientific Name
common loon	*Gavia immer*	common raven	*Corvus corax*
horned grebe [a]	*Podiceps auritus*	tree swallow	*Tachycineta bicolor*
red-necked grebe	*Podiceps grisegena*	cliff swallow [a]	*Hirundo pyrrhonota*
green-winged teal	*Anas crecca*	barn swallow [a]	*Hirundo rustica*
mallard	*Anas platyrhynchos*	boreal chickadee	*Parus hudsonicus*
blue-winged teal	*Anas discors*	red-breasted chickadee	*Sitta canadensis*
northern shoveler	*Anas clypeata*	ruby-crowned kinglet	*Regulus calendula*
American widgeon	*Anas americana*	Swainson’s thrush	*Catharus ustulatus*
ring-necked duck	*Aythya collaris*	hermit thrush	*Catharus guttatus*
lesser scaup	*Aythya affinis*	American robin	*Turdus migratorius*
common goldeneye	*Bucephala glangula*	cedar waxwing	*Bombycilla cedrorum*
bufflehead	*Bucephala albeola*	Tennessee warbler	*Vermivora peregrina*
bald eagle [a]	*Haliaeetus leucocephalus*	yellow-rumped Warbler	*Dendroica coronata*
northern harrier	*Circus cyaneus*	Cape May warbler	*Dendroica tigrina*
red-tailed hawk	*Buteo jamaicensis*	palm warbler	*Dendroica palmarum*
american kestrel [a]	*Falco sparverius*	bay-breasted warbler	*Dendroica castanea*
spruce grouse	*Dendragapus canadensis*	black and white warbler	*Mniotilta varia*
sora	*Porzana carolina*	blackpoll warbler	*Dendroica striata*
American coot	*Fulica americana*	Canada warbler	*Wilsonia canadensis*
greater yellowlegs	*Tringa melanoleuca*	Wilson’s warbler	*Wilsonia pusilla*
solitary sandpiper	*Tringa solitaria*	ovenbird	*Seiurus aurocapillus*
spotted sandpiper	*Actitis macularia*	common yellowthroat	*Geothlypis trichas*
common snipe	*Gallinago gallinago*	American redstart	*Setophaga ruticilla*
bonaparte’s gull	*Larus philadelphia*	chipping sparrow	*Spizella passerina*
mew gull	*Larus canus*	clay-colored sparrow	*Spizella pallida*
ring-billed gull	*Larus delawarensis*	Savannah sparrow	*Passerculus sandwichensis*
black tern	*Chlidonias niger*	LeConte’s sparrow	*Ammodramus leconteii*
common nighthawk	*Chordeiles minor*	fox sparrow	*Passerella iliaca*
belted kingfisher	*Ceryle alcyon*	Lincoln’s Sparrow	*Melospiza lincolnii*
yellow-bellied sapsucker	*Sphyrapicus varius*	swamp sparrow	*Melospiza georgiana*
black-backed woodpecker	*Picoides arcticus*	white-throated sparrow	*Zonotrichia albicollis*
northern flicker	*Coaptes auratus*	white-crowned sparrow	*Zonotrichia leucophrys*
least flycatcher	*Empidonax minimus*	dark-eyed junco	*Junco hyemalis*
warbling vireo	*Vireo gilvus*	rose-breasted grosbeak	*Pheucticus ludovicianus*
red-eyed vireo	*Vireo olivaceus*	red-winged blackbird	*Agelaius phoeniceus*
blue-headed vireo	*Vireo solitarius*	red crossbill	*Loxia curvirostra*
gray jay	*Perisoreus canadensis*	pine siskin	*Carduelis pinus*

[a] recorded in project area but > 1.0 km from proposed development.

From Western and Golder 2000

Table 7.6-3 Bird Species within the Cameron Hills Project Area

Habitat Type	Birds
Deciduous Trembling aspen; upland areas (top of Cameron River valley)	Potential habitat for red-eyed vireo and ovenbird.
Graminoid fen Open Carex/sphagnum moss/wet	Solitary sandpiper, spruce grouse.
Marsh/open water Open water/wetland complex	Ring-necked duck, mallard, green-winged teal, blue-winged teal, northern shoveler, American widgeon, bufflehead, common goldeneye, common loon, red-necked grebe, American coot, sora, black tern, Bonaparte's gull, ring-billed gull, mew gull, greater yellowlegs, tree swallow, savannah sparrow, red-winged blackbird.
Mixedwood Aspen/jack pine ridge	White-throated sparrow, hermit thrush, Tennessee warbler, chipping sparrow.
Mixedwood/old burn Old Burn; regenerating trembling aspen/black spruce/willow	Tennessee warbler, hermit thrush, northern flicker, fox sparrow, white-throated sparrow, chipping sparrow, Lincoln's sparrow, yellow-rumped warbler, palm warbler
Mixedwood/coniferous Trembling aspen/black spruce	Hermit thrush, chipping sparrow, Tennessee warbler, yellow-rumped warbler, white-throated sparrow.
Mixedwood/coniferous Jack pine/black spruce and trembling aspen ridge tops	Yellow-rumped warbler, chipping sparrow, cedar waxwing, Tennessee warbler, least flycatcher.
Mixedwood Jack pine ridge; some trembling aspen/ black spruce	Hermit thrush, yellow-rumped warbler, chipping sparrow, grouse.
Mixedwood Jack pine/trembling aspen/white spruce (mature) (mid-slope of Cameron River valley)	Blue-headed vireo, red-breasted nuthatch, and dark-eyed junco.
Riparian	Ring-necked duck, spotted sandpiper, belted kingfisher.
Riparian/Shrubby fen Moist/wet/tall shrub area/ willow-dwarf birch	Common snipe, Lincoln's sparrow, clay-colored sparrow, white-crowned sparrow.
Riparian/wooded	Swamp sparrow, LeConte's sparrow, Tennessee warbler.
Wooded/shrubby bog Black spruce bog/stunted black spruce/ lichen/moss	Blackpoll warbler, palm warbler.
Wooded/shrubby fen Black spruce/scattered tamarack/ few mature white spruce	Tennessee warbler, chipping sparrow, yellow-rumped warbler, palm warbler, pine siskin (overhead).
Wooded bog/shrubby bog Black spruce bog/stunted wet areas	Dark-eyed junco, palm warbler, Tennessee warbler, chipping sparrow, yellow-rumped warbler, hermit thrush.
Wooded bog/shrubby bog Black spruce bog (mid to lower slope of Cameron River valley)	Palm warbler, hermit thrush, fox sparrow, yellow-rumped warbler, white-throated sparrow, and spruce grouse.

Adapted from Golder and Alpine 2001

Fragmentation effects were quantified in the Vegetation section (Section 7.8). However, fragmentation can affect wildlife species; much of the fragmentation-wildlife literature has focused on forest songbirds. For example, Ortega and Capen (1999) have shown that territory density for ovenbirds were lower within 150 m of roads than forested areas greater than 150 m of the road and that territory size was inversely related to distance from the road. However, they found no differences in reproductive success as a factor of distance from the road. Nonetheless, the reduced number of territories suggests that increasing the number of roads may have a significant cumulative effect on this species. Also, nest predation may be affected by proximity to roads, further suggesting that habitat quality is higher away from the road. For example, Boulet and Darveau (2000) found that predation of artificial bird nests was highest along forest-highway edges, intermediate in forest-logging road edges and riparian forest strips along lakes, and lowest in riparian forest strips along rivers. This is not necessarily the case when it comes to seismic lines. In a comparison of predation of artificial bird nests along natural edges (e.g., where two forest stands meet) versus anthropogenic edges (e.g., seismic lines, clear cuts), there was no increase in nest predation as a result of anthropogenic disturbances (Song and Hannon 1999). Thus, although fragmentation may result in some habitat degradation for songbirds, it appears that fragmentation does not affect reproductive output or productivity. It is likely that direct habitat loss is more critical for songbirds than forest fragmentation.

7.6.2 Listed Wildlife Species

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2003) evaluates the population status of wildlife species in Canada, and lists them accordingly:

- Endangered: A species facing imminent extirpation or extinction.
- Threatened: A species likely to become endangered if limiting factors are not reversed.
- Special Concern: A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Listed species are protected to varying degrees under the newly established SARA legislation (Bill C-5). SARA prohibits the killing, harming, harassing, capturing or taking of species officially listed as threatened, endangered or extirpated, and the destruction of their residences.

Seven wildlife species with historical ranges that overlap with the TSA have been listed by COSEWIC (2003), and therefore represent special management concerns (Table 7.6-4).

Table 7.6-4 COSEWIC Species Potentially in the Cameron Hills Region

Common Name	COSEWIC Status	RWED Status
Peregrine falcon – anatum subspecies	Threatened	At risk
Wood bison	Threatened	At risk
Woodland caribou	Threatened	Sensitive
Wolverine	Special concern	Secure
Short-eared owl	Special concern	Sensitive
Grizzly bear	Special concern	Sensitive
Yellow rail	Special concern	May be at risk

In addition to providing listings, COSEWIC provides information about why each species is listed (Table 7.6-5). This provides insight into the types of mitigation measures that are necessary to protect these species.

Table 7.6-5 Reasons for COSEWIC Listing

Common Name	Reasons for Listing
Peregrine falcon – anatum subspecies	Factors that limited its populations in the past (such as DDT, which led to a population crash), are now largely under control on the breeding grounds, but threats still exist on the wintering range.
Wood bison	Populations remain at risk from disease (brucellosis and tuberculosis) and hybridization with the Plains Bison subspecies.
Woodland caribou	Threatened from habitat loss and increased predation.
Wolverine	This species' habitat is increasingly fragmented by industrial activity, especially in the southern part of its range, and increased motorized access will increase harvest pressure and other disturbances. The species has a low reproductive rate and requires vast secure areas to maintain viable populations.
Short-eared owl	The main cause of concern is an important and well-documented decline in the past resulting from the loss of its preferred habitat.
Grizzly bear	The grizzly bear's habitat is at risk from expanding industrial, residential, and recreational developments. Its behavior frequently brings it into conflict with people, leading to increased mortality where human activities expand.
Yellow rail	Declining because of continuing habitat losses, especially on the wintering grounds.

Information gathered from http://www.cosewic.gc.ca/eng/sct1/searchform_e.cfm

7.6.3 Methods

7.6.3.1 Valued Ecosystem Components Selection

To assess the cumulative effects of development within the TSA, three wildlife species and one species guild were selected to quantify the impacts of various Development Cases. The species and guild selected are: woodland caribou, moose, marten and forest songbirds. The VECs selected for wildlife habitat assessment, and the rationale for their selection, are shown in Table 7.6-6.

Table 7.6-6 Valued Ecosystem Components Selection Rationale for Wildlife

VEC	Selection Rationale
moose	economic importance, recreational importance, ecological importance (early successional species), ease of monitoring, traditional importance, abundant information
woodland caribou	federal status, ecological importance, traditional importance
marten	traditional importance, ecological importance
forest songbird community	recreational importance, contains species of ecological importance, habitat specificity

7.6.3.2 Potential Impacts

Effects from the Cameron Hills Project on wildlife will be discussed in terms of the various components of the project: drilling, seismic, pipeline construction, and production operations. Project development typically progresses through the four components in order, permitting the reuse of elements disturbed earlier (i.e., seismic lines are utilized for drilling access, flow-line routing), during subsequent components. Approximately 50% of new disturbances will be re-used for other components of the project. Potential effects of the project include direct habitat loss, sensory disturbance potential, fragmentation, increased access and barriers to movement. Table 7.6-7 summarizes the potential effects on wildlife and wildlife habitat.

Table 7.6-7 Potential Effects to Wildlife and Wildlife Habitat and Proposed Mitigation for Paramount's Cameron Hills Project.

Project Effect	Proposed Mitigation
Loss or alteration of habitat.	▪ Pre-project surveys completed to identify sensitive locations for avoidance; ▪ Construction activities limited to the pipeline ROW and well leases; ▪ Maximum use of existing disturbance corridors (i.e., cutlines and winter access); ▪ Construction operations will be completed in an expeditious manner; ▪ Organic material soil seed bank salvaged for replacement during reclamation to assist natural plant regeneration; ▪ Revegetation program will be implemented as required.
Nest sites could be impacted.	▪ Pre-project surveys completed to identify sensitive locations so that they could be avoided; ▪ Construction completed during winter to avoid sensitive breeding and nesting periods; ▪ Nest trees encountered during construction (e.g., cavity nest) will not be cut down if possible.
Increased wolf predation along pipeline.	▪ Revegetation encouraged.
Creation of a long line-of-sight.	▪ Natural topography expected to provide visual obscurity to minimize lines-of-sight; ▪ Bends and corners on proposed pipeline route will reduce a long line-of-sight.
Construction noise and light may cause temporary displacement of wildlife.	▪ Construction completed in as expeditious manner as safety allows; ▪ All work maintained within the surveyed ROW and wellsites.
Habitat fragmentation may occur.	▪ ROW width will be minimized where possible; ▪ Pipeline routes will avoid paralleling potential animal movement corridors (i.e., drainages); ▪ Vegetation regeneration and encroachment encouraged on all access ROWs and well leases.
Increased access to remote areas.	▪ Staffed or locked gate during construction or when winter road is in service; ▪ No permanent all-weather road will be built along the ROW; ▪ Revegetation of the ROW not used for production operations will be encouraged.
Physical barriers to wildlife movement (e.g., slash windrows, snow berms).	▪ Openings left in snow berms, slash and spoil windrows at regular intervals or at known game trails to facilitate wildlife movement.
Wildlife harassment and habituation.	▪ Construction personnel will be instructed to keep a clean work area and to not harass animals encountered; ▪ Garbage and wastes will be properly disposed of; ▪ Firearms (except with written Paramount permission) and dogs prohibited on the project; ▪ Drivers instructed to be aware of wildlife and speed limits will be enforced.
Increased vehicle-wildlife collisions.	▪ Operators instructed to reduce speeds on the winter access; ▪ Openings left in snow berms at regular intervals to allow escape routes for animals caught on the ROW.

Project Effect	Proposed Mitigation
Visual barrier to movement for species such as caribou or other species that prefer cover.	▪ Access ROW width minimized and bends in the pipeline will limit the line-of-sight; ▪ Existing disturbance corridors used where feasible and widened; ▪ Natural encroachment of cover will occur over time.
Disturbance to wildlife during line inspections and operational inspections.	▪ Line inspections may be completed with a helicopter. ▪ Well inspections completed with ATVs, trucks or snowmobiles, depending on the season. ▪ Land based disturbance limited to the operational access routes.
Bridges may ease access across drainages for species such as wolves.	▪ Only applicable during the open-water season. ▪ Operational access, and associated crossings minimized to the extent feasible, with human safety considerations. ▪ It is anticipated that wolves would cross drainages regardless of the presence of the bridges.
Bird interactions may occur with the power lines.	▪ Routes are not within high use migratory bird areas. ▪ Powerlines will be placed adjacent to existing clearings.

7.6.3.2.1 Seismic

Seismic operations are typically short-term duration projects concentrated in small geographic areas. Seismic operations are typically seasonal in nature, and occur during periods of frozen ground conditions. Impacts associated with seismic include: direct habitat loss due to clearing, sensory disturbance potential, fragmentation, increased access and wildlife/human encounters.

7.6.3.2.2 Drilling

Drilling is typically a short-term activity, concentrated in small geographic areas (i.e., leases). Direct habitat loss, sensory disturbance and increased wildlife/human encounters are typical impacts. As drilling access typically use existing disturbances (i.e., seismic lines, camps) to the maximum extent feasible, clearing requirements are typically concentrated at the lease, the camp and at the water source lake. Like seismic programs, drilling in the Cameron Hills has typically been completed only under frozen ground conditions.

7.6.3.2.3 Flow-lining

Flow-lining operations are also typically short-term duration projects concentrated in small geographic areas. Existing disturbances are again utilized to the maximum extent feasible, thereby causing only small incremental disturbances. Other impacts associated with flow-lining operations include: sensory disturbance, wildlife/human encounters, and temporary displacement. Flow-lining operations are typically seasonal in nature, and occur during periods of frozen ground conditions.

7.6.3.2.4 Production

Production activities include the maintenance of existing infrastructure including wells, flow-lines and facilities. These activities are typically of medium-term duration, and occur over small (e.g., the ROW and lease) but wide spread (e.g., distance between wells and the battery) areas. Impacts from these activities differ from the other components because they are chronic in nature. Sensory disturbance occurs year-round but is intermittent on the leases and ROWs, and more constant at the battery, where activity is concentrated. Other impacts such as habitat loss do not normally occur, as additional clearing is not required, and displacement is reduced following wildlife habituation to the disturbance.

7.6.3.3 Residual Impacts

Assessments completed for the previous Paramount project components on the Cameron Hills (Golder and Western 2000; Golder and Alpine 2001) predicted that the residual impacts resulting from the exploration and production activities may include: direct habitat loss/alteration from clearing, sensory disturbance potential, habitat fragmentation, barriers to movement and increased access (i.e., wolves and hunters/trappers).

Air dispersion modelling results presented in Section 7.2 predict that the ground level impacts are below the established air quality criteria. Therefore, no direct impacts on wildlife are expected to occur as a result of the emissions associated with the Development Cases. Indirect effects of air emissions on wildlife resulting from changes in the vegetation communities are also not predicted. Predicted ground level concentrations are below those levels identified as resulting in vegetation effects, therefore no indirect impacts on wildlife are expected. As such, no residual impacts to wildlife resulting from air emissions are predicted.

7.6.3.4 Cumulative Effects Assessment Methods

7.6.3.4.1 General Approach

The predicted residual effects outlined in the previous section will be assessed quantitatively and qualitatively for each Development Case. A quantitative assessment of direct and indirect habitat loss is described below for direct and sensory disturbance potential; while fragmentation effects were quantified in the Vegetation section (Section 7.8). A qualitative assessment will be conducted for the effects of increased access on hunting, trapping and predation issues and barriers to movement based on development of linear disturbances within the TSA.

7.6.3.4.2 Habitat Suitability Index (HSI) models

A habitat suitability approach was taken to assess the availability of wildlife habitat in the TSA and to predict the effects of each of the Development Cases on wildlife habitat quality and quantity. The approach was a simplified version of the habitat evaluation procedures of the U.S. Fish and Wildlife Service (1981) that use habitat suitability index (HSI) models to quantify habitat.

HSI models are analytical tools for determining the relative potential of an area to provide habitat for wildlife species. Habitat is defined in the models according to physical structures, the land area of vegetation communities and the arrangement of these communities in the landscape. An assumption made when modeling habitat suitability is that the total amount of habitat is related to the potential of the land to support individuals or populations of a wildlife species. It is also assumed that habitat areas may be summed within an area of interest to determine the total area of habitat, expressed as habitat units (HUs), available to a species. Once habitat areas are summed, they can be used to quantify habitat losses and gains as a result of changes in land use. These changes were tracked and quantified with use of GIS.

Simple HSI models were derived for the project using habitat rankings from previous EIAs, results of incidental field observations, literature review, review of secondary information, and professional judgment by experienced biologists.

Indices were used to evaluate the habitat quality for each key species in the vegetation types sampled. Four levels or scores of habitat suitability were employed: 0 = nil, 0.33 = low, 0.67 = moderate and 1.0 = high suitability. These indices were then used to quantify habitat changes as a result of the Development Cases. Appendix V has descriptions of the HSI model for each species used in this assessment.

For each Development Case, a summary of the area in hectares (ha) of each vegetation type in the TSA was generated. The HSI values generated for each vegetation type were multiplied by the area (ha) of the vegetation type to determine the number of habitat units (HUs) available for each wildlife species. Using the aspen mature closed vegetation type and the woodland caribou as an example, there is a total of 579 HUs available for this habitat/species pairing in the TSA. This is derived by multiplying the total area of the aspen mature closed vegetation type in the TSA (1,755 ha) with the associated HSI value for the woodland caribou (0.33). HUs for each vegetation type were then summed to derive a total HU value for the TSA for each key species. Changes in HUs for each Development Case were then summarized by overlaying the development footprint and removing habitat. This allowed the potential impact for each Development Case to be quantified.

7.6.3.4.3 Sensory Disturbance Potential

Wildlife species may avoid or reduce their use of habitat adjacent to areas of human activity. These indirect impacts are related to sensory disturbance, and generally, the effectiveness of habitat in supporting wildlife needs is reduced. An assessment on the suitability of habitat is not considered complete unless the effects of sensory disturbance are taken into account.

Once the disturbance layers were created for each Development Case, disturbance features were buffered to reflect the Zones of Influence (ZI) of disturbance. A ZI is the assumed maximum distance to which a disturbance (e.g., noise) influences wildlife use of habitat. A Disturbance Coefficient (DC) is applied in the ZI. The DC is the effectiveness of the habitat within the ZI in fulfilling the requirements of a particular species. Disturbance Coefficients were assumed to remain constant over the ZI. For example, a habitat with a DC of 0.5 represents 50% habitat effectiveness. Different ZI and DC are applied for each VEC and each human activity type (Table 7.6-8).

Table 7.6-8 Valued Ecosystem Components Zones of Influence and Disturbance Coefficients by Disturbance Type

Species	Disturbance Type					
	Access		Facilities and Developments [a]		Utility Corridors [b]	
	ZI (m) [c]	DC 2[d]	ZI	DC	ZI	DC
Moose	250	0.5	250	0.5	100	0.5
Woodland caribou[e]	100 250 500 1000	0 0.25 0.5 0.75	250	0.5	100	0.5
Marten	250	0.25	250	0.5	100	0.5
Forest Songbirds	50	0.5	50	0.5	50	0.5

(a) New wellsites and associated infrastructure
(b) Seismic lines, power lines and pipelines
(c) Zone of influence refers to the maximum distance that a disturbance will potentially affect the species
(d) Disturbance coefficient refers to the multiplier used to reduce habitat effectiveness or suitability.
(e) Woodland caribou ZI and DC based on Dyer (1999)

For most wildlife species, data on the degree of habitat avoidance due to sensory disturbance is limited. As a result, most displacement models rely heavily on professional judgement when quantifying the degree of sensory disturbance a development produces and how it influences the behaviour of a given species. Information on woodland caribou was based on work done by Dyer (Dyer 1999).

The use of the DCs and ZIs presented in Table 7.6-8 represents a conservative approach to assessing the impacts of sensory disturbance. This approach reflects the behaviour and habitat needs of animals that would be sensitive to human disturbance rather than habituated animals that may exhibit tolerance to sensory disturbance. It is anticipated that most animals will learn to tolerate noise as long as the disturbance is predictable in both time and space.

Most wildlife species are likely to exhibit some degree of sensitivity to human disturbance. This sensitivity varies based on aspects of their behaviour including the degree to which they adapt and habituate to human disturbance. A conservative approach (i.e., worst case scenario) was used, as roads in the Cameron Hills study area are only winter roads, thus they are not used on a year-round basis. As indicated in Table 7.6-8, the ZI is greatest for road and facility disturbance types, while for utility corridors the ZI is much lower. Using marten as an example, with a road disturbance DC of 0.25 and ZI of 250 m, all habitat within 250 m of a road is only 25% as effective as similar habitat beyond 250 m.

Information on habitat avoidance within a specific ZI was not available for the songbird community. This VEC was considered to be less affected by disturbance than ungulates and carnivores due to their small home ranges. As a result, the ZI surrounding human facilities and developments was set at 50 m. As most of the disturbance in the project area is during the winter months, this is felt to be a conservative approach as songbirds are not present during this time.

This approach for assessing indirect habitat loss due to sensory disturbance is considered to be ultra-conservative, revealing an unlikely, worst-case scenario. Sensory disturbance is dynamic in nature, and this modeling approach is static. The model does not account for progressive reclamation and natural encroachment of vegetation. In addition, the model does not account for other mitigation strategies such as seasonality of disturbance or habituation. For these reasons, the confidence in the findings is considered low; the data are still presented to provide an indication of sensory disturbance potentially resulting from the project.

Most wildlife species can adapt to sensory disturbance if it is predictable in time and space, which the Paramount project is. The constant operation of pumps and flares on wellsites would typically represent a low impact noise, with species such as moose expected to become habituated to the noise.

It is predicted that large wildlife species such as lynx and caribou, which are less tolerant of disturbance will avoid active production areas due to vehicular and human noise and light at these areas. The distance of this temporary avoidance is expected to vary, depending on the individual and the species. This avoidance is expected to be mitigated by the expected low densities of these species in the general project area during the winter months. Smaller mammals may not be influenced as greatly as moose and caribou. Any avoidance is predicted to last for the life of the project in that local area, and it is predicted that animals will return to use the habitat once the project is complete, noise levels cease, and revegetation occurs.

7.6.4 Results

7.6.4.1 Environmental Setting

Results from the HSI models for the Environmental Setting Case within the TSA are presented in Table 7.6-9. The results indicate that marten, with 57,689 habitat units (HU) and woodland caribou (55,274 HU) have the greatest amount of suitable habitat within the TSA. The model results also indicate that moose have the least amount of suitable habitat within the TSA. Figures 7.6-1 to 7.6-4 show results of the HSI models for each VEC under the Environmental Setting Case with the project footprint overlayed.

Table 7.6-9 Environmental Setting Habitat Units

Species	Environmental Setting HUs
Woodland caribou	55,274
Moose	35,259
Marten	57,689
Forest Songbirds	41,849

HUs = Habitat Units.

7.6.4.2 Baseline Case

7.6.4.2.1 Existing Information

Multi-day, winter track count surveys have been conducted as part of a five-year wildlife monitoring program conducted by Paramount on their gathering system and Transborder Pipeline (Golder 2003). The tracks of nine wildlife species were observed on the transects: Canada lynx, grouse, marten, a mouse/vole species, mink, red fox, red squirrel, snowshoe hare, and a weasel species. No moose, woodland caribou, or wolf tracks were observed

Analysis of the transect data suggested that habitat type had a significant effect on the abundance of wildlife. There was greater wildlife activity in the mixedwood and pine habitat types, as compared with the black spruce and riparian habitat types.

Paramount and their contractors also report all wildlife sightings and sign observed within the project area, by using Wildlife Sighting Cards. These cards provide for information on:

- Observer's name and company affiliation;
- Wildlife Sightings (species, number, activity or behaviour);
- Wildlife Sign (browse, pellets, scat, tracks);
- Location; and
- Interaction (human-wildlife or vehicle-wildlife).

The following paragraphs provide a summary of information collected within Paramount's SDL. See Appendix VI for all information collected in 2002 and 2003.

In 2002, information from completed Wildlife Sighting Cards show that wildlife observed in project area include: wolf, lynx, marten, wolverine, grouse sp. (referred to as spruce hen or prairie chicken), ptarmigan, fox, beaver, black bear, Canada goose, woodland caribou, eagle, mallard, moose, porcupine, sandhill crane, spruce grouse, and wolf. Specific locations of the sightings are often lacking, making direct inference to project components difficult. With respect to SARA species, 7 observations (animals and/or tracks) were reported for caribou, and 5 observations for wolverine. Based on the locations provided, caribou sightings in the project region ranged from a single caribou observed approximately 3 km from N-28, to 4 groups of tracks within the TSA, and to 2 sets of tracks with no location provided. All 5 of the wolverine tracks noted appear to be within the TSA. Also of note, one of the black bear sightings was at the C-50 well, where a sow and cub walked onto the lease to eat grass while men were working.

Information from the 2003 Wildlife Sighting Cards includes observations made between January and the beginning of April. Species observed in or near the TSA include: woodland caribou, grouse sp., lynx, coyote, marten, mink, porcupine, snowshoe hare (referred to as rabbit on cards), squirrel, weasel sp, gray jay, and wolverine. SARA species observations included a single wolverine track and 19 observations of caribou and/or their tracks. The lone wolverine track was noted on the G-74 wellsite/flowline in March. Fourteen of the caribou locations cannot be confirmed, four appear to be within the TSA, and 1 is located outside the TSA. Of the four observations in or near the TSA, three herds of 4, 6 and 15-16 animals were all noted near the Alberta/NT border; the fourth observation was tracks on the C-74 lease/flowline. Observations were made from the winter road, as well as the other project components such as pipeline ROWs and leases. The bison that were recorded in 2003, were outside the TSA, and well into Alberta.

What is not clear from the Wildlife Sighting Card information, is the overlap of observations of the same animals by different observers, or on different days within the same area. However, the data clearly shows that a diverse assemblage of wildlife, including SARA listed species, continue to utilize the habitat available within the TSA, including the access and leases.

7.6.4.2.2 Habitat Loss / Alteration

HSI model results for both direct habitat loss as a result of the project footprint and sensory disturbance potential for the Baseline Case are presented in Table 7.6-10 and Table 7.6-11, respectively. Approximately 2% of habitat for all VECs has been directly lost due to existing/ approved developments under Baseline conditions, compared with the Environmental Setting (Table 7.6-10).

Table 7.6-10 Direct Habitat Loss for Valued Ecosystem Components: Baseline Case

Species	Environmental Setting HUs	Loss of Habitat Units Following Baseline Case – Direct Impacts	
		HUs Lost	% of Environmental Setting
Woodland caribou	55,274	1180	2.1%
Moose	35,259	717	2.0%
Marten	57,689	1176	2.0%
Forest Songbirds	41,849	851	2.0%

HUs = Habitat Units.

Table 7.6-11 Sensory Disturbance Potential for Valued Ecosystem Components: Baseline Case

Species	Environmental Setting HUs	Sensory Disturbance Potential Baseline Case – Indirect Impacts	
		Affected HUs	% of Environmental Setting
Woodland caribou	55,274	11,922	22%
Moose	35,259	6,511	18%
Marten	57,689	10,979	19%
Forest Songbirds	41,849	4,654	11%

HUs = Habitat Units.

Sensory disturbance potential affected 11% to 22% of VEC habitat for the Baseline Case compared to the Environmental Setting case (Table 7.6-11). These values are due to conservative estimates of sensory disturbance and the level of seismic cutline disturbance (i.e., 2,668 km of seismic existing and approved). Most of the seismic lines will be allowed to revegetate, and will not be subjected to any additional disturbance. The indirect impact results indicate that woodland caribou are potentially impacted to the greatest extent, primarily because they are susceptible to disturbance over a greater distance (Table 7.6-8).

7.6.4.2.3 Barriers to Movement and Increased Access

The assessment of these potential effects were combined as they are related to the amount of linear disturbances. The amount of linear disturbance for the Baseline Case is 2,882 km (i.e., 2,668 km of seismic and 214 km of access and pipeline ROW), this equates to a linear disturbance density of 3.0 km/km^2. However, this disturbance is relatively localized in the central and southern areas of the SDL, and does not extend throughout the entire TSA. Therefore, it is anticipated that barrier effects on wildlife movement from the project would be localized, both in time (i.e., winter season only) and space (i.e., localized within the seismic program areas). In addition, there are relatively low densities of animals in the Cameron Hills that could be affected, thus any barrier effects would be predicted to be minimal.

Increased access through linear disturbances may lead to increased hunting, trapping and predation. For reasons stated above, increased access is predicted to be localized and there will not be equal opportunities for access throughout the TSA. The Cameron Hills are remote and potentially difficult to get to, particularly during the unfrozen seasons, which would tend to limit the potential for access, for any reason. As animal densities are typically low, it is anticipated that increased opportunities for hunting and trapping would be low.

There have been limited observations of wolves in the Cameron Hills, likely due to low densities of prey species. The majority of observations in 2002, were of a single animal, or its tracks, in the vicinity of the camps. No wolves were reported in the TSA in 2003. Therefore, increased predation from wolves due to increased ease of access is anticipated to be negligible.

7.6.4.3 Application Case

7.6.4.3.1 Habitat Loss / Alteration

HSI model results for both direct habitat loss and sensory disturbance potential for the Application Case are presented in Tables 7.6-12 and 7.6-13, respectively. The data are presented in both an incremental and cumulative perspective to illustrate the potential changes caused by the Application Case. The incremental loss from current conditions in the Cameron Hills (i.e., Baseline Case) is <1% (i.e., 0.1%) (Table 7.6-12). The Application Case results in a cumulative direct habitat loss of 2.2% habitat for all VECs, when compared with Environmental Setting Case (Table 7.6-12).

Table 7.6-12 Incremental and Cumulative Direct Habitat Loss for Valued Ecosystem Components: Application Case

Species	Environmental Setting HUs	Loss of Habitat Units Following Application Case – Direct Impacts				
		Incremental Since Baseline Case		Cumulative (Baseline + Application)		
		Loss of HUs	% of Environmental Setting	Loss of HUs	% of Environmental Setting	% Increase Since Baseline
Woodland caribou	55,274	18	<1%	1,198	2.2%	<1%
Moose	35,259	12	<1%	729	2.1%	<1%
Marten	57,689	18	<1%	1,194	2.1%	<1%
Forest Songbirds	41,849	15	<1%	866	2.1%	<1%

HUs = Habitat Units.

Sensory disturbance potential is anticipated to increase by <1% from the Baseline Case for all VECs except woodland caribou, which shows 2.7% of habitat affected by sensory disturbance (Table 7.6-13). Cumulative indirect habitat loss due to sensory disturbance ranges from 11% for forest songbirds to 24% for woodland caribou (Table 7.6-13).

Table 7.6-13 Incremental and Cumulative Sensory Disturbance Potential for Valued Ecosystem Components: Application Case

Species	Environmental Setting HUs	Sensory Disturbance Potential Application Case – Indirect Impacts				
		Incremental Since Baseline Case		Cumulative (Baseline + Application)		
		Affected HUs	% of Environmental Setting	Affected HUs	% of Environmental Setting	% Increase Since Baseline
Woodland caribou	55,274	1,464	2.7%	13,386	24.2%	2.7%
Moose	35,259	190	0.5%	6,701	19.0%	0.5%
Marten	57,689	365	0.6%	11,345	19.7%	0.6%
Forest Songbirds	41,849	54	0.1%	4,708	11.2%	0.1%

HUs = Habitat Units.

7.6.4.3.2 Increased Access and Barriers to Movement

Increased linear disturbance for the Application Case consists of 22 km, however, only 6.6 km of this is new disturbance, while 15 km of 18 m ROW will be developed on existing seismic lines. This amounts to a 0.2% increase of linear disturbance length over the Baseline Case. Therefore, the Application Case is expected to result in a negligible effect to wildlife VECs as a result of increased access and barriers to movement.

7.6.4.4 Planned Development Case

7.6.4.4.1 Habitat Loss / Alteration

HSI model results for both direct habitat loss and sensory disturbance potential for the Planned Development Case are presented in Table 7.6-14 and Table 7.6-15, respectively. The Planned Development Case is predicted to result in an increased direct habitat loss of 0.1% (marten) to 0.4% (caribou) over the Application Case (Table 7.6-14).

Cumulatively, direct impacts are anticipated to result in direct habitat losses of 2.2% (marten and forest songbirds) to 2.3% (woodland caribou) as a result of Paramount's Planned Development Case footprint in the Cameron Hills (Table 7.6-14). When compared with existing and approved disturbances (i.e., Baseline Case) in the Cameron Hills, this amounts to direct habitat losses of <1% for all VECs (Table 7.6-14).

Table 7.6-14 Incremental and Cumulative Direct Habitat Loss or Valued Ecosystem Components: Planned Development Case

Species	Environmental Setting HUs	Loss of Habitat Units Following Planned Development Case – Direct Impacts				
		Incremental Since Application Case		Cumulative (Baseline + Application + Planned Development)		
		Loss of HUs	% of Environmental Setting	Loss of HUs	% of Environmental Setting	% Increase Since Baseline
Woodland caribou	55,274	77	0.4%	1,275	2.4%	0.2%
Moose	35,259	66	0.2%	795	2.3%	0.2%
Marten	57,689	62	0.1%	1,256	2.2%	0.1%
Forest Songbirds	41,849	66	0.2%	932	2.3%	0.2%

HUs = Habitat Units.

Sensory disturbance potential for the Planned Development Case reaches its greatest levels for all VECs (Table 7.6-15). The highest levels and greatest increases in indirect habitat loss are anticipated for woodland caribou (i.e., 31%). Indirect habitat loss for woodland caribou is anticipated to increase 9% from the Baseline Case. Moose and marten are predicted to experience a <3% increase in indirect habitat loss compared to the Baseline Case, while songbird communities experience the lowest (<1%) increase in indirect habitat loss compared to the Baseline Case.

Table 7.6-15 Incremental and Cumulative Sensory Disturbance Potential for Valued Ecosystem Components: Planned Development Case

Species	Environmental Setting HUs	Sensory Disturbance Potential Planned Development Case – Indirect Impacts: Incremental Since Application Case		Cumulative (Baseline + Application + Planned Development)		
		Loss of HUs	% of Environmental Setting	Loss of HUs	% of Environmental Setting	% Increase Since Baseline
Woodland caribou	55,274	3,473	6.3%	16,859	30.5%	8.9%
Moose	35,259	725	2.1%	7,426	21.0%	2.6%
Marten	57,689	1,243	2.2%	12,588	21.8%	2.8%
Forest Songbirds	41,849	179	0.4%	4,887	11.7%	0.5%

HUs = Habitat Units.

7.6.4.4.2 Increased Access and Barriers to Movement

The Planned Development Case results in an additional 75 km of linear disturbance from the Project Application Case, however, 70 km of this disturbance will be built on existing seismic lines. Thus, the cumulative amount of linear disturbance under the Planned Development Case is 2,887 km for a total density of 3.0 km/km^2 within the TSA. There is little difference in the amount of linear disturbance under the Planned Development Case when compared to the Baseline Case. The Planned Development Case is predicted to result in a negligible effect on increased access and barriers to movement when compared to the current conditions.

7.6.4.4.3 Residual Impact Classification

The residual impact classification for direct habitat loss, sensory disturbance potential, and increased predation/hunting/trapping due to increased access and barriers to movement for each VEC species is presented in Table 7.6-16. Magnitude was determined based on quantified information for direct and indirect habitat loss; while a qualitative assessment of magnitude was conducted for increased predation/hunting/trapping and barriers to movement. Geographic extent was considered to be regional (i.e., TSA), duration was determined to be medium-term (i.e., life of the project), all effects were considered to be reversible through mitigation and/or reclamation, and frequency was considered to be low.

Table 7.6-16 Residual Impact Classification for Wildlife – Planned Development Case

Parameter	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Environmental Consequence
Direct Habitat Loss							
Woodland caribou	negative	low (+5)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	negligible (+5)
Moose	negative	low (+5)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	negligible (+5)
Marten	negative	low (+5)	local (0)	medium-term (+2)	reversible (-3)	low (0)	negligible (+4)
Forest Songbirds	negative	low (+5)	local (0)	medium-term (+2)	reversible (-3)	low (0)	negligible (+4)
Sensory Disturbance Potential							
Woodland caribou	negative	high (+15)	regional (+1)	short-term (+1)	reversible (-3)	low (0)	moderate (+14)
Moose	negative	high (+15)	regional (+1)	short-term (+1)	reversible (-3)	low (0)	moderate (+14)
Marten	negative	high (+15)	local (0)	short-term (+1)	reversible (-3)	low (0)	moderate (+13)
Forest Songbirds	negative	moderate (+10)	local (0)	short-term (+1)	reversible (-3)	low (0)	low (+8)
Increased Predation/Hunting/Trapping							
Woodland caribou	negative	low (+5)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	negligible (+5)
Moose	negative	low (+5)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	negligible (+5)
Marten	negative	low (+5)	local (0)	medium-term (+2)	reversible (-3)	low (0)	negligible (+4)
Forest Songbirds	negative	negligible (0)	local (0)	medium-term (+2)	reversible (-3)	low (0)	negligible (0)
Barriers to Movement							
Woodland caribou	negative	moderate (+10)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	low (+10)
Moose	negative	moderate (+10)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	low (+10)
Marten	negative	moderate (+10)	local (0)	medium-term (+2)	reversible (-3)	low (0)	low (+9)
Forest Songbirds	negative	moderate (+10)	local (0)	medium-term (+2)	reversible (-3)	low (0)	low (+9)

The environmental consequence from residual impacts does not consider far future conditions after reclamation and natural vegetation encroachment. It is anticipated that reclamation and encroachment will restore habitat quantity and quality to similar levels under the Environmental Setting (see Section 7.6.4.5 below).

The probability that the impacts in the Baseline Case will occur is rated high because they already exist or are permitted. Assuming the Application Case is approved, there is a high probability that the impacts would occur. The probability of impacts predicted for the Planned Development Case is considered to be moderate, because there is uncertainty about the number and the timing of developments in the region.

7.6.4.5 Far Future Case

A Far Future Case was developed to assess the wildlife habitat potential of the predicted vegetated landscape of the TSA 50 years post-operations (i.e., 2073), following reclamation and regeneration of the natural cover. This case was developed by making assumptions as to how vegetation communities, through natural encroachment and reclamation, will respond to disturbances after operations have ceased. Assumptions for determining landscape conditions under the Far Future Case are outlined in the vegetation section (Section 7.8.3.4).

HSI models were run on the Far Future landscape to determine the potential habitat quantity and quality for VEC species. HSI results for the Far Future Case show that habitat quantity is slightly more (i.e., 100%) than under the Environmental Setting Case for caribou and moose and slightly less (i.e., 99%) for marten and forest songbirds (Table 7.6-17).

Table 7.6-17 Far Future Case Habitat Units

Species	Environmental Setting HUs	Far Future HUs	% of Environmental Setting Habitat Returned
Woodland caribou	55,274	55,550	100%
Moose	35,259	35,280	100%
Marten	57,689	57,005	99%
Forest Songbirds	41,849	41,554	99%

HUs = Habitat Units.

7.6.5 Wildlife Conclusions

7.6.5.1 Direct Habitat Loss

Direct habitat loss as a result of the Planned Development Case is low for all VEC species, with losses ranging from 2.2% (marten) to 2.3% (woodland caribou). The environmental consequence of direct habitat loss was determined to be negligible for all VECs including species listed by COSEWIC. The probability of this effect being realized is moderate due to uncertainties associated with the anticipated project footprint, depending on drilling success and other financial considerations. However, it is probable that a smaller footprint may occur.

7.6.5.2 Sensory Disturbance Potential

The greatest effect of the Planned Development Case on wildlife was due to sensory disturbance potential. Sensory disturbance potential under the Planned Development Case ranged from 12% for forest songbirds to 31% for woodland caribou. This magnitude of change resulted in a moderate (caribou) to low (forest songbirds) environmental consequence. The probability of these effects being realized by wildlife VECs, including COSEWIC listed species, is considered to be low to moderate due to uncertainties related to species responses and individual responses to different sources and levels of sensory disturbance. The approach for assessing sensory disturbance was considered to be ultra-conservative, considering that clearing and construction will only occur in the winter when migratory species are absent.

7.6.5.3 Increased Predation/Hunting/Trapping

The Planned Development Case is predicted to result in 2,887 km of linear disturbance within the TSA for a total linear disturbance density of 3.0 km/km^2. Increased predation/hunting/trapping due to this increased access was predicted to have a negligible environmental consequence for all VEC species. Although this is a high level of linear disturbance, due to the remoteness of the Cameron Hills and low densities of wildlife, this area typically experiences little human use. Wolf observations have been low, likely a result of low prey densities, thus predation rates are not expected to greatly increase as a result of increased access. The probability of these effects being realized by wildlife VEC, including species listed by COSEWIC is low to moderate, due to uncertainties associated with species responses to linear disturbances.

7.6.5.4 Barriers to Movement

The Planned Development Case is expected to result in 2,887 km of linear disturbance within the TSA for a total linear disturbance density of 3.0 km/km^2. These disturbances were assessed for their potential to act as a physical barrier for species movement. In addition, the amount of sensory disturbance also was considered as a potential barrier for movement. This qualitative assessment resulted in an environmental consequence of negligible for all VEC species. The probability of this effect being realized by wildlife VEC, including species listed by COSEWIC is moderate due to uncertainties as to responses of species and individuals to linear disturbances and sensory disturbance, and overall low wildlife densities.

7.6.5.5 Far Future Case

The Far Future Case represents a hypothetical vegetated landscape based on reclamation and natural vegetation encroachment on disturbed portions of the project footprint. Habitat quantity for this case was shown to be comparable to pre-disturbance conditions (i.e., Environmental Setting Case) with moose and woodland caribou having slightly higher amounts of available habitat (i.e., an approximate 1% increase) and marten and forest songbirds having slightly less amounts of available habitat (i.e., approximately 1% decrease) as compared to the Environmental Setting Case. The probability of landscape conditions under the Far Future Case being realized is considered to be moderate, due to uncertainties with encroachment in some vegetation types as a result of growing conditions in the Cameron Hills. As such, the carrying capacity of the habitat in the Far Future Case is expected to support a similar assemblage of wildlife species, as would occur under natural processes.

7.7 FISH

This section addresses Section G-5 of the MVEIRB ToR:
This section should deal with direct impacts on fish and wildlife, e.g., through short-term disturbance, interruptions of fish and wildlife movement, and changes to habitat. In particular, the DAR is to address changes in effective or critical habitat for boreal woodland caribou. Also, the DAR should identify any species protected by the Species At Risk Act and describe how potential impacts will be minimized.

7.7.1 Environmental Setting (1960)

The Cameron River originates in the northeast portion of the Cameron Hills Plateau, flows southwest through the middle of the plateau and turns north before emptying into Tathlina Lake. The watershed relief of the Cameron River is minimal and the headwater reach contains numerous shallow waterbodies and wetlands.

As there is limited information available on the extent and/or condition of the fisheries and fish habitat within the SDL prior to development, we can only assume that the investigations described in previous EIAs (Golder and Alpine 2001) represent the pre-disturbance Environmental Setting (circa 1960). There has been some early hydrocarbon exploration documented north of the SDL (south of Tathlina Lake; 1959 and 1973), and northeast of the SDL (northwest of Buffalo Lake; 1969) (Janicki n.d.).

The drainages within the SDL, based on the digital map created by Universal Surveys (1999), are comprised of the Cameron River (38.9 km) and unnamed drainages (132.8 km). To generate representative areas of available fisheries habitat within the drainages, we used field measurements (Golder and Alpine 2001) to calculate an average bankfull channel width for the drainages. The average width of the Cameron River was calculated to be 33.8 m (n=3), while the average width for the remaining drainages was calculated to be 4.2 m (n=14). These measurements indicate that the Cameron River provides a maximum of 131 ha of wetted area, while the drainages provide 56 ha of wetted area, containing an undetermined area of useable fish habitat. To provide quantitative comparison, we use this wetted area as a surrogate for fish habitat.

Minimal baseline historical information for fish and fish habitat in the Cameron Hills area was identified during the development of the EIA for the Paramount gathering system and facilities project (Golder and Alpine 2001). In general, other than the Cameron River, fish habitat was limited within the general project area, due to shallow water depths and lack of pool or deep run habitats suitable for overwintering of fish species.

Little documentation exists for commercial or domestic fishing use, as access to the CESA is limited primarily to winter roads and/or helicopter and floatplane. The closest commercial fishery identified downstream of the Cameron Hills was Tathlina Lake. The lake has supported a commercial fishery for walleye (*Stizostedion vitreum*) since 1953 (Roberge et al. 1988). Department of Fisheries and Oceans (DFO 1979) conducted an experimental gill netting program to determine the status of the walleye populations in Tathlina Lake. During this work, northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*), burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*) and white sucker (*Catostomus commersoni*) were also identified in the lake (Table 7.7-1).

Table 7.7-1 Fish Species Reported to be Present or May Occur within the Cameron Hills Significant Discovery Lease Area

Species		Present[a]	Potential[b]
Common Name	**Scientific Name**		
Arctic grayling	*Thymallus arcticus* (Pallas)		X
Burbot	*Lota lota* (Linnaeus)	X	
Lake whitefish	*Coregonus clupeaformis* (Mitchill)	X	
Tullibee (Cisco)	*Coregonus artedi* Lesueur		X
Northern pike	*Esox lucius* Linnaeus	X	
Walleye	*Stizostedion vitreum vitreum* (Mitchill)	X	
Longnose sucker	*Catostomus catostomus* (Forster)	X	
White sucker	*Catostomus commersoni* (Lacepède)	X	
Lake chub	*Couesius plumbeus* (Agassiz)	X	
Brook stickleback	*Culaea inconstans* (Kirtland)	X	
Emerald shiner	*Notropis atherinoides* Rafinesque		X
Sculpin spp.	*Cottus spp.*		X

(a) Present in the watershed based on literature or field investigations.
(b) Exist in Hay River drainage (Nelson and Paetz 1992; Jim Rosen, ASRD pers. comm. 2003).

Two lakes that drain into the Cameron River from the west were identified to have potential to support northern pike (Helmer 1990). A northern pike was reported to have been angled in the southern lake, currently identified as a water source Lake #1 (Figure 7.4-2). Similar habitat conditions (e.g., depth, size, and substrate) were reported for the second lake within the same drainage and it is presumed to also contain northern pike.

Test net sampling was conducted in 1992 by Alberta Sustainable Resource Development (Jim Rosin, ASRD, Peace River, pers. comm. 2003) in the Alberta portion of the Cameron Hills and included Johnson Lake (Table 7.7-2). The fish species present included northern pike, lake whitefish, burbot, and tullibee (*Coregonus artedi*).

In July 2000, 58 waterbody crossings for pipelines and access, and one lake (potential water source location) within the Cameron Hills area were assessed for fish and fish habitat potential (Golder and Alpine 2001; Golder unpublished data). In general, the fisheries potential in the surveyed streams was limited. Several of the crossing locations were low-lying drainages with unconfined channels and depths insufficient to provide overwintering habitat to fish species. Beaverdam obstructions were also noted on many of these streams, creating barriers to upstream fish movements. The lake, now designated as Lake #3, had a mean depth of 1.0 m, a maximum depth of 1.5 m, and was considered to be not capable of supporting a self-sustaining fish community.

Table 7.7-2 Fish Species Sampled from Selected Lakes in the Alberta Portion of the Cameron Hills, 1992

Lake	Land Location	Species
Johnson Lake	Sec. 8 -126-21-W5	Lake whitefish Northern pike Tullibee Burbot
Little Johnson Lake	Sec. 2 -126-21-W5	Lake whitefish Northern pike Tullibee Burbot
Skinny or Long Lake	Sec. 11 -126-21-W5	Lake whitefish Northern pike Burbot
Unnamed Lake	Sec. 35 -125-22-W5	Northern pike Burbot

Source: Jim Rosen, ASRD, pers. comm.. 2003

Forage fish species (i.e., white sucker, longnose sucker, lake chub *[Couesius plumbeus]*, and spoonhead sculpin *[Cottus ricei]*) were sampled from two locations on the Cameron River, while longnose sucker, lake chub, and brook stickleback *[Culaea inconstans]* were collected from a tributary to the Cameron River (Golder and Alpine 2001). Several of the fish captured were juveniles, indicating that spawning and rearing habitat were available within the system.

Walleye and northern pike were not captured during the fisheries investigations (Golder and Alpine 2001), however these species are present in surrounding drainages (Tathlina Lake, Kakisa River, unnamed lake) and may reside in the Cameron River in low numbers. Fisheries potential for northern pike and walleye was considered low in the upper reaches of the drainage based on available habitat; however, the Cameron River contained suitable spawning, rearing, feeding and overwintering habitats for these species. A high gradient section of the river located downstream of the SDL may restrict upstream migratory movements of fish from Tathlina Lake.

As such, we assume that the fish and fish habitat in the region were under natural conditions during the Environmental Setting Case, with potential limited disturbance from traditional land use and natural environmental conditions. For example, the aerial surveys completed in the 1960s (Colosimo 1968, Lines 1969) noted several beaver lodges on the Cameron River and adjacent lakes. This suggests that beaver activity in the area (e.g., dams) may have historically been affecting fish movements in given areas or drainages. Further, natural high water level events, such as spring runoff, are expected to have caused erosion along the banks of the Cameron River and the tributaries, particularly on outside bends or cuts in the banks that caused eddies to form. The amount of siltation caused by this erosion, and the resulting effects (e.g., siltation on eggs, increased turbidity) on fish, was likely variable. However, this is a natural occurrence, and therefore this effect would fall within natural variability, with the severity and duration dependant on spring runoff levels and high rainfall events.

Tathlina Lake is shallow, and elders noted that the lake becomes turbid when the wave action stirs up the bottom of the lake. Fish that have survived in this environment would be expected to have adapted to the varying conditions of this lake, as it pertains to shallow depths and increased turbidity during windy periods.

7.7.2 VEC Selection

Fish and fish habitat were identified as VECs for the project, primarily based on their importance as a food source for humans (i.e., traditional land use) and other wildlife (e.g., bald eagles), as identified in past assessments, community consultation meetings and traditional knowledge reports. Therefore the VECs selected for this assessment are:

- fish habitat; and
- fish distribution and abundance.

Discussions for the CEA are primarily related to qualitative assessments of fish species that are presumed to inhabit the drainages and waterbodies, the habitat types that are potentially present in these drainages and waterbodies, and the potential effects from the various Development Cases to which the CEA has been applied. The number of drainage crossings and extent of drawdown at watersource lakes are discussed qualitatively.

7.7.3 Spatial and Temporal Boundaries

The past, present, and foreseeable future impacts are restricted to the activities of Paramount, because there are no other resource users (e.g., agriculture, forestry, domestic or commercial fisheries) known to be impacting the area.

The CESA for fish and fish habitat assessment (Figure 7.1-2) for this project encompasses the following:

- the Cameron River watershed north to Tathlina Lake;
- the headwater waterbody that originates in the southeastern corner of the SDL and flows into the Hay River drainage;
- a small waterbody that originates in the southeastern corner of the SDL, flows to the southeast and into the Hay River drainage; and
- small waterbodies in the southern portion of the SDL and the drainages to the south that flow into Johnson Lake in Alberta.

For the purposes of this assessment, the above boundary represents the downstream extent of these drainages to a point where they encounter a significant waterbody. This is to allow consideration of the unlikely event that a deleterious substance enters the Cameron River watershed from a point within the SDL, as a result of Paramount's activities.

The temporal extent of the assessment considers the four development cases, and their associated time frames, described earlier: Environmental Setting; Baseline Case; Application Case; and Planned Development Case.

7.7.4 Potential Impacts

Potential impacts to fish and fish habitat resulting from Paramount's activities in the Cameron Hills, that have been identified during previous EIAs include:

- alteration to fish and habitat from increased sediment loading (e.g., bed, suspended and wash load);
- alteration to bed substrate, bank vegetation and top of bank;
- alteration to water quality;
- alteration to water quantity;
- water intake may entrain fish;
- lake levels may be reduced due to drawdown for water use;
- potential bank and bed instability of the trenchline during operations;
- chronic disturbance to banks and bed during fording by ATVs during operations; and
- water contamination from wastes and spills.

Seismic, drilling, and pipeline activities will all be conducted during the winter period during base flows in the waterbodies, and under frozen ground conditions, and are predicted to have a minimal impact on the available fish habitat when:

- best management practices, as outlined in the EPPs, are followed; and
- the habitat impacted is not considered suitable overwintering habitat.

The operation and maintenance of the facility will require year-round access to the various wellsites using either all terrain vehicles (ATVs) or trucks (winter road access), which must cross some small waterbodies.

7.7.4.1 Seismic

As the seismic exploration will be conducted during the winter period, the immediate effects to the small waterbody crossings are expected to be minimal, because they are typically frozen to the bottom, and a snow bridge is used. Further, vegetated buffers were maintained between the cleared lines and the Cameron River and major tributaries. However, during the spring melt period and during rainfall events potential impacts to fish and fish habitat may result from increased surface erosion during runoff and potential increased sediment load. The magnitude and duration of impact would depend on the residual vegetation, soil type, aspect, slope, and drainage type. With a vegetation buffer being left intact (according to best management practices/regulations) at the main waterbody margins, these impacts are expected to be minimal.

7.7.4.2 Drilling

Drilling activities will have no direct impact to fish and fish habitat, as the leases are located at least 100 m from a drainage or waterbody. Indirect impacts to fish and fish habitat may occur with respect to access routes that cross waterbodies and water withdrawal from watersource lakes for use as a constituent of the drilling fluids.

7.7.4.3 Pipeline Installation

The pipelines/flowlines will be constructed during the winter period and any waterbodies that are frozen to the bottom will be open cut. Should flow be present during the time of the crossing, an effective isolation method (i.e., dam and pump) or a trenchless technique (i.e., horizontal directional drill) would be used. Where permanent bridges (road or ATV) are installed, the flowlines will be attached to the bridge to avoid disturbance to the bed and banks of the stream.

Primary impacts to the waterbodies crossed by the pipelines may include bed and bank (e.g., soil and vegetation) disturbances at the crossing location, however, impacts are expected to be limited to local, minor disturbances. This is primarily related to the winter conditions and the "first-out-last-in" rule for the trench, which ensures that the substrate material is replaced on the stream bed and that the substrate replaced onto the trench will not dam water. Although there may be a small increase in sediment flush from the drainage bed crossing location in the spring (i.e., fine material flushed from the roach), this is expected to be localized, of low magnitude and within natural variations of a spring flush event. Any potential sedimentation resulting from runoff/erosion from the ROW, as a result of the pipeline installation, will be mitigated using conventional sediment and erosion control practices. Impacts to the bed and banks of waterbodies are predicted to be low when appropriate mitigation and reclamation techniques outlined in previous sections are used.

7.7.4.4 Production

Increased surface runoff and potential sediment input may be encountered at drainage crossing locations, particularly in the spring/summer following construction and throughout the operations period, with the potential depending on high runoff events and heavy rains, residual vegetation/slash, slope, soil type and erosion control measures employed (e.g., water diversion ditches) on the ROW. With the appropriate mitigation options (e.g., diversion ditches, diversion berms, silt fence) in place, impacts are expected to be local, of low magnitude, short duration, and of low impact.

Operations, including maintenance and well site monitoring, will occur throughout the year. The primary potential impact to fish and fish habitat during operations is related to the physical disturbance to drainages caused by repetitive crossings by ATVs during the unfrozen period. It is predicted that there will be increased sediment disturbance and bank deterioration within waterbodies and small drainages (low-lying wetlands and depressions). Measures have been taken to reduce these impacts (e.g., bridge and plank installation) where appropriate and feasible.

Impacts to fish and fish habitat within the access ROWs during the winter period are not expected, as bridges and snow and ice cover are expected to mitigate impacts to the underlying waterbodies. For the installation of temporary winter access, the Department of Fisheries and Oceans (DFO) Protocol for Temporary Winter Access Water Crossings for Oil and Gas Activities in the Northwest Territories (DFO 2002a) will be adhered to.

7.7.4.5 Water Withdrawal

During the construction, drilling and production phases, water will be withdrawn from identified supply lakes. Water will be used for drilling and winter road construction (e.g., ice bridges). Water withdrawal for the project will adhere to the DFO Protocol for Water Withdrawal for Oil and Gas Activities in the Northwest Territories (5% of maximum volume of fish bearing waterbodies during the winter period under 1 m of ice [DFO 2002b]). Further, water withdrawal hoses will be screened (i.e., screen mesh of 5 mm) to minimize potential impingement and entrainment of overwintering fish.

Based on the available bathymetric profile data of the water supply lakes and the assessment of the hydrologic process (see Section 7.4), should the lake not be recharged each spring from snowmelt, there could be a reduction in lake levels (5% water withdrawal; Table 7.7-3). In the unlikely event of a reduction in lake level caused by drawdown, there would be a predicted decrease in the amount of available littoral habitat (shallow-water lake margin habitat) available for use by fish. However, based on the predicted recharge of the lakes, no residual impacts to fish/fish habitat are predicted as a result of water withdrawal from the source lakes.

Table 7.7-3 Reduction in Lake Elevation Levels for Water Supply Lakes in the Cameron Hills Significant Discovery Lease Area Based on 5% Removal of Available Volume

Water Supply Lake	Reduction in Lake Level (based on 5% withdrawal)
Lake 1	0.07 m
Lake 2	0.03 m
Lake 3	0.03 m
Lake 4	0.12 m

7.7.5 Baseline Case

The Baseline Case, with respect to fisheries issues, includes the existing and approved developments as of June 2003 and includes 42 waterbody crossings (13 flowlines, 29 access). These crossings and the associated impacts are described in previous Environmental Assessments (Golder and Alpine 2001; Paramount and Golder 2001a,b,c, 2002a, and 2002b; Golder and Paramount 2002). Of these, two (Cameron River and tributary) have quad bridges, one (Cameron

River) has a vehicle bridge, and one (pipeline crossing between J-37 and L-47) has not yet been built. The only issue related to fish and fish habitat that has arisen during the Baseline Case is erosion on the ROW that has resulted in limited sediment transport into the Cameron River. This issue has been addressed with enhanced remediation with diversion ditches and silt fence (Golder and Paramount 2002), and is no longer considered to be an issue.

Based on the available calculations generated for the Environmental Setting, the direct (i.e., physical disturbance to the stream bed) disturbances to potential fish habitat in the Baseline Case is estimated to be 0 ha for the Cameron River, because all the existing crossings are aerial (i.e., double walled pipe attached to bridges), or are planned to be directionally drilled (J-37 to L-47 pipeline). For the unnamed drainages, the direct physical disturbance from flowline construction is estimated from 12 crossings in the SDL (the 13th crossing is on the TransBorder pipeline, outside the SDL). Considering an 18 m wide ROW, the crossings would represent 0.09 ha of physical disturbance to the drainages/potential fish habitat. This area corresponds to approximately 0.16% of the available wetted habitat calculated for the unnamed drainages. It must be noted that this is a conservative approach, because it is normally only the trenchline that is physically disturbed at the crossing locations, which would result in an actual disturbance being less than 2 m wide.

Limnological data was collected for water source Lakes #1 and #3, by Paramount during the winter of 2002/2003 (file data). Paramount collected information on ice thickness, water depth, dissolved oxygen, and temperature in each of these lakes immediately prior to and at completion of water withdrawal, and voluntarily provided this information to DFO to assist them in building an appropriate data base for this region of the NT. Ice thickness and water depth were measured at two week intervals during water withdrawal, and all measurements were taken at the point of withdrawal. Dissolved oxygen and temperature profiles are presented in Table 7.7-4, and the results of ice thickness and water depth measurements are presented in Table 7.7-5.

Table 7.7-4 Water Depth, Dissolved Oxygen and Temperature Measured at Lake #1 and Lake #3 at the Withdrawal Location, Cameron Hills, NT

December 2002 (prior to water withdrawal)			April 2003 (after completion of water withdrawal)		
Depth of water under ice (m)	Dissolved oxygen (mg/l)	Temperature (°C)	Depth of water under ice (m)	Dissolved oxygen (mg/l)	Temperature (°C)
Lake #1, Cameron Hills 2002/2003					
0.2	12.64	2.51	0.2	0.77	1.23
0.4	12.35	2.65	0.4	0.85	1.32
0.6	12.51	2.64	0.6	1.08	1.33
0.8	12.76	2.64	0.8	3.75	2.29
1.0	12.82	2.65	---	---	---
1.2	12.92	2.70			
1.4	13.1	2.74			
1.6	13.3	2.75			
1.8	13.1	2.74			
Lake #3, Cameron Hills 2002/2003					
0.2	10.24	3.79	Frozen to bottom	---	---
0.4	10.12	3.82			
0.6	9.84	3.92			

Source: Paramount file data

For Lake #1, dissolved oxygen levels during the initial measurements taken in December 2002 ranged from 12.35 to 13.3 mg/L. The uniformity of the these measurements indicates that the annual fall mixing process was completed for the lake, which provided high oxygen levels at the onset of the winter months. As the winter progressed, decomposition processes, reductions in available free water below the ice, water movement and water flow, as well as limited influx of ground water resulted in decreased dissolved oxygen levels.

Table 7.7-5 Ice Thickness and Water Depth Recorded Bi-monthly at Lake #1 and Lake #3 at the Withdrawal Location, Cameron Hills, NT

Date	Ice Thickness (m)	Water Depth (m) Under the Ice	Snow Depth (m)
Lake #1			
19 December 02	0.28	1.95	0.17
04 January 03	0.47	1.76	0.18
18 January 03	0.69	1.54	0.17
05 February 03	0.59	1.64	0.23
28 February 03	0.72	1.51	0.33
15 March 03	0.80	1.43	0.35
01 April 03	1.00	0.90	0.17
Lake #3			
19 December 02	0.39	0.71	0.17
04 January 03	0.29	0.81	0.21
18 January 03	0.59	0.51	0.20
05 February 03	0.71	0.39	0.23
28 February 03	0.80	0.30	0.26
15 March 03	0.84	0.26	0.25
01 April 03	1.10	0	0.17

Source: Paramount file data

A decrease in dissolved oxygen levels throughout the winter months during under-ice conditions is a typical occurrence for shallow muskeg lakes, such as Lake #1. The substrate in the water withdrawal area of Lake #1 consisted of fine organic muck and detritus. The decomposition of detritus throughout the winter during under-ice conditions consumes available oxygen and releases carbon dioxide. During the winter sampling period, the ice thickness on Lake 1 increased from 0.28 m in December, 2002 to 1.0 m in April 2003, thus lowering the amount of available free water under the ice. There was a corresponding decrease in the depth of the available free water which decreased from 1.95 m of water below the ice at the withdrawal location in December, 2002 to 0.9 m of water below the ice in April 2003.

Lake #3 is shallow (i.e., maximum depth of 1.4 m), not connected by a permanent waterbody to any other waterbody, and expected to be anoxic during the winter. According to the 2002 DFO Protocol, it is acceptable to use water from lakes that are shallower than 1.5 m with no connectivity, as the potential for fish over-wintering habitat should be low. This is supported by the previous assessment of Lake #3 which was completed to determine possible impacts to fish and fish habitat caused by water withdrawal prior to submission of the *"Environmental Screening*

Report for the Cameron Hills Drilling Project" (August 2000). Results of the assessment indicated that Lake #3 did not provide fish overwintering habitat because of its shallow depth and a lack of any permanent connection to fish bearing water bodies.

Further, ice thickness is known to be quite variable on Lake #3, depending on weather conditions such as temperature and snow cover, and have ranged from 0.45 m to freezing to the bottom during past drilling programs. The fact that Lake #3 froze to the bottom in 2002/2003 is neither uncommon nor unexpected.

7.7.6 Application Case

There are five wells and six waterbody crossings (each is a common access and flowline ROW) proposed under the Application Case. Based on the drainage classification system used for the original environmental assessment (Golder and Alpine 2001) these crossings are likely to be shallow drainage areas/wetlands that are expected to freeze to the bottom during the winter.

As such, the potential impacts to fish and fish habitat would be related to disturbances to the habitat at the crossing, and water withdrawal for access construction and drilling. Based on the average crossing size discussed earlier, the Application Case is predicted to affect approximately 0.05 ha, or 0.09% of the calculated available potential habitat. This represents a cumulative increase over the Baseline Case to 0.14 ha or 0.07% of the available potential habitat.

7.7.7 Planned Development Case

The Planned Development Cases is projected to include up to 48 wells and associated flowlines. Based on the locations that have been projected, 14 waterbody crossings are anticipated for pipelines and access for future development until 2013. This assumes the unlikely scenario that all proposed wells will be successful. Based on the average 4.2 m width for the smaller drainages, the 14 waterbody crossings would result in a disturbance of 0.11 ha, or 0.06% of the available habitat.

Operations of the Paramount facility for production will continue until 2023.

7.7.8 Impact Analysis

Because the water sources lakes are predicted to recharge on a yearly basis (see Hydrological assessment), no changes (i.e., no net loss) outside of natural variation, are predicted for fish and/or fish habitat within any of these waterbodies. Further, as Paramount has not, and will not alter the course of any waterbodies that support potential fish habitat, it is predicted that fish distribution within the CESA will not be affected by any of the cases presented in this document. Fish populations may be affected by several natural factors, and considering the minimal effects to habitat predicted to result from the project, no impacts to fish abundance are predicted as a result of any of the cases.

No net loss of fish habitat is expected within the drainages, as a result of Paramount's activities in the Cameron Hills. Crossings completed in the winter under frozen conditions are expected to experience a brief flushing of sediment from the trench crossing location in the spring, with no residual impact, and within natural variability. The primary waterbody, the Cameron River has been crossed with bridges (and a future directional drill), and therefore, no direct impacts to fish habitat has or would be predicted for this waterbody. During the planning phases of the development cases, Paramount recognized the importance of the Cameron River and has limited the crossings required, and has applied adaptive management principles to increase erosion control measures at crossing locations.

The small drainage that originates in the southeastern corner of the SDL, and eventually flows to the Hay River, is not predicted to be impacted by the Application Case, nor the Planned Development Case. As such, existing conditions are predicted to continue for this drainage, with no impacts to the drainage, nor downstream to the Hay River.

Fish can be indirectly affected by air emissions that result in the acidification of local water bodies. However, no acidifying effects to waterbodies are predicted for the project, given the low ground level concentrations predicted (NT air quality standards met) and the separation distance between the battery and wells and fish bearing waterbodies in the general region. No residual impacts to fish or fish habitat are predicted to occur from emissions resulting from the completion of well evaluations or production operations of the project.

The predicted residual effects to fish and fish habitat that would be predicted to continue through the development cases, and therefore be cumulative, are:

- the alteration of the soil and vegetation cover, and associated increased erosion potential, on the bed, banks and adjacent ROW during pipeline installation; and,
- disturbance to drainage banks and beds (i.e., those that are not bridged) during ATV use for inspections.

The predicted consequence of these residual impacts is shown in Table 7.7-6.

Iterative processes that can combine to cause an impact to fish and fish habitat likely will be limited to short-term sediment input from unprotected slopes resulting from seismic, drilling, pipeline and operational phases, lasting only until revegetation occurs. These impacts are expected to be mitigated by the use of best management practices for sediment and erosion control and site reclamation near the waterbody crossings and by the use of temporary or permanent bridge crossings.

The increased activities within the CESA, during the daily operations resulting from increased ATV traffic may lead to deterioration of the habitat within and/or adjacent to drainages in low or wet areas, and result in the potential for elevated sediment input into waterbodies. These additive impacts are expected to only be incurred during the spring-fall period during snowmelt or heavy rainfall conditions when ATVs are accessing the well sites for routine inspections and maintenance, and water levels are such that sediment transport can occur.

Table 7.7-6 Consequence of Potential Residual Impacts to Fish and Fish Habitat

Component	Potential Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Consequence
Fisheries	Alteration to soil and vegetation cover on the banks/bed	negative	low (+5)	local (0)	short-term (+1)	reversible (-3)	low (0)	negligible (+3)
	Disturbance to drainage banks and beds during fording.	negative	low (+5)	local (0)	medium-term (+2)	reversible (-3)	low (0)	negligible (+4)

The cumulative alterations to potential fish habitat are summarized in Table 7.7-7.

Table 7.7-7 Cumulative Alterations to Potential Fish Habitat in the Significant Discovery Lease Area

Aquatic Habitat	Environmental Setting		Baseline Case		Application Case		Planned Development Case	
	Area (ha)	% of Available Habitat	Area (ha)	% of Available Habitat	Area (ha)	% of Available Habitat	Area (ha)	% of Available Habitat
Disturbed Riverine Habitat in SDL	0	0	0.09	0.05	0.14	0.07	0.25	0.13
Undisturbed	187.26	100	187.17	99.95	187.12	99.93	187.01	99.87

7.7.9 Residual Impact Classification

The environmental consequence of alteration of fish habitat is rated as negligible for all cases (Table 7.7-8). This is due to Paramount avoiding disturbing the highest potential fisheries habitat in the project area (i.e., the Cameron River), the limited potential for the remaining drainages to provide habitat for fish, construction during the winter under frozen conditions, and the use of best management practices for the construction and operation of the Cameron Hills Project. Further, the low impact rating also relates to the small cumulative disturbance to potential fish habitat resulting from construction and operation of the project.

Table 7.7-8 Residual Impact Classification for Fish Habitat

Parameter	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Environmental Consequence
Baseline Case							
Alteration / disturbance to fish habitat	negative	low (+5)	local (0)	medium-term (+2)	reversible (-3)	low (0)	negligible (+4)
Application Case							
Alteration / disturbance to fish habitat	negative	low (+5)	local (0)	medium-term (+2)	reversible (-3)	low (0)	negligible (+4)
Planned Development Case							
Alteration / disturbance to fish habitat	negative	low (+5)	local (0)	medium-term (+2)	reversible (-3)	low (0)	negligible (+4)

The direction was determined to be negative because the physical disturbance of the construction of open cut crossing techniques and operation of the ATVs is predicted to result in disturbance to the plants and/or substrate at the crossing location, and potentially release sediment into the water column (i.e., only during open water disturbance during operations).

The magnitude was rated as low, due to poor habitat quality (e.g., seasonal, no defined channel) typically encountered at the crossing locations, and because disturbances would only be seasonal during the unfrozen period and when helicopters were not used for access when wet conditions prevailed.

The geographic extent was rated as local because any effects of habitat disturbance are predicted to remain within the ROW. As such, any negative effects to fish habitat are not anticipated to extend to Tathlina Lake, nor the Hay River.

The duration was rated as medium-term, as operations will continue for the life of the project. However, it must be recognized that as wells that have access that cross drainages are decommissioned, the disturbance to drainages is expected to decrease as disturbance to the drainages would not be expected to continue.

The effects were rated as reversible, because once disturbance is stopped, the drainage banks would be expected to revegetate and return to a near natural condition over time.

The frequency was rated as medium, because the disturbance to fish habitat resulting from site-specific erosion and/or disturbance from ATV access, is expected to occur intermittently (i.e., only during the open season), depending on the condition of the crossing location, and the weather conditions during any given season (e.g., high run-off events).

The environmental consequence of this predicted cumulative effect is rated at negligible (+4), as the definition of negligible is a total that lies between 0 and 5.

The linkage diagram presented at the beginning of this section indicates that a negative effect to fisheries could be sequential to wildlife (e.g., food source for osprey, bald eagles) and Traditional Land Use (e.g., fishing). Based on the negligible rating of the project effects to fish and fish habitat, it is predicted that the linkage would be of negligible consequence to wildlife and Traditional Land Use.

7.7.10 Summary

The construction and production of the Planned Development case is predicted to result in no residual impacts that could affect fish distribution and abundance. The consequence of the cumulative effects to fish habitat resulting from the construction and operation of the Planned Development case, is predicted to be negligible. The predicted direct disturbance is conservatively estimated to be approximately 0.25 ha or 0.13% of the available habitat within the SDL, and will be restricted to the ROW and the aquatic CESA. As such, no impacts to fish and/or fish habitat within Tathlina Lake and the Hay River are anticipated.

The impacts of the Baseline Case have a high probability because they already exist or are permitted to be constructed and operated. The impacts predicted for the Application Case and the Planned Development Case are moderate, because there is uncertainty about the number, location and the timing of developments in the SDL.

7.8 VEGETATION

This section addresses Section G-6 of the MVEIRB ToR: In addition to the effects of vegetation removal this section should address potential effects of the introduction of foreign species, accidental or through re-seeding efforts.

7.8.1 Environmental Setting

The project is located within the Cameron Hills Uplands that covers an area on both sides of the Alberta/NT border. It is a major physiographic feature of the Northern Alberta Uplands Ecoregion within the Taiga Plains Ecozone (Ecological Stratification Working Group 1995).

The Taiga Plains Ecozone is considered the transitional zone between the tundra to the north and the boreal, coniferous forest to the south. Much of the region is affected by poor drainage; approximately 50% to 70% of the area consists of wetlands. Vegetation of the Taiga Plains Ecozone is characterized by open, typically slow growing; predominantly black spruce coniferous forests. The often well developed shrub communities consist of willow, dwarf birch and

Labrador tea, while bearberry, mosses and sedges comprise the dominant understory species. Mixedwood forests are characterized by white and black spruce, tamarack, lodgepole pine, and white birch. Trembling aspen and balsam poplar tend to establish on foothills and upland areas and on south aspects that are better drained and warmer (Ecological Stratification Working Group 1995). Black spruce with feather moss undercover interspersed with large swamps and fens are the characteristic vegetation type. A summary description of the major communities has been provided below.

7.8.1.1 Environmental Setting Vegetation Communities

Eighteen representative community types were identified during a July 2000 survey of the TSA and are listed in Table 7.8-1 (Golder and Alpine 2001) and outlined in Figure 7.8-1.

Table 7.8-1 Native Vegetation Communities in the Cameron Hills

Vegetation Communities	Community Type	Area
White Spruce Mature Closed	Upland	2,629
Black Spruce Closed Uneven Sized	Upland	23,919
Black Spruce Mature Open with sphagnum and lichen	Wetlands	12,669
Black Spruce Mature Closed	Upland	10,724
Black Spruce Open Uneven Sized with Lichen	Wetlands	9,327
Pine Mature Closed	Upland	13,838
Pine Young Closed	Upland	6,009
Aspen Young Closed	Upland	2,278
Aspen Mature Closed	Upland	1,755
Shrubland	Wetlands	1,154
Herbaceous with Shrubs	Wetlands	388
Herbaceous Wet	Wetlands	4,260
Herbaceous	Wetlands	699
Shallow Water	Water	4,145
Water	Water	582
Bare Ground	Bare Ground	204
Burn	Burn	399
Clouds	Clouds	1,250
Total TSA		96,231

Wetland vegetation communities comprise approximately 28,497 ha (or 30%) of the TSA and upland communities comprise approximately 61,152 ha (or 64%) (Table 7.8-1). Impacts to vegetation likely to have occurred prior to 1960 include natural incidences such as fire or insect damage.

7.8.1.1.1 Upland Communities

Coniferous Forest

Coniferous forest composition within the area is dependant on the moisture regime within the particular stand. Mesic sites associated with low slope positions produce pure black spruce stands or black spruce/white spruce mixes, while drier sites located on upper- and mid-slope positions promote the growth of black spruce-pine communities. The understorey associated with the black spruce-pine forests often consists of black spruce, willow, Labrador tea, bog cranberry, bunchberry, bastard toad-flax, reindeer lichen and various feather mosses. Feather mosses typically cover the entire forest floor.

Mixedwood Forest

Mixed wood forests consisting of aspen, birch, lodgepole and spruce stands occur throughout the area, typically in well-drained crest, upper- and mid-slope positions. The average tree height varies from 10 to 15 m, with a crown closure averaging less than 50%. Typical shrub understories include white or black spruce, willow, prickly rose, Labrador tea, bog cranberry, and twinflower. Bunchberry, reindeer lichen and stair-step moss are common in the herb and moss layers.

Trembling Aspen Forest

Trembling aspen communities of varying ages occur throughout the TSA. The understorey generally consists of willow, rose, bog cranberry, Canada buffalo berry and scattered white and black spruce seedlings and saplings. Herbaceous forbs consist of bunchberry, fireweed and palmate-leaved coltsfoot. The ground surface cover is predominantly aspen litter (>80%) with the remaining cover of various mosses

7.8.1.1.2 Wetland Communities

Graminoid and Shrubby Fens and Shallow Open Water

Graminoid and shrubby fens occur in three different landscapes. These include: depressional areas within black spruce bog complexes, transition zones between bogs and upland forests, or along water bodies. Both fen types, as well as the open water, can support a variety of rare plants, none of which were found during the 2000 field study.

Graminoid and shrubby fens are characterized by flowing water and alkaline, nutrient-rich conditions. These fens have a greater abundance of decaying sedges than sphagnum, whereas bogs contain more decaying sphagnum and brown mosses and are acidic. Graminoid fen species include sedges, leather-leaf, northern bog laurel, and sphagnum mosses. The characteristic shrubs identified within the shrubby fens consisted of bog birch and willows. Cloudberry, sedges and sphagnum mosses, respectively, dominate the herb, grass and moss layers.

Black Spruce Bog (Wooded Bog)

Black spruce bogs are common throughout the surveyed area. These bogs are depressional, sub-hygric to hygric and typically dominated by black spruce. Black spruce bogs contain organic material (peat), are acidic and nutrient poor. The majority of bog communities have an open canopy with a relatively dense shrub cover, but vegetation structure varies considerably. The understory vegetation is comprised of regenerating black spruce, Labrador tea, bog cranberry, cloudberry, bog birch, small bog cranberry, horsetails, sedges, and sphagnum mosses. Reindeer lichen is also present, particularly in older stands where the cover can vary from 0% to more than 30%.

Riparian Forests

The riparian forests within the TSA consist of deciduous to coniferous stands. Trembling aspen and a sub-hygric black spruce/white spruce forest located in well-drained areas. The wide variation in moisture conditions and nutrient regimes promote a variety of vegetation types in the riparian areas. Understory vegetation within the drier (mesic) aspen stands typically consist of bog cranberry, willows (>5 m tall), fireweed, tall lungwort, milk-vetch, and various feather mosses. Leaf litter provides the majority of ground surface cover. The understory within the wetter spruce stands typically consists of species such as prickly rose, bog birch, twinflower, shrubby cinquefoil, bog cranberry and various shrubby willows. Though not abundant, the herb layer consists of palmate-leaved coltsfoot, dwarf-scouring rush, fireweed, blunt-leaved bog-orchid, and tall lungwort. The moss layer is predominantly stair-step moss. Overall, these riparian areas are typically species rich, and have a high rare plant potential; however, no rare plants were observed in these communities during the survey.

7.8.1.2 Listed Plant Species

Listed plant species listed in Table 7.8-2 have been ranked according to provincial lists (MacJannet et al. 1995). High potential rare plant habitats have been identified based on an assessment of potential rare plant species habitat associations. These include wetland habitat such as bogs and marshes; aquatic habitats; seeps, saline areas; and riparian areas such as rivers and stream banks (i.e., exposed sand and gravel areas). Sixteen rare (listed) plant species have the potential to occur within the Cameron Hills area based on published range maps of NT rare plant species by MacJannet et al. 1995. None of these sixteen were identified during the previous field surveys. None of the sixteen plant species are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2003).

Table 7.8-2 Potential Listed Flora for the Cameron Hills Project Area

Scientific Name	Common Name	NT[a]	Preferred Habitat
Adoxa moschatellina	moschatel	R	boreal moist partly shaded woods and thickets
Apocynum cannabinum	indian hemp	R	boreal exposed river banks
Artemisia tilesii	Herriot's sagewort	NL	open woods and river flats
Asplenium viride	green spleenwort	R	boreal moist rocky slopes
Aster pauciflorus	few-flowered Aster	R	alkaline flats
Caltha palustris var palustris	marsh marigold	R	boreal Shallow water and wet marshy places
Carex crawfordii	Crawford’s sedge	R	boreal damp meadows
Carex sychnocephala	many headed sedge	R	boreal wet places and open woodland meadows
Elymus canadensis	Canada wild rye	R	boreal sand and gravelly places
Epilobium leptophyllum	narrow-leaved willowherb	R	boreal marshes, sloughs, bogs and sedge meadows
Gentianopsis macounii	fringed gentian	R	prairie gravelly beaches, marly shores, marshy areas
Juncus stygius ssp americanus	marsh rush	R	boreal wet margins of bogs and marly seepages
Najas flexilis	slender naiad	R	aquatic shallow lakes and ponds
Pedicularis macrodonta	swamp lousewort	R	bogs and marshes
Prunus virginiana	chokecherry	R	boreal thickets
Sarracenia purpurea	common pitcherplant	R	bogs and peatlands

[a] R = Rare – listed as rare in the territory (MacJannet et al. 1995).
NL = Not listed – no rating available in the territory, status unknown.

7.8.2 Methods

7.8.2.1 Valued Ecosystem Components

Eighteen representative community types were identified for the TSA (Golder and Alpine 2001). These community types have been amalgamated into upland and wetland VECS based on the available LandSat image coverage (Figure 7.8-2). The vegetation communities are considered to be similar in distribution and composition to the communities present at the 1960 Environmental Setting date.

Vegetation growth in the interim 40 plus years is expected to have been relatively slow due to short, cool summers with limited degree growing days and early killing frosts (Strong and Leggat 1992). This growth pattern has resulted in mid to mature seral stage vegetation communities. No other known studies have been located that would provide additional information regarding earlier vegetation community compositions.

7.8.2.2 Spatial and Temporal Boundaries

The spatial boundaries for potential impacts to vegetation were evaluated within the TSA, and considered to occur primarily within the footprint (i.e., cleared area) of the project activity.

The temporal boundaries are the Environmental Setting (1960) and considers the various Development Cases described in Section 7.1.1.2.

7.8.2.3 Potential Impacts

Some disturbances, such as winter road access, pipeline ROWs and seismic lines all occur on the same footprint as various phases progress. The following disturbances have the potential to impact the vegetation communities in the TSA. Table 7.8-3 lists the project phase during which each impact is likely to occur. These disturbances were combined into three categories, roads, facilities and utilities. Changes from these categories were analyzed at the Baseline Case, Application Case, and the Planned Development Case.

Vegetation community disturbances considered for the Baseline Case include construction of facilities, air strip (not built), and borrow pits and waste pits and sumps. This may involve removal of all vegetation down to mineral soil. Disturbances such as these will affect vegetation to a larger extent than disturbances such as seismic line/winter access route construction, which generally only removes the tree and shrub layer but leaves the understorey relatively intact. For analysis purposes these disturbances have been consolidated into the category "disturbances" to provide a conservative estimate and to simplify analysis.

Well drilling disturbances include site-specific disturbances to the organic layer around the wellhead; temporary loss of treed habitat on the lease and potential vegetation related air emissions issues.

Table 7.8-3 Potential Impacts to Vegetation by Disturbance Type

Project Component	Environmental Setting	Baseline Case	Application Case	Planned Development Case
Winter roads/access roads		✓	✓	✓
Seismic		✓	✓	✓
Drilling and evaluations		✓	✓	✓
Flowline and facility construction		✓	✓	✓
Camps		✓	✓	✓
Airstrip construction		✓		
Borrow pits		✓	✓	✓
Air quality effects to vegetation		✓	✓	✓
Introduction of foreign vegetation species via construction equipment		✓	✓	✓
Fire	✓	✓	✓	✓
Insect damage	✓	✓	✓	✓
Potential Sensitive/Rare plant disturbance via various anthropogenic habitat disturbances		✓	✓	✓
ATV traffic on access routes		✓	✓	✓

Flowline construction involves vegetation disturbances related to clearing the ROW of trees and shrubs to accommodate safe equipment movement; potential compaction and rutting due to traffic on the ROW if operations occur during unfrozen conditions; storage of windrowed slash, spoil, and organic material, as well as the trench excavation. Potential impacts to vegetation are related to the loss and/or alteration of vegetation communities in cleared areas of the ROW, and the effect of construction, such as soil admixing. Leaving subsoil on the surface may slow the revegetation process. The principal disturbance will be the clearing of the tree/shrub layer(s).

ATV traffic along access roads and pipeline ROWs during operations is predicted to result in vegetation disturbance primarily during non frozen periods when no snow cover is present. These effects will be at least partially mitigated by the use of appropriate equipment (i.e., balloon tired ATVs), driving on winter roads, responsible ATV operation and the construction of corrugated and or board trails over wetland areas.

Vegetation clearing is expected to result in increased habitat fragmentation, and in turn increased habitat fragmentation would result in increased edge habitat. Loss of mature vegetation communities and associated habitat can affect wildlife movement.

Project planning included avoidance of high potential rare plant habitat to limit the potential for disturbance.

7.8.2.4 Cumulative Effects Assessment

The vegetation impact analysis examined the loss/alteration of VEC units throughout the TSA and the impacts of fragmentation to undisturbed areas at Baseline, the Application Case and the Planned Development Case. Vegetation communities were combined into upland and wetland classes as described above for the analysis of the loss/alteration to VEC units.

The cumulative effects to vegetation is determined based on an increase in disturbed area through the various Development Cases using a combination of LandSat imagery and GIS. Individual effects are assessed and an overall environmental consequence is then assigned to each VEC based on the cumulative effect to the area.

Fragmentation of undisturbed areas was analyzed using FRAGSTATS (McGarigal and Marks 1995). FRAGSTATS is a spatial pattern analysis program for quantifying landscape structure. Six metrics were chosen to assess fragmentation based on their ease of measurement, intuitive description and ecological relevance. The following six metrics were assessed:

- class area – the total area of a landscape element;
- number of patches – the number if individual units of a landscape element present within the TSA;
- mean patch size – the average size of element patches in the TSA;
- total core area index – a measure of the amount of each element that is classed as core area;
- core area – the area of a patch that is greater than 100 m from the nearest edge; and
- patch coefficient of variation – the variation of patches with a higher degree of variation being beneficial to natural systems. The variability of patches exceeds 100% when they are more than twice the size of the mean patch size.

A decrease in total edge is reflective of a less fragmented landscape.

7.8.3 Results

7.8.3.1 Vegetation Loss

7.8.3.1.1 Baseline Case

A total of 643 ha (<1% of TSA) wetlands and 1,208 ha (1.3% of TSA) of uplands have been affected between 1960 and June 2003 by man made disturbances (Table 7.8-4). Development of winter road access routes, leases, plant site, pipeline ROWs, camps, borrow pits, waste pits, sumps, and seismic lines have all produced vegetation disturbances.

Table 7.8-4 Cumulative Loss or Alteration due to Activities in the Terrestrial Study Area

VEC	Environmental Setting Case	Baseline Case		Application Case		Planned Development Case	
	(ha)	(ha)	% [(a)]	(ha)	% [(a)]	(ha)	% [(b)]
Wetlands	28,497	643	0.7	652	0.7	691	0.7
Uplands	61,152	1,208	1.3	1,228	1.3	1,315	1.4
Bare Ground	204	8	<1	8	<1	9	<1
Water	4,727	36	<1	36	0	37	0
Burn	399	4	<1	4	<1	4	<1
Cloud	1,250	19	<1	19	<1	19	<1
Total	**96,231**	**1,918**	**2.0%**	**1,946**	**2.0%**	**2,093**	**2.2%**

(a) changes are based on the change in area of each case compared to the total area of the TSA

(b) note that there are an additional 19.2 ha of disturbance for emergency access that are not accounted for as locations are unknown at this time, thus total cumulative disturbance is 2,093 ha for the PDC.

7.8.3.1.2 Application Case

Development by Paramount for 2003/2004 will result in a cumulative disturbance of 1,228 ha or 2.0% of upland vegetation and 652 ha or 2.3% of wetland vegetation within the TSA. The cumulative impacts of the Application Case are categorized by vegetation VECs in Table 7.8-4. Incremental loss for the Application Case is presented in Table 7.8-5.

Table 7.8-5 Incremental Loss or Alteration due to Activities in the Terrestrial Study Area

VEC	Environmental Setting Case (ha)	Baseline Case (ha) (%)	Application Case (ha) (%)	Planned Development Case (ha) (%)
Wetlands	28,497	643 (<1%)	9 (<1%)	39 (<1%)
Uplands	61,152	1,208 (1%)	20 (<1%)	87 (<1%)
Bare Ground	204	8 (<1%)	<1 (<1%)	<1 (<1%)
Water	4,727	36 (<1%)	<1 (<1%)	<1 (<1%)
Burn	399	4 (<1%)	0	0
Cloud	1,250	19 (<1%)	<1 (<1%)	<1 (<1%)
Total	**96,231**	**1,918 (2%)**	**28(<1%)**	**147 (<1%)**

Note that there are an additional 19.2 ha of disturbance for emergency access that are not accounted for as locations are unknown at this time, thus total cumulative disturbance is 147 ha for the PDC.

7.8.3.1.3 Planned Development Case

The Planned Development Case is expected to disturb 39 ha of wetlands (cumulatively 691 ha of wetlands or 0.7% of the TSA) and 87 ha of uplands (cumulatively 1,315 ha of upland communities or 1.4% of the TSA) (Tables 7.8-4 and 7.8-5). Total disturbance in the TSA at the Planned Development Case is expected to be 2,093 ha (including emergency access routes) or 2.2% of the TSA.

The direct impact to vegetation communities from the Planned Development is considered to be low, as it translates into an increase in disturbance area of only 0.09% over the Application Case, and 0.23% over the Baseline Case.

7.8.3.1.4 Invasive Species

Two primary mechanisms exist for the introduction of weed species to the project area. One is by inadequately cleaned construction equipment and the other is by contaminated seed mix used for reclamation. Paramount does require, and will continue to require, that all construction equipment be thoroughly cleaned before entrance into the project area. It must be recognized that with the winter road being opened, unauthorized access may occur, and would create another opportunity for introduction of weeds (e.g., mud from the undercarriage of a quad or truck). Paramount uses only Canada #1 certified seed mix for seeding erosion prone slopes.

Paramount will use best reasonable efforts to eliminate weeds, if they are encountered. Disturbed areas will be monitored (i.e., revegetation monitoring program) to detect the presence of weed species. Maintenance of vegetation surface cover can minimize the potential for weedy species to establish. With proper mitigation in conjunction with short growing seasons, it is anticipated that invasion of weed species will be minimal.

7.8.3.1.5 Residual Impact Classification

Residual impacts on both upland and wetlands vegetation communities are predicted to be negligible on a regional scale (TSA). The residual impacts to vegetation communities are predicted be of low magnitude and long-term, but reversible, and of a low frequency.

Employment of effective mitigation techniques is expected to greatly reduce the risk of invasive weedy species into the TSA, therefore, the environmental consequence is negligible.

Table 7.8-6 summarizes the residual impacts associated with the Planned Development Case and provides a rating related to each vegetation impact predicted to occur. This rating is intended to assist in determining the environmental consequence.

Table 7.8-6 Planned Development Case Residual Impacts by Valued Ecosystem Component

Component	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Environmental Consequence
Vegetation Loss/Alteration							
Wetlands	negative	low (+5)	regional (+1)	medium-term (+2)	low (0)	reversible (-3)	negligible (+5)
Uplands	negative	low (+5)	regional (+1)	medium-term (+2)	low (0)	reversible (-3)	negligible (+5)
Invasion of Foreign Species							
Disturbed Uplands and Wetlands	negative	negligible (0)	regional (+1)	medium-term (+2)	low (0)	reversible (-3)	negligible (0)

7.8.3.2 Vegetation Fragmentation

Table 7.8-7 identifies the fragmentation of habitat caused by human disturbance. The fragmentation of these areas affects the connectivity of the natural patches used by plants and wildlife. The primary habitat components impacted within the TSA are the uplands and wetlands. The remainder of the components identified in Table 7.8-4, are insignificant or unidentified (e.g., cloud cover of the LandSat imagery) and were not considered. Minor differences in total areas (ha) between fragmentation analysis and vegetation loss is due to conversion of GIS data (i.e., raster to vector to raster).

Table 7.8-7 Fragmentation of Undisturbed and Disturbed Areas

Fragmentation Metrics			Environmental Setting Case	Baseline Case		Application Case		Planned Development Case		Net Change due to Project
				Metric value	Cumulative % change	Metric value	Cumulative % change	Metric value	Cumulative % change	
class area [a]	undisturbed areas	ha	89,656	87,738	-2.0	87,710	-2.1	87,563	-2.3	-2,067
	disturbed areas	ha	0	1,918	2.0	1,946	2.0	2,093	2.3	2,093
number of patches	undisturbed areas	#	470	4,147	782	4,182	790	4,280	811	3,810
	disturbed areas	#	0	461	–	451	–	447	–	447
mean patch size	undisturbed areas	ha	190.8	21.2	-89	21.0	-89	20.5	-89	-170.3
	disturbed areas	ha	0	4.3	–	4.6	–	4.9	–	4.9
total core area index	undisturbed areas	%	88.7	56.4	-36	56.4	-36	56.5	-36	-32.2
	disturbed areas	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
patch size coefficient of variance	undisturbed areas	%	2,161	2,002	-7	2,013	-7	2,039	-6	-122
	disturbed areas	%	0	2,109	–	2,087	–	2,078	–	2,078
total edge	undisturbed areas	km	1,093	6,632	507	6,627	506	6,644	508	5,551
	disturbed areas	km	0	5,776	–	5,771	–	5,791	–	5,791

[a] totals for undisturbed and disturbed lands do not sum to the area of the TSA. Water, burns, bare ground and cloud area were not included in the results table

7.8.3.2.1 Environmental Setting

Undisturbed areas make up 89,656 ha of the TSA with a mean patch size of 190.8 ha (Table 7.8-7). The total core area of these patches is 88.7% while the patch size coefficient of variance (PSCV) is 2,161%. The total edge of undisturbed areas is 1,093 km. These values are indicative of a natural forest mosaic, with no human influences.

7.8.3.2.2 Baseline Case

At Baseline, undisturbed areas were 87,762 ha of the TSA while disturbed areas accounted for 1,918 ha. The mean patch size of undisturbed areas decreased by 89% to 21.2 ha from the Environmental Setting. The total core area index (TCAI) for undisturbed land from 88.7% to 56.4% core area, a decreased of 36%. The PSCV decreased from 2,161% to 2,002%. The total edge of undisturbed areas increased by 507% from 1,093 km to 6,632 km.

The above changes in parameters, means that the undisturbed areas at Baseline are primarily composed of smaller patches that are fragmented by linear disturbances such as seismic cutlines. However, these areas continue to contain large amounts of core area and a variety of patch sizes, thus maintaining core area habitat and landscape heterogeneity that are important for wildlife and vegetation species (e.g., the habitat remains functional).

7.8.3.2.3 Application Case

At the Application Case, undisturbed areas would be 87,676 ha of the TSA, while disturbed areas accounted for 1,946 ha. The mean patch size of undisturbed areas decreases by 89% to 21.2 ha from the Environmental Setting. The TCAI for undisturbed land changes from 88.7% to 56.4% core area, a decreases of 36%, the same as at Baseline. The PSCV decreases from 2,161% to 2,013%. The total edge of undisturbed areas increases by 506% from 1,093 km to 6,627 km. The Application Case analysis shows only small changes to undisturbed areas compared to Baseline.

7.8.3.2.4 Planned Development Case

At the Planned Development Case, undisturbed areas would be 87,589 ha of the TSA while disturbed areas would account for 2,100 ha. The mean patch size of undisturbed areas decreases by 89% to 20.5 ha from the Environmental Setting. The total edge of undisturbed areas remains approximately the same as the Application Case at 6,644 km, a 508% increase from the Environmental Setting. Changes to undisturbed areas from the Environmental Setting has resulted in smaller patches with a higher degree of fragmentation. The TCAI for undisturbed land changes from 88.7% to 56.5% core area, a decrease of 36%, the same as at Baseline. The PSCV increases from the Application case from 2,013% to 2,039%. Total core area values indicate that approximately half of the undisturbed areas exist as core area habitat that is greater than 100 m from the nearest disturbance. High PSCV values are indicative of a heterogeneous landscape that is composed of a variety of patch sizes. The combination of these parameters indicates that undisturbed areas continue to be composed of core habitat patches of varying sizes that is important to vegetation and wildlife.

Undisturbed areas in the Planned Development Case do show a degree of fragmentation when compared to the Environemental Setting. However, the ecological parameters measured indicate that the landscape composition that exists after the Planned Development Case is predicted to continue to be capable of supporting existing wildlife and vegetation species.

7.8.3.3 Project Disturbances

A summary of disturbance area for three categories; access, facilities and utilities, is provided in Table 7.8-8.

Table 7.8-8 Cumulative Changes to Disturbance by Class

	Baseline Case		Application Case		Planned Development Case	
	ha	**% of TSA**	**ha**	**% of TSA**	**ha**	**% of TSA**
roads	116	0.1	139	.1	222	0.2
facilities	169	0.2	175	0.2	239	0.3
utilities	1,633	1.7	1,633	1.7	1,633	1.7
Total	**1,918**	**2.0**	**1,946**	**2.0**	**2,093**	**2.2**

The increase in disturbed areas from the projected Planned Development Case over the current Baseline Case is minimal, being 0.2% of the TSA, and only a 2.2% increase compared to the Environmental Setting Case.

7.8.3.3.1 Residual Impact Classification

Table 7.8-9 summarizes the residual impacts associated with fragmentation created by the Planned Development Case and provides a rating relative to natural areas and the impact prediction. This rating is intended to assist in predicting the environmental consequence.

Residual impacts on the class area of undisturbed areas are predicted to be negligible on a regional scale (TSA). The residual impacts to vegetation communities are predicted to be of low magnitude and long-term, but reversible and of a low frequency. Residual impacts to mean patch size and total edge of undisturbed areas is predicted to be low.

Table 7.8-9 Planned Development Case Residual Impacts for Fragmentation of Natural Areas

Component	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Environmental Consequence
class area	negative	low (+5)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	negligible (+5)
mean patch size	negative	moderate (+10)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	low (+10)
total edge	negative	moderate (+10)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	low (+10)

Table 7.8-10 summarizes the residual impacts by individual disturbance types associated with the project Planned Development Case and provides a rating relative to each disturbance type considered to occur. This rating is intended to assist in determining the environmental consequence.

Table 7.8-10 Planned Development Case Residual Impacts by Disturbance Type

Component	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Environmental Consequence
Access	negative	low (+5)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	negligible (+5)
Facilities	negative	low (+5)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	negligible (+5)
Utilities	negative	low (+5)	regional (+1)	medium-term (+2)	reversible (-3)	low (0)	negligible (+5)

7.8.3.4 Far Future

To assess post-disturbance conditions, a far future (i.e., ca. 2073) scenario was developed based on assumptions of how the disturbed areas would revegetate. The assumptions were based on what the vegetation community type was under the Environmental Setting, and how vegetation communities would re-establish, considering the type of disturbance. In general, it was assumed that aspen will come back in upland areas unless pine was the previous vegetation type and that upland black spruce types will return. It was assumed that black spruce bogs, will likely revert to black spruce uplands, because the peat layer would have been too disturbed to revert back to a peatland. The decision rules are presented in Table 7.8-11.

The resultant far future vegetation composition of the TSA is presented in Table 7.8-12. Please note, however, that the far future vegetation composition presented in the table does not account for changes in vegetation communities due to ecological succession.

Table 7.8-11 Decision Rules for Vegetation Re-establishment based on Pre-Disturbance Conditions in the Cameron Hills

Pre-Disturbance Vegetation Community	Far Future Vegetation Community
Aspen Mature Closed	Aspen Young Closed
Aspen Young Closed	Aspen Young Closed
Black Spruce Closed Uneven Sized	Black Spruce Open Uneven Sized with Lichen
Black Spruce Mature Closed	Black Spruce Open Uneven Sized with Lichen
Black Spruce Mature Open with sphagnum and lichen	Black Spruce Open Uneven Sized with Lichen
Black Spruce Open Uneven Sized with Lichen	Black Spruce Open Uneven Sized with Lichen
Burn	Aspen Young Closed
Clouds	Clouds
Bare Ground	Bare Ground
Herbaceous	Herbaceous
Herbaceous Wet	Herbaceous Wet
Herbaceous with Shrubs	Herbaceous with Shrubs
Pine Mature Closed	Pine Young Closed
Pine Young Closed	Pine Young Closed
Shallow Water	Shallow Water
Shrubland	Shrubland
Water	Water
White Spruce Mature Closed	Aspen Young Closed

Table 7.8-12 Far Future (ca. 2073) Vegetation Composition in the Cameron Hills

Pre-Disturbance Vegetation Community	Environmental Setting Area (ha)	Far Future Case	
		Area (ha)	% of Environmental Setting Condition
Aspen Mature Closed	1,755	1,726	98%
Aspen Young Closed	2,278	2,339	103%
Bare Ground	204	204	100%
Black Spruce Closed Uneven Sized	23,919	23,349	98%
Black Spruce Mature Closed	10,724	10,482	98%
Black Spruce Mature Open with sphagnum and lichen	12,669	12,346	97%
Black Spruce Open Uneven Sized with Lichen	9,327	10,462	112%
Burn	399	395	99%
Clouds	1,250	1,250	100%
Herbaceous	699	699	100%
Herbaceous Wet	4,260	4,260	100%
Herbaceous with Shrubs	388	388	100%
Pine Mature Closed	13,838	13,501	98%
Pine Young Closed	6,009	6,346	106%
Shallow Water	4,145	4,145	100%
Shrubland	1,154	1,154	100%
Water	582	582	100%
White Spruce Mature Closed	2,629	2,601	99%
Total	**96,229**	**96,229**	**100%**

7.8.4 Conclusions

The Baseline Case has introduced 1,851 ha of vegetation community disturbance (i.e., 1,918 ha in total) compared to the Environmental Setting. The Application Case increased the disturbance by 28 ha and the Planned Development Case is predicted to add another 147 ha of disturbance, for a total cumulative disturbance effect to vegetation of 2,093 ha of the total 96,231 TSA (i.e., 2.2%). This level of vegetation loss/alteration is predicted to result in a negligible environmental consequence to the VECs (uplands and wetlands vegetation communities), including listed plants. This impact is seen as reversible with communities returning to their respective classes following completion of the project, as described for the Far Future Case.

Fragmentation of undisturbed areas is predicted to result in a negligible environmental consequence. The mean patch size and total edge of these areas indicate a low environmental consequence resulting from the project. These patches are expected to maintain connectivity with the remainder of the landscape and the remaining patches are expected to have sufficient core area (56%) to support interior wildlife and vegetation forest species.

7.9 CULTURAL AND HERITAGE RESOURCES

This section addresses Section G-7 of the MVEIRB ToR:
Identify archaeological and heritage resources as well as sites or areas of cultural significance in or near the project area. To protect these resources, their location should NOT be included in the DAR. The DAR should, however, demonstrate that the developer is aware of the locations of known archeological sites and has procedures in place to detect and protect yet unknown sites as the project progresses. The Prince of Wales Northern Heritage Centre may be contacted for further information on archeological sites. The developer is further encouraged to consult the people of Kakisa about cultural and heritage resources in or near the project area.

7.9.1 Environmental Setting

7.9.1.1 Regional Cultural Setting

The general study area lies within the Cameron Hills Uplands straddling the Northwest Territories/Alberta border (Figure 7.9-1). Current land uses in the general region include oil and gas exploration, trapping and hunting. There are two trappers in the project area and general hunting licenses are issued.

The study area falls within the traditional lands of several local aboriginal communities. Although collectively known by a number of names in the past (e.g., Slavey Indians), First Nations of the region (Alberta and Northwest Territories) are now described as the Dené ('people') (Asch 1981). The primary Dene social and economic unit was the local group; typically comprised of between 10 and 20 persons. Local groups tended to remain semi-isolated for much of the year, occupying a small territory centred near a fish lake. In the summer, or when subsistence conditions proved favourable, local groups aggregated at a central campground. These gatherings could grow as large as 200 to 250 persons. Bistcho Lake, just south of the study area, was such a gathering place.

For most circumstances, one of two types of dwelling were used by the Dené – the conical, tipi-like structure or an oblong shed-roofed structure. The conical structure was built using four poles and covered with bark or moose hide. When abandoned, the skin covering was removed for transport but the frame was left in place. The oblong cabin structure had two doorways and was made from logs chinked with moss or cemented. A shed-style pitched roof was covered with spruce boughs. The building had a central fire hearth with smoke escaping through an overhead fire hole. As conical structures were found mostly at the large camping grounds and along major travel routes, it is thought they may have been used in the summer months. The shed-roof structures are typically associated with small fish lake encampments, suggesting they were favoured in the winter months. Small trees were bent and covered with moose hide coverings to serve as temporary travel shelters.

The primary hunting technique for taking small game was snaring. Larger game, such as moose, was hunted with a bow and arrow, clubs or spears. Fishnets made from woven willow or babiche were used in lakes and rivers. Weirs were used for fishing in areas with running water. Edible berries and roots were utilized extensively. Food or equipment caches consisted of either a smooth pole, with the bark removed, measuring 3 m to 4.5 m in length, or, buried pits in the winter months.

In the summer, travel was largely by water in one- or two-person canoes covered with spruce or birch bark. Overland travel in the summer was on foot with goods carried on the back with the assistance of a tump line. Winter travel was on foot with the aid of snowshoes and toboggans. During the transitional break-up and freeze-up periods, water systems were not navigable, making long distance travel impossible.

The patterns of landscape use employed by Dené peoples provide a general basis for estimating the potential of certain features of the landscape to contain the remains of their activities.

7.9.1.2 Archaeological Setting

The above described lifestyle would have had considerable antiquity in this region, therefore any archaeological assemblages exhibiting evidence of this lifestyle will have suffered significant deterioration, owing to the removal of virtually all organic materials through natural processes. Additionally, given the high degree of mobility exhibited by regional aboriginal groups, it is generally not possible to establish by archaeological means the ethnic affiliations of the people responsible for archaeological sites that may occur within the region.

As almost no prior archaeological research has been undertaken within the general study region, the cultural setting in the study area can only be described based on the regional cultural history described above for adjacent areas.

7.9.1.3 Known Heritage Resources

As part of the preliminary studies completed for the Cameron Hills Project, prior to any in-field assessment, the database of the Canadian Museum of Natural History was searched, through the Prince of Wales Northern Heritage Centre (PWNHC). No known heritage resource sites within the study region were reported. Further, Lucie Johanis (Sites Officer, pers. comm. July 2000) confirmed through a search of the database and a visual inspection of the project area that there are no known sites recorded in or near the study area.

Consultations with local communities have indicated that traditional land uses have concentrated in areas outside the Cameron Hills. These areas generally have better access by foot or boat, or have a higher potential for game species.

7.9.1.4 Palaeontological Resources

Palaeontological resources of Tertiary age and greater typically occur as fossilized specimens in bedrock contexts. The project area occurs on the heights and sloping margins of the Cameron Hills, which were overridden by Laurentide ice during the final stages of the Holocene glaciation, as indicated by the orientation of the landforms and the presence of considerable amounts of morainal deposits on their surface. This situation suggests that in-situ bedrock formations lie under a blanket of Holocene glacial material throughout the Cameron Hills.

Quaternary palaeontological materials, consisting of the remains of Ice Age mammals and other contemporary remains, are typically found in alluvial deposits along major rivers where they have been concentrated and preserved in relatively deep sedimentary contexts. Although the upper portion of the Cameron River occurs within the SDL, these sections are not deeply incised suggesting moderate levels of flow and limited potential to concentrate materials of this nature.

Consequently, there is a low potential for the occurrence of significant palaeontological remains in a context that might be affected by proposed development activities. Only the downhole portions of the project will penetrate bedrock and this impact would be predicted to have a negligible negative effect. There is no prior indication that Holocene palaeontological material occurs in any concentrations in this area and no landform types that would be considered as having potential for palaeontological resources occur with in the study area.

7.9.2 Heritage Resources Assessment Approach

7.9.2.1 Valued Ecosystem Component Selection

For the purpose of this cumulative effects assessment, individual heritage resources are considered VECs relevant to this section of the report.

7.9.2.2 Potential Impacts

Heritage resources are generally located at, or near, the ground surface and as such are highly susceptible to any activities that result in disturbance to the ground. Well site construction would involve forest clearance, stripping and grading of specific areas, drilling and movement of heavy equipment. Proposed pipeline developments would involve soil stripping, trenching, and spoiling. Development of airstrips, access roads, river crossings, campsites, borrow pits, and facility sites would likely require soil stripping, spoiling, grading and filling. Soil stripping can result in the removal of artifacts from context, as well as the destruction of artifacts and/or cultural features (e.g., fire hearths). Trenching and grading can impact on heritage resources that are more deeply buried and, by virtue of this fact, of greater age than shallower deposits. Feature and artifact removal and destruction are also potential results of trenching and grading activities. Spoiling, fill introduction, and road bed compaction can all result in impacts to cultural deposits in terms of soil strata compression, potentially mixing narrowly separated cultural strata.

7.9.2.3 Assessment Methods

The approach adopted for the cumulative effects assessment for heritage resources takes place in several stages. First, background information on the heritage resources in the region is reviewed.

This includes an evaluation of the heritage resource potential based on the topography, hydrology and vegetation and proximity to the Cameron River and other drainages in the area. The evaluation is based on general principles relating to the distribution of known resources and recognized land use patterns. Secondly, the results of previously conducted heritage inventory work for the area surrounding the project was reviewed, as well as Traditional Knowledge and heritage resource monitoring results that have been collected. Thirdly, this information was then used to refine an assessment of the potential for future proposed development activities to affect heritage resources.

For the purpose of assessment of the combined effects of the predicted development activities on heritage resources, the distribution of development areas defined for each case was overlaid on a model of terrain potential (described below). This approach provides a quantitative analysis of the potential impact of the combined developments on areas of low, moderate and/or high potential in the Historical Resources study area.

7.9.2.4 Temporal Boundaries

The temporal boundaries for the historical resources assessment considers the Environmental Setting and the various Development Cases described in Section 7.1.

7.9.2.5 Spatial Parameters

For the purpose of a cumulative effects assessment on heritage resources, a study area comprised of the SDL has been selected (Figure 7.1-2), as this is the area within which all currently proposed and reasonably foreseeable future developments would take place. Because no other developments are currently known in the region surrounding this area, the cumulative effects assessment for heritage resources assumes that regional development would be limited to those currently proposed by Paramount.

7.9.2.6 Heritage Resources Potential Analysis

Given the fact that this area is remote and does not occur along any major transportation routes, or in an area that is known for prior exploration or resource development activities, it is considered unlikely that the SDL will have any potential for significant Historic Period archaeological, structural or documentary resources. Consequently, the greatest historical resource potential in the development area occurs in relation to Prehistoric archaeological sites and objects, and traditional sites and areas. In this latter respect, consultation with regional community members has indicated that, with the exception of a single trapper's cabin, no major cultural resources relating to community traditional use of the SDL landscapes occur.

As a result, general principles relating to archaeological and traditional site distributions were used to develop a series of landscape characteristics that could be used to assign potential for archaeological and traditional resource occurrence throughout the SDL. In this assessment, consideration was given to topographic variation, hydrology, terrain unit classification, vegetation cover and inferred soil type. Criteria developed included:

- proximity (within 200 m) to a major drainage (none of which exist in the SDL);
- within 100m of a minor drainage (including the Cameron River and its tributaries);
- proximity (within 200 m) to the shoreline of a major lake (none of which exist in the SDL);
- within 100 m of a lakeshore with a solid shoreline
- within 100 m of a major break in slope (considered to be represented by 3 contour lines); and
- on well drained land forms such as eskers and other morainal features surrounded by water saturated conditions.

Application of these criteria to the SDL resulted in an estimate of heritage resources potential within the SDL, which is displayed here as Figure 7.9-1. Based on known site distribution parameters and traditional land use information, this model focuses on water bodies and drainage systems, as these are source areas for resources known to have been exploited in the recent and distant past and also served as transportation routes for people conducting traditional activities. In addition, specific landforms, identified by topographic variation, vegetation and soil types have been selected as possibly having potential. This model is applied to the assessment of the various project development cases considered below.

The Environmental Setting stage of this analysis resulted in an assessment of the heritage resource potential of the terrain within the SDL based on principles of relating to known site distributions and long-term traditional use patterns. Subsequently, the heritage resources work completed for the Baseline and Application Case development scenarios provided basis for modifying these predictions. These studies indicated that although some areas of potential would be affected, no heritage resources appear to be present in areas examined. Furthermore, consultation with local aboriginal groups and individuals suggested that with the exception of a single trapper's cabin, no major traditional cultural resources occur in these areas. As a consequence, the areas defined as having heritage resources potential for the Environmental Setting stage of analysis were considered to have moderate potential at best. In other words, there are no areas in the SDL that are considered to have a high potential for historical resources.

7.9.2.7 Residual Effects Assessment Criteria

Taking into consideration implementation of mitigation procedures, a classification of residual development effects for the Planned Development Case is provided (Section 7.9.5 below).

Potential residual impacts are considered in terms of the following criteria: direction, magnitude, geographic extent, duration, reversibility, and frequency. Each of these criteria is given a weighting as described in Table 7.1-1.

7.9.2.7.1 Direction

The direction of predicted impacts can be negative, positive, or neutral. Negative impacts occur in association with physical disturbance or destruction of heritage resources. Positive effects accrue when heritage resources are discovered and preserved, and valuable information not previously known becomes part of the prehistoric and/or historic record. Neutral effects result when there is no change from the previous condition and heritage resources are neither discovered nor threatened in any way.

7.9.2.7.2 Magnitude

Alteration of the landscape can result in damage or the complete destruction of historical resources. These alterations may involve a range of negative effects from displacement of artifacts resulting in loss of valuable contextual information to destruction of artifacts and features, resulting in the complete loss of important information. As a result of development activities within zones of influence, the potential direct physical impacts to heritage resources vary. These potential impacts are affected by the nature of the ground disturbing activity as well as by environmental conditions under which it takes place. For example, activities that take place over snow covered, frozen ground may have less effect that they would under summer conditions. A further critical determinant is the significance of the individual resources that may be affected. Therefore, assessment of overall magnitude to impacts must include consideration of the significance of the resources as well as the nature of the predicted disturbance.

Direct Effects

High magnitude impacts would be expected in areas of severe physical impact when resources of high value are affected. Moderate magnitude direct effects are anticipated in areas of moderate or partial physical impact when high or moderate value resources are affected. These depend on the nature of the ground disturbance. Low magnitude direct effects could be anticipated in areas of minimal physical impact, or when few or low value resources are affected, depending on the types of development proposed. Negligible magnitude direct effects are expected to occur in areas where no physical impact takes place or no sites occur.

Indirect Effects

Indirect effects may be expected in areas outside proposed direct impact zones but generally have less severe effects as they are unplanned and cannot be predicted in advance. As such, they can only be discussed in terms of their potential. Like direct effects, the magnitude of indirect effects would depend on the significance of the resources that might be affected. Where significant resources occur directly adjacent to proposed development zones, potential accidental (indirect) impact is high. Where significant resources occur in nearby areas that might be subject to high levels of recreational use, potential for accidental impact or vandalism is comparatively high. Where moderate or lower value sites occur well distant from proposed developments, or in areas that are not likely to see increased levels of use, the potential magnitude of indirect effects is expected to be low or negligible.

High magnitude positive effects can be anticipated if a unique or highly significant site is identified and information is recovered before development impact occurs. Moderate positive effects are anticipated if sites similar to others in the region are found and information is recovered before development impact occurs. Low magnitude positive effects will take place if few, low value, or even no sites are found.

Regional effects can be experienced at sites in the region if they are indirectly affected by increased use of the area or demand for other facilities. It is not possible to predict indirect effects with high confidence.

7.9.2.7.3 Geographic Extent

The geographic extent of the impacts of the project can occur at both local and regional levels. Local effects are experienced at any site situated in the zone of influence that is directly affected by development activities. The geographical extent of these impacts is limited to actual physical impact zones within the zone of influence.

Negative effects may be experienced regionally if a project were to result in a substantive influx of population within the region and increased use of regional resources were to take place. Increased recreational use of lakes within the region, for example, may result in indirect impact to heritage resources at considerable distances from the project development zone.

The regional heritage resource base may experience positive effects as a result of project-related activities. If a resource significant to regional history is discovered, recorded and its information conserved as part of project-related assessment and mitigation procedures, positive effects would be achieved at the regional level.

7.9.2.7.4 Duration

The physical effects of project development occur in construction zones. Each impact occurs immediately at the time of impact and can occur throughout the construction and operations phase as new lands are affected. These effects are permanent and irreversible but can be offset by effective mitigation procedures completed in advance of scheduled land disturbance.

7.9.2.7.5 Reversibility

Since historical resources are non-renewable, negative impacts are irreversible.

7.9.2.7.6 Frequency

Frequency of impacts does not apply to historical resources.

7.9.2.8 Environmental Consequence

Environmental consequence is an overall attribute associated with an impact and is a function of direction, magnitude, duration, frequency, geographic extent, and reversibility. A screening system is used to determine an environmental consequence for residual impacts to heritage resources. The screening system uses a numerical score for each of the parameters considered in evaluating an impact. The total is then used as a guide to assign environmental consequence of residual impact. Professional judgment has been used, as appropriate, to determine the associated ranking of the environmental consequences. This quantitative assessment system is intended to be used as a guide to facilitate the final assessment step; it is not intended to provide a definitive value. The Environmental Consequence is described in detail in Section 7.1.1.5.3 of this report.

7.9.3 Baseline Case Assessment

In late summer and fall, 2000 an Heritage Resources Impact Assessment (HRIA) was completed to assess the effects of Baseline Case developments on heritage resources under Northwest Territories Archaeologists Permit #2000-901.

7.9.3.1 Project Elements Examined

Areas that were examined during the HRIA, included:

- the proposed gathering system ROWs, including existing cutlines and new routes to be cut;
- the proposed campsites (both temporary and permanent);
- the proposed H-03 central battery site and H-04 satellite site;

- the airstrip and the all season access between the battery and the airstrip; and
- construction and operations access routes.

7.9.3.2 2000 Heritage Resourse Impact Assessment

The primary objectives of the HRIA were to:

- consult with local First Nations communities to determine whether any culturally significant sites or areas might be affected;
- identify and evaluate archaeological resources within the project area;
- assess the heritage significance of any identified sites;
- assess potential developmental impacts to the sites; and
- recommend viable measures for managing potential adverse impacts.

The methods employed during this study adopted a phased approach, undertaking prefield research, community consultation and in-field inspection of proposed development areas as well as analysis and reporting. As indicated above, a search of the Canadian Museum of Civilization archaeological site database and accompanying NTS map sheets indicated that no previously recorded sites occur in the study area or adjacent areas. First Nations groups consulted as part of the HRIA included the Dene Tha' and the K'atlodeeche. Elders were asked to provide insight with respect to the traditional use of the study area, including place names, trapline information, and past uses of the landscape.

Field methods undertaken for the HRIA included aerial examination of the proposed development areas, examination of existing surface exposures, examination of existing subsurface exposures (e.g., riverbanks and road cuts), and judgemental subsurface testing in areas of assessed moderate to high archaeological potential. Particular attention was paid to well-drained areas and river crossings.

The entire development area was flown by helicopter numerous times in Paramount of Elders and other representatives from First Nations communities to document traditional ecological knowledge the Elders may have concerning the study area and to identify areas of moderate or high archaeological potential. Areas noted by Elders or areas of assessed moderate to high archaeological potential were subjected to more detailed field inspections. A number of low potential areas were also examined and shovel tested to confirm the assessed archaeological potential. Field inspections were undertaken by a professional archaeologist and a First Nations assistant and involved a combination of aerial survey, pedestrian survey, the examination of existing soil exposures (e.g., river cut banks), and the excavation of both judgementally and systematically placed shovel tests.

In general, much of the study area was found to have low archaeological potential given its generally wet and low-lying condition. Crossings of the Cameron River and other elevated, well-drained areas exhibited the greatest archaeological potential, but a thorough examination of these areas did not reveal archaeological materials. Although a trapper's cabin is located within the project area, it was located away from the proposed developments and was not be affected by the project. No heritage resources were identified during the HRIA.

In 2001, Paramount proposed amendment of its access infrastructure for its development in the Cameron Hills area including a winter road, camp ands airstrip. Since all of the areas proposed for development occurred in areas that had been disturbed previously and many of these areas had been examined during the 2000 HRIA, no heritage resources studies were deemed necessary.

7.9.4 Application Case Assessment

Heritage resource studies associated with these wells were conducted in 2001, focussing on site investigations and monitoring of the proposed locations. Prior to investigations, a monitoring manual was developed by professional archaeologists at Golder Associates and was delivered to the community representative engaged by Paramount to oversee this work. Subsequently, Mr. Fred Simba, an elder from the Kà à Gee Tu First Nation and Mr. Roy Buggins, trapper from the K'atlodeeche First Nation reviewed the development for heritage resource concerns. There were no concerns raised by Mr. Simba or Mr. Buggins with the final access routes or wellsites.

In addition, no HRIA was required by the Prince of Wales Northern Heritage Center for this portion of the project.

7.9.5 Planned Development Case Assessment

7.9.5.1 Project Elements Examined

The Planned Development Case relates to the development of an additional 48 wells and related infrastructure to be drilled over a 10 year period up to and including 2013.

7.9.5.2 Impact Assessment

As this assessment if focussed on the cumulative effects assessment, this section describes the impacts of the Planned Development Case as the "worst case scenario". This conservative approach involves a discussion of all past, present and reasonably foreseeable future activities in quantitative and qualitative terms. For historical resources, if there are no impacts of moderate or high consequence in the Planned Development Case, then it follows that each of the previous cases (Baseline Case and Application Case) would not result in a moderate or high consequence when assessed in isolation or in combination. If a prediction of moderate or high consequence results from analysis of the Planned Development Case, a discussion of Baseline Case and Application case would follow. In this assessment, the impacts to heritage resources is predicted to be low, therefore, a discussion of impacts due to the other cases is not necessary.

7.9.5.3 Potential Impact

For the Planned Development Case analysis, the distribution of developments in all three development cases were overlaid on the areas of heritage resource potential (see Figure 7.1-2) to gain an impression of the amount of land considered to have potential that would be affected in each case. These areas are displayed in Table 7.9-1 below.

Table 7.9-1 Areas of Predicted Heritage Resources Potential to be Affected by All Development Cases

Heritage Resource Potential	Potential Effects Due to Development Activities in the SDL						
	Environmental Setting Case (ha)	Baseline Case		Application Case		Planned Development Case	
		(ha)	% [a]	(ha)	% [a]	(ha)	% [a]
High	0	0	0	0	0	0	0
Moderate	3,842	451	11.7	455	11.8	466	12.1
Low	28,710	1,467	5.1	1,491	5.2	1,627[b]	5.8
Total	32,552	1,918	5.9	1,946	6.0	2,093	6.4

(a) Percent is calculated as the amount of disturbance in each case divided by the resource present in the Environmental Setting Case.

(b) includes 19 ha of emergency access, of unknown location.

This analysis suggests that within the full 32,552 ha SDL, 3,842 ha would be considered to have moderate heritage resources potential while 28,710 ha would be considered to have low heritage resources potential. Within the 1,918 ha Baseline Case development area, 451 ha (11.7%) of moderate heritage resources potential landscape would be affected. Addition of the 28 ha Application Case developments would increase the affected areas of moderate potential by four additional hectares (0.1%). Finally the Planned Development Case includes an additional 11 ha (0.3%) of lands considered to have moderate heritage resource potential affected by development.

7.9.5.4 Residual Impact Summary

The heritage resource studies completed for the Baseline and Application Case indicated that no heritage resources of significance would be affected by those stages of the proposed Cameron Hills development. For the Planned Development Case scenario, impacts can only be predicted but are expected to be limited. Overall, cumulative environmental consequence of the project is considered to be low. Factors contributing to this assessment include the following:

The **direction** of the effects of the project will be both positive and negative. Developments would likely affect any heritage resources that were not identified during the heritage resources studies that precede future developments. Positive effects would be realized if heritage resources are identified in the future and conserved either by avoidance or information recovery.

The **magnitude** of project effects have been evaluated as being low. This is based on the limited distribution of areas of moderate potential throughout the SDL and the negative results of the studies completed to-date but adopts a conservative evaluation of the likelihood that heritage resources may be encountered in the heritage monitoring that precede future development plans.

The **geographic extent** of the effects of the project on heritage resources is considered to be localized. No heritage resources have been identified in any previous study. Those that may be identified in future are likely to reflect use patterns that are highly localized and have a high probability of occurring in similar contexts in surrounding regions. Any positives effects as a result of learning that might assist in improved management of adjacent areas would reduce these effects and may even result in overall positive consequence locally and regionally.

Any negative effects resulting from the project would occur immediately upon landscape disturbance during the construction stage of development. Consequently **duration** is evaluated as having a negligible environmental consequence for heritage resources.

Frequency of effect is not relevant for heritage resources.

Any negative effects that may be experienced by heritage resources would be **irreversible,** as damage to heritage resources themselves cannot be repaired and much of the significance of these rests in their context, which would be destroyed or significantly altered during land disturbing construction activities.

Combining these evaluations results in an overall prediction of **low environmental consequence** for the heritage resources component of this analysis.

Table 7.9-2 summarizes the residual impact assessment for heritage resources in the Cameron Hills project area.

Table 7.9-2 Residual Impacts for Heritage Resources

Component	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Environmental Consequence
Heritage Resources	negative and positive	low (+5)	local (0)	immediate (0)	n/a	no (+3)	low (+8)

7.10 TRADITIONAL HARVESTING

This section addresses Section G-8 of the MVEIRB ToR: Describe the direct and indirect impacts this development may have on hunting, fishing, and trapping.

This section assesses the potential impacts of the Cameron Hills project on hunting, fishing and trapping as described in Section G8 of the Terms of Reference.

7.10.1 Environmental Setting

The region containing the Cameron Hills experiences Aboriginal traditional land use as well as activities other than oil and gas exploration and development. This has included timber harvesting, which took place on portions of the north and east slopes, outside of the TSA.

For the purpose of this analysis, it was assumed that there was no industrial disturbance in the Cameron Hills prior to the 1960s; this scenario was chosen to describe the Environmental Setting. Based on information presented in previous EIAs, it appears that there was limited use of the Paramount SDL within the Cameron Hills at that time. Tathlina Lake and the Kakisa River appear to have been subject to intensive traditional land use in the past, which continues to the present, and is expected to continue into the future.

Moose and caribou are sparse within the Cameron Hills (Colosimo 1968, Lines 1969, Golder and Alpine 2001). Moose are reportedly not hunted because it is difficult to carry heavy loads of meat down the hill and the distance to reasonable access. There is good moose habitat around Tathlina Lake, and good caribou habitat to the northwest of Tathlina Lake.

The Deh Cho Atlas (Deh Cho Land Use Planning Committee 2003) provides additional information regarding the reported status of biophysical resources within the Deh Cho Territory. The Cameron Hills are within woodland caribou range. The Cameron Hills are classified as providing year-round habitat, and calving grounds. In terms of wildlife conservation rank, the Cameron Hills are rated as ‘high’, while the area to the north, around Tathlina Lake and the Kakisa River, are ranked ‘moderate’.

There are reportedly some fish in the lakes in the Cameron Hills region, however, the majority of fishing occurs at Tathlina Lake, Kakisa Lake, and the Kakisa River. As discussed in the Fish section (Section 7.7), minimal baseline historical information for fish and fish habitat in the Cameron Hills area was identified during previous EIAs (Golder and Alpine 2001). In general, other than the Cameron River, fish habitat was limited within the SDL, due to shallow water depths and lack of pool or deep run habitats for overwintering of fish species. Little documentation exists for commercial or domestic fishing use, as access to the CESA is limited primarily to winter roads and/or helicopter and floatplane. The closest historical commercial fishery identified downstream of the Cameron Hills was Tathlina Lake. Currently, Swat Lake and Lori Lake, located approximately 5 km west of the Cameron River, are used for recreational fishing (Al Helmer, RWED, Hay River, pers. comm. 2003), with access gained with snowmachines on cutlines, some of which are within the southern portion of the Paramount SDL. No important fish spawning or migration routes are reported for the Cameron Hills area (Deh Cho Land Use Planning Committee 2003).

Colosimo (1968) reported that the cover on top of the Cameron Hills was very thin, and that a lot of the area was burnt over. Beaver lodges, and tracks of fox and lynx were noted. However, Colosimo noted that the area does not lend itself to good habitat for furbearers. Lines (1969) reported seeing tracks of lynx, wolverine and wolf, and a density of 36 beaver houses/100 square miles, mostly along the Cameron River and adjoining lakes. Marten were reported to be very numerous by Lines (1969).

There appears to be only limited trapping in the area, likely due to a combination of low fur prices and the high price of fuel, in addition to the distance being a factor for accessing the area. Nonetheless, there are two trappers that use the general project area. These trappers, Mr. Dennis Strang and Mr. Roy Buggins have been contacted to review the project, identify concerns and discuss appropriate mitigative measures. If their traplines are affected as the project progresses through the various development cases, the trappers will be compensated for any demonstrable loss. Marten is reported to be the primary species trapped on the Cameron Hills plateau.

The above information was then used to determine the types and extent of potential disturbances and/or conflicts with traditional harvesting that may arise from the various Development Cases proposed by Paramount.

7.10.2 Valued Ecosystem Component Selection

Valued Ecosystem Components (VECs) for traditional harvesting were determined to be the opportunity to hunt, trap and fish in the project region. Harvesting, trapping and fishing records for the Cameron Hills are not available (Al Hymers, RWED, pers. comm. 2003; Bruce Hanna, DFO, pers. comm. 2003), therefore, it was not possible to assess changes in the number of animals harvested or trapped, nor fish caught, as a result of the different assessment cases. However, a qualitative assessment was conducted based on our current understanding of traditional harvesting activities in the Cameron Hills in the past, and predicted effects from the Cameron Hills Project on wildlife/habitat (Section 7.6 and fish/fish habitat (Section 7.7).

7.10.3 Spatial and Temporal Boundaries

The socio-economic study area was considered to be the spatial boundaries for this component of the assessment (Figure 7.1-2), as local communities could all potentially use the project area for hunting, trapping and fishing. As such, it encompasses those communities identified in previous EIAs, as potentially using the Cameron Hills in the past, present and future.

The temporal boundaries extend into the past, to the Environmental Setting (circa 1960), considering available information, and considering the Development Cases outlined in Section 7.1.1.2.

7.10.4 Potential Effects

Paramount's Cameron Hills project has the potential to affect traditional harvesting in a variety of ways, both positive and negative. There may be effects on human use of the area due to habitat alteration, increased noise levels, aesthetic issues, and increased access (e.g., the use of linear disturbances as travel routes). These effects would be related to fish and wildlife abundance and opportunities for harvesting. Improved access in the winter may result in greater opportunities for harvesting within the Cameron Hills region.

The effects to water quantity and quality, wildlife/habitat and fish/fish habitat as a result of the project components has been predicted to be of low consequence. Based on the limited quality of habitat in the 1960's, and the low reported use of the Cameron Hills plateau (i.e., in the SDL), Paramount feels that this would translate into low traditional use. Part of this rationale, is that better hunting, trapping and fishing areas are located to the north (Tathlina Lake, Kakisa Lake and Kakisa River) and to the east (Hay River. This suggests that harvesting opportunities are not expected to be significantly different from the Environmental Setting Case for those that might choose to use the area for traditional pursuits through the different Development Cases. Indeed, the SDL continues to be used by the two trappers today, as they have in the past, in conjunction with the Paramount activities.

There has been increased ease of access into the Cameron Hills area as a result of the Baseline Case (i.e., winter access and cutlines), but this is not expected to change as the project proceeds through the Application Case and Planned Development Case. Further, this winter access has not been built every year in the past, but will be from the Baseline Case going forward through the Planned Development Case. Access development is not planned to be permanent, and winter roads will continue to be the only means of ground access into the Cameron Hills during the winter. There is some existing access in the form of old seismic cutlines that extend from the surrounding lowlands into the Cameron Hills, which are likely not well used due to long distances of soft ground (i.e., muskeg) and drainages that would have to be crossed.

Potential impacts to traditional harvesting that may arise from the various project components include:

- alteration of terrestrial and/or aquatic habitat that could lead to wildlife population/distribution changes;
- alteration of fish habitat that could lead to fish population changes;
- alteration of wildlife distribution and/or travel routes due to human activity/equipment disturbance;
- increased ease of access into the Cameron Hills with the construction of the winter road;
- physical disturbance to traplines and/or traps; and
- blocking traditional snowmobile trails with slash and/or snow.

Considering the mitigation plans proposed by Paramount, no residual impacts to traditional land use were identified during previous EIAs (Golder and Alpine 2001). However, the above impacts were considered in the cumulative context, as the project proceeds through the various Development Cases.

In addition to Paramount's developments in the area, one of the trappers in Paramount's SDL has indicated an interest in using the winter access road to move building materials in via truck to build a cabin near the north end of the SDL.

7.10.5 Results

In the following sections, the effects of Paramount's project on traditional harvesting is compared to the Environmental Setting across three cases: Baseline Case (June 2003), Application Case (2003/2004) and Planned Development Case (2013).

7.10.5.1.1 Baseline Case

According to Al Helmer (Renewable Resource Officer, RWED Hay River, pers. comm. 2003), there is very little hunting activity in the Cameron Hills. Today, most hunting occurs between Tathlina and Kakisa Lakes. There is, however, some snowmobiling in the Cameron Hills, but it is mainly to access Swat and Lori lakes for ice fishing, and only one person (Roy Buggins) uses the Cameron Hills plateau for trapping.

Similarly, Deb Johnson (Regional Biologist, RWED Fort Smith, pers. comm. 2003) noted that most of the caribou hunting in the region is well outside of the SDL, occurring mainly west of Kakisa Lake. A few people from Hay River and Northern Alberta may hunt on the hills.

The largest incremental change in disturbance levels is associated with the completion and operation of the Baseline Case (Table 7.10-1). Work completed prior to June 2003 has resulted in 1,918 ha (2.0%) of direct disturbance within the 96,229 ha terrestrial TSA. The majority of this disturbance has resulted from seismic cutlines. Subsequent access routes, well drilling, and construction of flowlines, make use of these seismic lines to the maximum extent feasible as the project proceeds, which minimizes incremental or cumulative disturbances.

Table 7.10-1 Disturbances Associated with the Various Development Cases for the Cameron Hills

Case	Year	Total Disturbed (ha)	Percent Disturbed
Environmental Setting (96,229 ha)	circa 1960	0	0
Baseline Case	May 2003	1,918	2.0%
Application Case	2003/2004	1,946	2.0%
Planned Development Case	2013	2,093	2.2%

Wildlife and fisheries assessments of the Baseline Case, predicted low environmental consequences to wildlife/habitat and fish/fish habitat. Ease of access (i.e., the creation of the winter road) is expected to have increased the ease of access into the project area, but Paramount reports little use of winter road, except the local trappers discussed previously.

As such, the effects to traditional harvesting, trapping and fishing within the SDL resulting from the Baseline Case are predicted to be negligible to low (see Table 7.10-2).

7.10.5.1.2 Application Case

The Application Case includes drilling five wells and constructing approximately 15 km of access and flowline. The amount of direct disturbance to terrestrial habitat increases by approximately 28 ha, which is less than 0.1% above the Baseline Case (Table 7.10-1). Additional effects (i.e., above the Baseline Case) to wildlife in terms of habitat loss/alteration and related human disturbance are expected to be limited as the project moves through the Application Case. The proposed wells and flowlines of the Application Case are within or near existing disturbance corridors in the SDL (i.e., the regional extent of the project is not expanding, but is remaining mainly in the central portion of Paramount's SDL). Ongoing communication with the trappers in the project area is expected to minimize the potential for conflicts during winter construction. As such, impacts to hunting and trapping in the area resulting from the completion of the Application Case are predicted to be minimal.

For the Application Case, there will be no new crossings of the Cameron River, as the proposed drilling program and gathering system are on the south side of the river. The six small drainage crossings (i.e., flowline and operational ATV access) are expected to result in minimal disturbance to fish habitat, considering the proposed mitigation plans. In addition, effects to potential fish habitat within the water source lakes are predicted to be minimal, considering mitigation plans and adherence to DFO guidelines. As such, potential impacts to fish harvesting within the project area, resulting from the Application Case are expected to be negligible.

Consequently, impacts to water quality and quantity, and in turn fisheries resources, in the Cameron River and downstream waterbodies such as Tathlina Lake, which is traditionally used for fish harvesting, are also not anticipated.

Considering the small incremental increase in disturbance, the effects to traditional harvesting, trapping and fishing within the SDL resulting from the Application Case are predicted to be negligible to low (see Table 7.10-2).

7.10.5.1.3 Planned Development Case

The Planned Development Case includes up to 48 wells and associated flowlines and facilities. The amount of disturbance increases by 147 ha, which is approximately 0.2% above the Baseline Case, and the Application Case (Table 7.10-1). This results in a cumulative increase in disturbance of 2.2% for the Planned Development Case, over the Environmental Setting. As with the Application Case, disturbance is planned to utilize existing disturbance corridors to the extent practical, thereby limiting new habitat disturbance. As such, this is expected to result in minimal effects to wildlife/habitat, and therefore, minimal effects to hunting and trapping. The benefit of the yearly construction of the winter access to the trappers of the area must also be considered. This is expected to make it easier for the trappers to access their traplines, and indeed may allow them to expand, providing a positive benefit.

Fourteen small drainage crossings are anticipated for the Planned Development Case, which are predicted to affect fish or fish habitat. Effects to potential fish habitat within the water source lakes are predicted to be minimal, considering mitigation plans and adherence to DFO guidelines. Considering this, and the fact that the Cameron River will not be crossed again, effects to fish harvesting within the Cameron Hills are expected to be negligible.

Once again, the proposed wells and flowlines for the Planned Development Case are within existing disturbance corridors in the area.

For the Planned Development Case, there will be no new crossings of the Cameron River, as access routes and gathering flowlines follow existing ROWs to the maximum extent feasible, and making use of the vehicle bridge and two ATV bridges. Operational ATV traffic is expected to result in localized disturbance of the small drainage crossings in the unfrozen season, but this is not expected to affect fish harvesting, based on the findings of the fish/fish habitat assessment.

It is predicted that the effects to traditional harvesting, trapping and fishing within the SDL resulting from the Planned Development Case are predicted to be negligible to low (see Table 7.10-2).

7.10.6 Potential Impact Classification

Table 7.10-2 outlines the impact classification for potential impacts of the various cases to traditional harvesting, as represented by the VECs of hunting, fishing and trapping within the Cameron Hills, based on the discussion provided in the previous sections.

Table 7.10-2 Potential Impact Classification for Traditional Harvesting

Parameter	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Environmental Consequence
Baseline Case							
Effects to hunting	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	low (+7)
Effects to fishing	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	negligible (+2)
Effects to trapping	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	low (+7)
Application Case							
Effects to hunting	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	negligible (+2)
Effects to fishing	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	negligible (+2)
Effects to trapping	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	negligible (+2)
Planned Development Case							
Effects to hunting	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	negligible (+2)
Effects to fishing	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	negligible (+2)
Effects to trapping	negative	negligible (0)	regional (+1)	long-term (+3)	reversible (-3)	medium (+1)	negligible (+2)

The potential impact to traditional harvesting in the Cameron Hills area is expected, to some extent, to be related to population status of important subsistence species such as moose and woodland caribou. These species are reported to be traditionally hunted primarily in the vicinity of Tathlina Lake and Kakisa Lake, which are north of the Cameron Hills, and as such, not expected to be affected by the project.

Given the small amount of additional terrestrial disturbance associated with the Application and Planned Development Cases (an increase of 0.1% and 0.2% over Baseline Case disturbance, respectively), and considering the low activity levels during production, it is predicted that there is unlikely to be a significant impact on current wildlife populations in the Cameron Hills. Compared to the Environmental Setting Case, the Planned Development represents an increase in disturbance of 2.2% and only 0.2% over current conditions. Based on this analysis, the consequence of Paramount's activities in the area to traditional harvesting is predicted to be negligible for trapping and hunting.

The Cameron River will not be crossed by the Application Case, nor the Planned Development Case, and the predicted effects to fish and fish habitat are predicted to be low for the smaller drainages crossed by the flowline construction and operational access. DFO guidelines will be followed to protect the potential fish habitat in the watersource lakes. Considering the mitigation plans, the limits of the resource, and the low levels of use, the potential cumulative effect to fishing within the Cameron Hills is predicted to be negligible for all development cases.

7.10.7 Summary

In general, traditional harvesting in the vicinity of the Paramount SDL in the Cameron Hills appears to be limited to trapping activities by two individuals.

The project is not expected to have an adverse effect on the pursuit of traditional activities, nor the retention of traditional skills, largely due to the remoteness of the Cameron Hills. It is also not expected to introduce new forms of socio-cultural change, although it may contribute to changes already underway, such as the transition to a mixed economy. The absence of other large-scale economic activities within the development area also helps mitigate against significant cumulative impacts.

7.11 SOCIO-ECONOMICS

This section addresses Sections G-9 and G-10 of the MVEIRB ToR:

G-9: Health and Social Indicators: Describe how the proposed development may affect indicators such as use of social services (strain on infrastructure), alcohol and drug use, and teen pregnancy. Information on trends of these and other indicators to describe health and social well being may be obtained from the GNWT Bureau of Statistics or from service providers in the affected communities.

G-10: Economic Factors: The DAR should describe how the proposed development will impact on the economy in the NT in general and on the economy of the affected communities in particular. This section should also include information on hiring policies with respect to NT residents and residents of the affected communities, including barriers to employment, minimal skill requirements, availability of employees, and any proposed training or education initiatives.

7.11.1 Introduction

The proposed Cameron Hills project is situated in a remote and sparsely populated area extending north from the boundary between Alberta and the Northwest Territories. The closest communities on the Northwest Territories side of the border are outside a 60 km radius from the project. These communities are Enterprise, Hay River, the Hay River Dene Reserve, Kakisa and Fort Providence. Hay River is also home to the West Point First Nation. In addition, just across the Alberta border, is a small settlement of a few households called Indian Cabins.

The Paramount SDL lies within the Deh Cho administrative region of the Northwest Territories. The potentially affected communities lie within the Treaty 8 territory, with the exception of Fort Providence and Kakisa, which are subject to Treaty 11. In 1970, the federal government agreed to renegotiate the treaties with the Deh Cho on the basis that Ottawa had not met all of its obligations under the treaties. No comprehensive agreements have yet been reached. However, the Deh Cho Process, which is a unique negotiation between the Deh Cho First Nations, the Government of Canada, and the Government of the Northwest Territories, is underway. The parties to the Deh Cho Process have negotiated key interim arrangements that provide additional clarity and predictability in the land access and regulatory regime for the Deh Cho region. Among those agreements are the Interim Measures Agreement, an Interim Resource Development Agreement, and Interim Land Withdrawals which protects certain lands such as cultural and spiritual lands and major waterbodies and watersheds, and opens up other lands. The project area is exempt from these land withdrawals.

7.11.2 Spatial and Temporal Boundaries.

The spatial boundaries for the socio-economic components of this cumulative effects assessment are illustrated in Figure 7.1-2. Potentially affected communities are Enterprise, Hay River, the Hay River Dene Reserve, Kakisa and Fort Providence. These are settlements within a 150 km radius of the project, with populations whose members both potentially (but not presently) use the project area for traditional activity and may be in a position to benefit from economic impacts of the project. The total potentially affected population is just over 4,600, of which 80% live in and around Hay River.

For purpose of this assessment, the Environmental Setting is not considered due to a lack of data, but perhaps more importantly due to the inapplicability of the concept of “reversibility” to pre-development conditions insofar as socio-economic impacts are concerned. Socio-economic change is ongoing, and can be both negative and positive and is a result of a multitude of forces over and above the impacts of any particular development, but cannot be reversed.

The baseline is considered to be 2001, when the most recent census data was collected. The Application Case is that contained in the Cameron Hills Gathering System and Facilities Project EIA dated April 2001. The temporal boundary for the Application Case is 2013, when production is expected to cease on the up to eight wells that could be developed on the basis of that EIA.

The Planned Development Case temporal boundary is considered to be the year 2023. Should Paramount proceed to develop up to 48 more wells, it is expected that the operational life of these wells would not extend beyond the year 2023. Further, the most significant impacts are associated with the project’s construction phase and its employment opportunities, which are planned to extend only to the year 2013.

7.11.3 Baseline Conditions

7.11.3.1 Methodology

Baseline information contained in the EIA of April 2001 is repeated here, and updated on the basis of the newly reported census results. There are significant limits on the available data. This is particularly true for smaller communities, such as Enterprise, Kakisa and to a lesser extent Hay River Dene Reserve. Statistics Canada both rounds and suppresses data on confidentiality grounds, which affects the accuracy of percentage calculations.

Further, with small sample sizes, single events (for example the movement out of a settlement of one large family for a specific reason) can produce large shifts in the data that should be considered anecdotal rather than representative of trends. Interpretation of the data presented here therefore needs to consider these limits, and take into account familiarity with the affected communities.

The release of new census data, as well as much recent documentation on social change in the Northwest Territories, has made it possible to include in the description of baseline conditions some analysis of socio-economic trends over the recent past. Because socio-economic impacts cannot be isolated from ongoing trends, but interact with these to contribute to overall social change, an understanding of trends both in communities potentially affected by the project and in the Northwest Territories as a whole is important to an estimation of potential for impact, and for mitigation measures put in place in response.

The socio-economic data included in the following tables has been selected for availability and reliability of comparable data for relevant socio-economic parameters for the years 1996 and 2001. Additional data can be found on the Statistics Canada website (http://www.12.statcan.ca/english/profil01/PlaceSearchForm1.cfm). Much of the 2001 data are in improved presentation and detail over 1996 but are not included here for reasons of non comparability. At the time of writing, the Government of the Northwest Territories Bureau of Statistics had not released their treatment of the census data.

7.11.3.2 Community Profiles

7.11.3.2.1 Enterprise

Enterprise, incorporated in 1988, is the first community encountered going north from the project along Highway 1 (Mackenzie Highway), approximately 100 km northeast by road from the southern limit of the Paramount SDL. The town exists to service the traffic along Highway 1 and oil and gas activity in the region. The population is primarily non-aboriginal. Wage employment, in the service sector, but also significant employment in resource extraction, is the basis of the economy. Medical services are only available in Hay River, some 25 km to the northwest.

The data in Table 7.11-1 demonstrates that Enterprise had lost population between 1996 and 2001. The aboriginal population increased and the population overall aged.

Table 7.11-1 Selected Data for Enterprise

	Enterprise	
	1996	2001
Population	89	61
Population growth over 5 previous years (%)	75.5	-29.1
Aboriginal population (%)	12	33
Population > 15 (%)	66.7	83.3
Ratio of males to females	0.89	1.00
Aboriginal mother tongue (%)	12	15
Working age population with less than a high school certificate (%)	40	50
Participation rate (%)	75.0	80.0
Unemployment rate (%)	ds	ds
Average income ($)	ds	ds
Median family income ($)	ds	ds
Occupation (%)		
primary	2	0
secondary	18	25
tertiary	78	75
Lone parent families (%)	ds	ds

Source: Based on data from Statscan, 2003

For this, and the following tables generated from Statscan data 1) mother tongue is defined as the language first learned and still understood; 2) except in aboriginal settlements, mother tongue is only reported as English, French or other, which is reported in these tables as "aboriginal"; 3) the working age population is defined as 25+ in 1996 and 20-64 in 2001, thus the figures are not strictly comparable; 4) median family income is for "couple" families only, as this is the only family income data that is available from both the 1996 and 2001 census; 5) Average income is "income" for 1996 and "earnings" (which excludes government transfers for example) for 2001 thus the figures are not strictly comparable, with the 2001 figures understating total average income; 6) ds = data suppressed by Statscan.

7.11.3.2.2 Hay River

Hay River, incorporated in 1963, is located approximately 125 km from the project area by road. The town dates from 1893, when it was originally established as a trading post. It subsequently became a key transshipment point for settlements to the north, the home of the Great Slave Lake commercial fishery and a regional educational centre. It is linked to the south by rail and road.

Hay River is now an economically diverse, full-service community dominated by wage employment, including employment in the fishery, forestry and market gardening sectors. Service sector employment includes construction and transportation. In addition, the West Point First Nation community, governed separately from Hay River by an elected chief and council, depends in large part for livelihoods on traditional activity.

The data in Table 7.11-2 shows Hay River had also lost some population between 1996 and 2001. Aboriginals are increasingly represented in the population, which has aged. Educational status had improved and unemployment decreased. Incomes had increased by 2001, and were comparable to incomes in the Northwest Territories as a whole (see Table 7.11-6 for data for the Northwest Territories), however Statscan data indicate that the aboriginal population in 2001 was still significantly worse off economically than the white population. There had also been a large increase in lone-parent families over the five year period.

Table 7.11-2 Selected Data for Hay River

	Hay River	
	1996	**2001**
Population	3,611	3,510
Population growth over 5 previous years (%)	11.0	-2.8
Aboriginal population (%)	38	45
Population > 15 (%)	71.7	73.5
Ratio of males to females	1.09	1.06
Aboriginal mother tongue (%)	10	10
Working age population with less than a high school certificate (%)	30	24
Participation rate (%)	80.5	80.2
Unemployment rate (%)	12.5	10.6
Average income ($)	31,430	35,745
Median family income ($)	72,335	84,736
Occupation (%)		
primary	4	11
secondary	10	10
tertiary	85	79
Lone parent families (%)	14	22

Source: Based on data from Statscan, 2003

7.11.3.2.3 Hay River Dene Reserve

The Hay River Dene Reserve was formed in 1974 at the request of band members under the provisions of Treaty 8. It is governed by an elected chief and council. The reserve is accessible by air, road and water. Reserve residents earn their livelihoods from hunting, trapping, craft production, fishing and wage employment. Community facilities include churches, a school, a community center, a library and the Dene Cultural Institute and Treatment Centre. Additional educational, medical and recreational services are available in the adjacent town of Hay River.

The data in Table 7.11-3 shows the population had increased between 1996 and 2001. Unemployment had decreased and average incomes increased but were still significantly below Northwest Territories averages. There was on the reserve significantly more economic activity in the primary sector than in non-aboriginal communities, reflecting more traditional economic activity. However, the largest percentage of the population depends on wage employment in the service sector. There had been almost a doubling in lone parent families between 1996 and 2001.

Table 7.11-3 Selected Data for the Hay River Dene Reserve

	Hay River Dene Reserve	
	1996	**2001**
Population	253	269
Population growth over 5 previous years (%)	17.1	6.3
Aboriginal population (%)	98	100
Population > 15 (%)	65.9	66.7
Ratio of males to females	1.00	0.96
Aboriginal mother tongue (%)	36	34
Working age population with less than a high school certificate (%)	52	57
Participation rate (%)	63.9	61.1
Unemployment rate (%)	23.8	18.2
Average income ($)	13,433	19,028
Median family income ($)	35,032	48,256
Occupation (%)		
primary	15.8	18
secondary	10.5	9
tertiary	68.4	68
Lone parent families (%)	17	33

Source: Based on data from Statscan, 2003

7.11.3.2.4 Kakisa

The settlement of Kakisa is 180 km from the project by road, or about 60 km as the crow flies. It is the closest settlement to the project site. It is said to have been established in 1962 by residents of Tathlina Lake, so that they could be closer to the newly constructed Mackenzie Highway. Kakisa is governed by an elected chief and council. Today, a 13 km all weather road connects Kakisa to the Highway and there is access by float plane during the summer months. Residents must travel to Fort Providence or Hay River to access most public services.

Kakisa is a very small aboriginal settlement, with an economy based on hunting, trapping, fishing and some tourism as well as wage employment. There are few data for 1996 for Kakisa, due to its very small size and the consequent suppression of data by Statscan, however some data are available for 2001. The data in Table 7.11-4 shows Kakisa had grown in size between 1996 and 2001. As for the Hay River Dene Reserve above, participation rates were significantly lower than for non-aboriginal communities. Average incomes approximated those of the Northwest Territories overall, largely due to commercial fishing and employment by Paramount, and thus are significantly higher than has been typical for aboriginal communities in the area. Fully half the population worked in the primary sector, again reflecting practice of traditional economic activity as well as employment in fisheries and the oil and gas sector.

Table 7.11-4 Selected Data for Kakisa

	Kakisa	
	1996	**2001**
Population	36	40
Population growth over 5 previous years (%)	-7.7	11.1
Aboriginal population (%)	ds	100
Population > 15 (%)	ds	75.0
Ratio of males to females	ds	1.00
Aboriginal mother tongue (%)		20
Working age population with less than a high school certificate (%)	ds	ds
Participation rate (%)	ds	42.9
Unemployment rate (%)	ds	ds
Average income ($)	ds	ds
Median family income ($)	ds	81,533
Occupation (%)		
primary	ds	50
secondary	ds	0
tertiary	ds	50
Lone parent families (%)	ds	ds

Source: Based on data from Statscan, 2003

7.11.3.2.5 Fort Providence

The aboriginal hamlet of Fort Providence was incorporated in 1987, and is 250 km from the project by road, or 140 km as the crow flies. The community dates from 1861 when a Roman Catholic mission was established. Construction of the Hudson's Bay Company trading post soon afterward provided further incentive to dispersed area populations to settle in Fort Providence. The economy is mixed, based on hunting, trapping, and wage employment. The community is also renowned for traditional craft production. Fort Providence is well served with public services.

The data in Table 7.11-5 shows the population had barely changed between 1998 and 2001. Although educational achievement had not changed, unemployment did decrease and individual incomes have gone up. However, family incomes had declined, reflecting the significant drop in the participation rate (dropping out of the workforce on the part of some family members). Both individual and family incomes were well below those of the Northwest Territories. Lone parent families also had increased.

Table 7.11-5 Selected Data for Fort Providence

	Fort Providence	
	1996	2001
Population	748	753
Population growth over 5 previous years (%)	16.0	0.7
Aboriginal population (%)	90	89
Population > 15 (%)	71.1	73.5
Ratio of males to females	1.14	1.16
Aboriginal mother tongue (%)	42	29
Working age population with less than a high school certificate (%)	51	52
Participation rate (%)	70.1	60.4
Unemployment rate (%)	31.1	19.4
Average income ($)	17,433	22,048
Median family income ($)	40,468	36,608
Occupation (%)		
primary	12	16
secondary	14	11
tertiary	74	69
Lone parent families (%)	13	20

Source: Based on data from Statscan, 2003

7.11.3.3 Socio-economic Trends in the Northwest Territories and the Study Area

The Government of the Northwest Territories makes much information available on socio-economic trends (the information in this section largely comes from BS, 2003; CBC, 2002; and GNWT, 2002.), but with the exception of Yellowknife, not at the individual community level. It is difficult to generalize from this work to the study area specifically, whose potentially affected communities are each so different from the other. However the data in the previous section suggest that at least in some respects, and at least in some communities, overall trends are comparable.

Table 7.11-6 presents data for the Northwest Territories and the Fort Smith Region, within which the project site lies. Because the Fort Smith Region includes Yellowknife and accounts for over 75% of the total territorial population, there are not large differences in socio-economic characteristics between the territories as a whole and the region. Primary differences are that the region has a smaller aboriginal population proportionately, lower unemployment and higher incomes.

Table 7.11-6 Selected Data for the Northwest Territories

	2001	
	Fort Smith Region	NT
Population	28,824	37,360
Population growth over 5 previous years (%)	-4.6	-5.8
Aboriginal population (%)	43.8	50.5
Population > 15 (%)	73.8	72.9
Ratio of males to females	1.05	1.05
Aboriginal mother tongue (%)	19	20
Working age population with less than a high school certificate (%)	24	26
Participation rate (%)	79.1	77.2
Unemployment rate (%)	8.6	9.5
Average income ($)	38,428	36,645
Median family income ($)	85,622	81,533
Occupation (%)		
primary	10	10
secondary	8	9
tertiary	82	81
Lone parent families (%)	19	21

Source: Based on data from Statscan, 2003

The Northwest Territories lost population between 1996 and 2001, but numbers may be recovering with the improved economic performance, particularly in the mining, oil and gas and trade sectors, between 2000 and 2002. The non aboriginal population is considered to be comparatively mobile, moving into, around and out of the north in response to employment opportunities. With a low natural increase, migration is becoming the main driver of population growth. Overall, the territorial population is younger than in the rest of Canada, but birth rates are declining and the population is aging rapidly. Teen fertility rates, although stabilizing, are still three times the Canadian rate, perhaps accounting for much of the observed increase in lone parent families between 1996 and 2001.

Unemployment rates (Table 7.11-7) have been falling and participation rates peaking (with the exception of some aboriginal communities, participation rates are much higher than those in Canada as a whole). In the absence of an economic downturn, as educational achievement continues to improve and competition grows for northern employees, unemployment will continue to fall. There is already talk of a labour shortage; people not working are either those who chose not to participate in the labour force, or those that are very challenging to employ.

Table 7.11-7 Employment and Participation Rates

	Year						
	2001	**1999**	**1996**	**1994**	**1991**	**1989**	**1986**
Participation Rate (%)							
Northwest Territories	77.2	78.3	77.2	77.2	78.2	74.9	74.5
Fort Smith Region	79.1	79.2	79.2	79.0	80.3	77.1	76.8
Enterprise	80.0	69.9	90.9	87.0	71.4	75.9	62.5
Hay River	80.2	80.9	80.5	81.7	82.9	82.0	77.0
Hay River Dene Reserve	61.1	54.5	65.6	56.8	57.1	54.1	39.1
Kakisa	42.9	42.9	n/a	47.1	n/a	n/a	n/a
Fort Providence	60.4	62.4	69.2	51.2	60.4	44.8	63.5
Unemployment Rate (%)							
Northwest Territories	9.5	13.7	11.7	14.8	11.3	13.2	11.2
Fort Smith Region	8.6	12.2	10.8	12.4	9.5	11.9	10.0
Enterprise	0.0	10.6	n/a	14.9	n/a	13.6	n/a
Hay River	10.6	9.2	12.5	14.5	9.8	15.4	11.2
Hay River Dene Reserve	18.2	33.0	23.8	36.5	12.5	31.9	33.3
Kakisa	0.0	25.0	n/a	31.3	n/a	n/a	n/a
Fort Providence	19.4	25.5	31.1	37.2	29.1	36.0	26.5

Source: BS, 1999 with the exception of data for 2001, Statscan, 2003.

The employment gap between aboriginals and non aboriginals has been closing, and employment rates for women and in smaller communities have been increasing. Nevertheless aboriginals still participate less in the workforce and experience higher unemployment than non aboriginals. If total employment of territorial residents is to increase in response to the developing labour shortages, increasing the participation rates and skill levels of aboriginals will be necessary. The alternative would be an increase in "job tourists", who are considered to contribute less to the economy than permanent residents. Incomes in the Northwest Territories are also increasing, faster than inflation. The population on income support has been decreasing since 1995.

There is underway a transition to a wage based economy, and some evidence that pursuit of traditional economic activity has declined. This in turn has had impacts on a range of socio-economic parameters, from settlement patterns to aboriginal language use to nutritional status to weaker community support systems and family units. However, more enlightened terms of employment, evolving value systems, increased incomes and improved health and educational status (see below) may be contributing to slowing or reversing this decline.

The health status of residents has been improving over the past 20 years, and on average is generally similar to that of other Canadians. The exceptions are lower life expectancy, higher substance abuse and higher infant mortality, particularly for aboriginals. Public health parameters such as rates of family violence, teen births, suicides and crime rates are generally worse in the Northwest Territories than in the rest of Canada. Most of these parameters are showing improvements however, or are at least stabilizing, a result of a combination of factors including increased educational performance (see below), higher employment and income, and government programs targeted to address community social priorities.

Educational achievement has been steadily increasing. Although a smaller percentage of the population has completed high school than is the case for the rest of Canada, there are proportionately more graduates of post secondary diploma and training programs, and of university programs. Residents of small communities and aboriginals have lower educational achievement rates than the territorial population overall, but these are increasing over time.

7.11.4 Potential Impacts of the Application Case

7.11.4.1 Key Issues (Valued Socio-Economic Components)

Throughout the 20 year history of its activities in the project area, Paramount has carried out a consultation program with all stakeholders, including regulators, territorial and local governments, community leaders and the population at large. These consultations, in combination with literature reviews and analysis of secondary data available on populations potentially affected by the project have indicated that the following issues needed to be addressed in the Cameron Hills EIA of April 2001.

7.11.4.1.1 Potential Benefits

- Employment of northern residents;
- Contracting opportunities for northern businesses;
- Enhancement of northern individual and business capacity to participate in the economic benefits of large projects; and
- Benefits to the economy of the Northwest Territories, including increased revenue flows and economic diversification.

7.11.4.1.2 Areas of Concern

- Continued accessibility to resources for traditional economic activity;
- Retention of traditional skills and values;
- The potential for area population increases;
- Health and safety of project workforces; and
- The potential for impacts on social service and infrastructure.

7.11.4.2 Benefits Plan and Positive Impacts

Consistent with national and territorial requirements and in recognition of concerns as expressed during consultations, Paramount has in place a Benefits Plan (1991) and Update (2001)[1] to enhance potential benefits of projects approved for implementation to date. The content of the Benefits Plan and Update are described below.

7.11.4.2.1 Consultation

A consultation program with all project stakeholders to keep them informed of Paramount operations and to provide opportunities for stakeholders to provide input on these operations has been developed. This is currently being implemented through open house meetings in Hay River, the Hay River Dene Reserve, Kakisa, Fort Providence and Yellowknife, meetings with elders and special interest groups such as trappers, advertisements in newspapers, and one on one meetings and conversations upon request. Records are kept of all concerns expressed, and include Paramount responses. The overall results of the consultation program are that Paramount has a good working relationship with potentially affected communities, and high levels of support for the project.

7.11.4.2.2 Employment

In order to respond to the desire for successful participation of northerners as employees of the project, Paramount has undertaken to advertise in local communities positions available and work with band leaders to identify suitable candidates. Paramount also facilitates training both through contracted services and on the job, and provides information on training requirements and

[1] See Paramount 2001 for the full text of the Benefits Plan and Update

resources appropriate to oil and gas sector work. Paramount preferentially employs northerners consistent with the availability of competitively priced skills. Finally Paramount requires their contractors to adhere to these policies as well. The results have been that in the order of 25% of construction workers have been northerners to date. Three of four production staff are aboriginals. Such employment has also built skill levels in the oil and gas sector for northern employees. Because the construction phase employment is of such a short duration and the production phase employment is so limited, the employment benefits, although of high consequence to individuals employed and their families, are of low consequence in the context of the Northwest Territories and the regional economy as a whole.

7.11.4.2.3 Procurement

In order to enhance to successful participation of northern businesses as suppliers to the project, Paramount has undertaken to maintain consultations with northern businesses on prospective requirements for goods and services. A “Project Update” on procurement opportunities is circulated widely in the Territories and northern businesses are included on bidder’s lists. Paramount preferentially contracts northern businesses consistent with competitive principles. Finally, Paramount requires its contractors to adhere to these policies as well. The results have been that 20% of contracts by value have gone to northern businesses, in such areas as general trucking, catering, equipment rentals, fuel supply, fuel distribution and air transportation. This contracting is also building capacity in northern businesses to supply goods and services to the oil and gas sector. These supply contracts create additional indirect employment for northerners. The benefit is considered to be of moderate consequence to businesses in the project area, however because of the comparatively small size of the project, only of low consequence relative to the economy of the Northwest Territories.

7.11.4.2.4 Economic Benefits to NT

With an estimated 99% of Canadian content in the project, all economic benefits accrue to Canada. Based on the number of northern employees and contracts, it is estimated that 20-25% of these economic benefits stay in the Northwest Territories, not only as a result of direct payments by the project, but also as a result of induced economic impacts, and income and other taxes on salaries and purchases of goods and royalties. The Benefits Plan estimates that the capital cost of developing a well site is over $2.8 million, excluding the transborder pipeline costs and seismic work. The total potential construction cost for the Application Case is therefore estimated at about $14-15 million. The incremental annual operating cost for a well site is estimated at $30,000. Such levels of investment are comparatively small in relation to the size of the Northwest Territories economy as a whole, but are nevertheless considered as of low to moderate consequence, particularly if one considers the government's interest in developing the oil and gas sector.

The objective of the Benefits Plan and Update is to maximize project benefits to the Northwest Territories, within the constraints of cost effective operations and availability of labour, goods and services. Further, the employment, training and contracting initiatives are consistent with territorial government policy. They are consistent with, for example, the principles developed to guide economic development as described in the NT Economic Strategy, 2000 (RWED 2000) and with strategies developed by the Department of Education, Culture and Employment to achieve career and employment goals (ECE 1999).

7.11.4.3 Measures to Avoid or Minimize Potential Negative Impacts and Residual Impacts

The EIA of April 2001 also addressed the potential for negative impacts with respect to the areas of concern identified, with the following results.

7.11.4.3.1 Accessibility to Resources for Traditional Economic Activity

In consultation with communities and trappers associations, it was established that only two trappers used the immediate area of the project. Discussions with the two trappers were held, however the trappers were not certain that there would in fact be any affect on trap lines as a result of the project. Paramount committed however to compensate for any demonstrable loss that might occur in the future. To date, there has been only one claim filed and compensation was agreed upon of approximately $350 consisting of replacement traps and three cans of gasoline. One trapper has been seasonally employed by the project as well. Because the project area is so remote from human settlement and is so little used, impacts on accessibility of potentially affected communities to resources used for traditional economic activity were considered of negligible overall consequence.

7.11.4.3.2 The Retention of Traditional Skills and Values

The extent to which traditional skills and values have and can be maintained over time is a result of a very large number of variables, few of which can be attributable to the Cameron Hills project specifically. The recent erosion of tradition has been observed across the Northwest Territories and is largely a response to economic transition and the cultural and social transition that has resulted. The project does not significantly restrict access to land used in traditional activity. It is located far from established communities. Employment during construction is short-term and seasonal, affording opportunity to pursue traditional activities. There is limited employment during production. Employment practices emphasize cross cultural understanding, lending some support to traditional activity. Therefore the project's potential negative impact on traditional skills and values was considered of negligible consequence.

7.11.4.3.3 Population Impacts

There is negligible potential for population increases, and thus for either its positive or its negative impacts. The project is comparatively small, population centres are distant from the project site, the construction phase is of limited duration, there will be little employment during the operations phase, and both the construction and operations workforces will be housed at site. For these reasons the project was expected to have an impact of negligible consequence on population, on social services and on infrastructure in the area.

7.11.4.3.4 Workforce Health and Safety

As a responsible employer, Paramount adheres to health and safety standards, implements health and safety programs and staff training, and requires it contractors to the same. First aid training for selected staff on site is provided and in the event of a more serious accident, there would be an airlift to Hay River or Alberta. There is an on the job zero tolerance alcohol and drug policy in place. Air emissions were established in the EIA to be below concentrations that have potential to affect human health. While there is always a possibility that an emergency may occur, the impacts to health and safety of the workforce are considered of low consequence.

7.11.4.4 Application Case Summary

Thus overall, the EIA for the Cameron Hills Gathering System and Facilities Project of April 2001 concluded that there would be short-term economic benefits of the project and negligible negative impacts with respect to socio-economic impacts on the five potentially affected population centres, although some economic benefit to individuals and business would be of moderate consequence.

7.11.5 Potential Cumulative Impacts

7.11.5.1 Methodology

Unlike the case for environmental impacts, socio-economic impact assessment does not lend itself to analysis by project activity. Although there are exceptions, most socio-economic impacts are a response to the event the project in its entirety represents, in its footprint, relative scale and duration, proximity to population centres and other project characteristics. There are however significant differences in potential impacts during construction versus operations phases.

Socio-economic impact assessment first requires the identification of key issues (sometimes presented as VSECs). The issues for the cumulative effects assessment have been identified through Paramount’s ongoing consultations, as well as through Paramount’s experience in the area, on the basis of observation and literature reviews, and on the basis of issues identified as of concern in the Terms of Reference for this assessment.

With key issues as a starting point, socio-economic impacts are then articulated and assessed, prior to and after application of mitigation and social management measures, as for environmental impacts, with certain variations. For social impacts, it is not always the case that all these criteria can be applied usefully or in a straightforward, quantified way. For example, the impacts of employment are very great to individuals and their families, perhaps of less consequence locally and yet less consequence regionally. Thus employment has varying impacts, depending on how one defines the geographic extent. Further a job may last for months or a few years, however to the extent it prepares an individual for continued employment elsewhere, the impact cannot really be described as short-term, although the job may have been short-term.

Very broadly, where relevant, socio-economic impacts are discussed in terms of:

- Direction and magnitude, which are assessed as for environmental impacts, although assessment is more likely to be qualitative.

- Geographic extent, which is, for social impacts, considered in terms of administrative units. Local impacts are experienced by people in settlements in closest proximity to the proposed project, in this case the five settlements identified as potentially directly affected. There are also impacts on the economy of Northwest Territories. Finally, some impacts are experienced only by specific individuals.

- Duration, which refers to the length of time over which an impact occurs. Duration thresholds are generally a product of the project description. In the case of this project, short-term socio-economic impacts are those that occur over a single construction season (less than six months), medium-term over the full period of construction (up to 2013, or ten years) and long-term to beyond the life of the project (up to 2023).

- Consequence, which captures all of the above, is rated negligible, low, moderate or high. Socio-economic impacts generally see consequence described qualitatively, although there are exceptions – it is usual, for example, that employment benefits can be estimated for the construction and production phases of a project. It is straightforward to conclude that an impact is negligible if it is very small and affects few people, or is of high consequence if it is very large, occurs continuously and affects most people. In cases where impacts cannot be so straightforwardly addressed however, the assessment necessarily depends on the perceptions of affected people and their governments (as made evident through consultations, data collection and literature reviews), observations of the economic and social reality of the project area, and professional judgment.

Unlike the case for environmental impacts, socio-economic impacts are not generally conceived of as reversible, and the concept of reclamation does not apply. They are part of an ongoing process of social and economic change, extending into the future. This change is a product not only of an individual or group of resource development projects but equally of decisions and initiatives of individuals and their governments as these evolve over time.

Socio-economic cumulative impacts are those project specific impacts that act in combination with impacts not only of other past, present or reasonably foreseeable development projects or activities, but also those that interact with social and economic trends overall. In the case of this project, cumulative impacts that will be considered in the following sections will include:

- Incremental effects resulting from repeated seasons of construction activity. In this context, it is worth noting that the active labour force in the project area in any given year will be essentially the same as for the Application Case – the increase in employment is a function of construction activity over a ten year as opposed to a one year period, not of an increase in numbers on site at any given point in time.

- The interactions between the project and the social and economic fabric of the potentially directly affected communities, including any trigger or ripple effects, such as increased employment in turn affecting incomes and quality of life.

7.11.5.2 Key Issues

The key issues (VSECs) were identified in the Cameron Hills EIA of April, 2001 and are listed above in the Section 7.11.4.1 on the Application Case scenario. However, the Terms of Reference request that the cumulative assessment address an additional area of concern, that of the potential of the project to have an impact on substance abuse, teen pregnancies and other parameters of social wellness. The key issues for purposes of this cumulative impact assessment, slightly reorganized, are restated below.

7.11.5.2.1 Potential Benefits

- Employment of northern residents;
- Contracting opportunities for northern businesses; and
- Benefits to the economy of the Northwest Territories, including increased revenue flows and economic diversification.

7.11.5.2.2 Areas of Concern

- Continued accessibility to resources for traditional economic activity;

- Retention of traditional skills and values;
- The potential for area population increases, and associated impacts, for example on social service delivery and infrastructure;
- Health and safety of project workforces; and
- The potential for impacts on substance abuse, teen pregnancy and other social wellness parameters.

7.11.5.3 Socio-economic Cumulative Impacts

7.11.5.3.1 The Potential for Employment of Northern Residents

Consistent with government policy and expressed interests of communities, Paramount seeks to employ northerners. To enhance the potential for employment of northerners but more particularly residents of potentially directly affected communities, Paramount would continue to implement its undertakings as outlined in the Benefits Plan and Update. The practice of these initiatives, and experience with implementing them, are summarized here, and more fully described in Paramount's Annual Reports (monitoring reports on the Benefit Plan and Update) submitted to Indian and Northern Affairs Canada as per the requirements of the Canada Oil and Gas Operations Act.

- Advertisement in potentially directly affected communities and discussion with Band leadership to identify suitable candidates for job openings.

- Identification of individuals with previous training for work in the oil and gas sector. With the assistance of INAC and RWED, Paramount has identified contractors who have recently facilitated training for northerners. These people are then contacted to establish qualifications and availability for work on the project.

- Broad advertisement of available positions. Both Paramount and its contractors advertise employment opportunities not only locally, but also across the Northwest Territories. Experience to date suggests that where the required skill sets may not be available in the potentially directly affected communities, people may be found in other northern communities.

- Training. On the job training by both Paramount and its contractors has included in the past training in heavy equipment operations, electrician tasks, radiography, slashing, camp and catering services, safety and policies and procedures. Training will continue to be provided as a means towards enabling employment of northerners on the one hand, and raising skill levels in the interests of job advancement.

- Community Investment Plan. Paramount had offered potentially directly affected aboriginal communities (Deh Gah Got'ie Dene First Nation, Fort Providence Metis Nation, K'atl'odeeche First Nation, Ka'a'Gee Tu First Nation and West Point First Nation) an opportunity to participate in the project. The deadline that Paramount prescribed for a response lapsed without the communities announcing their decision. Further, Paramount has offered funding for education and training towards preparation for employment in the oil and gas sector.

- For the production phase, Paramount uses a two week on / two week off shift rotation, with each shift having a team of three operators – one lead operator and two assistants. Of the total of four assistant operators presently on staff, three are aboriginal.. Assistant operators are required to have a General Education Diploma, and receive both formal and on the job training.

Every effort is thus made to ensure that northerners, particularly those in the five communities closest to the project, are able to access employment by Paramount and its contractors. However, it should be noted that the construction skill requirements, while certainly available in the north, are not necessarily available to Paramount at the time they are needed. There is competition with other employment opportunities, which may offer work over longer periods and under less difficult conditions.

Paramount has kept records of total northern employment, by itself and by its contractors, over the 1999 to 2003 period. This period generally coincides with the recent surge in economic growth in the Northwest Territories. Experience and observation over this period indicate representation in the total workforce by northerners in the order of 25%. Table 7.11-8 presents data on past northern employment and procurement, from Paramount's annual monitoring reports. It should also be noted that the figure for 2002/2003 includes northerners working on projects of Paramount and its contractors elsewhere in the Northwest Territories and in Alberta and British Columbia. As northerners gain skills and experience, and become valued employees of construction contractors, they find work with these contractors wherever they go. It is expected that as skills and experience of northerners continues to expand, the representation of northerners in the workforce for Paramount's construction of up to 48 wells over ten years should grow.

Table 7.11-8 Employment and Procurement, 1999-2003

	1999/2000	2001/2002	2002/2003
Northern employment, person days	230	2,242	3,234
Northern procurement, $	150,000	3,737,000	3,767,450
Total procurement, $	1,497,000	18,171,900	20,348,800

Source: Paramount Annual Reports, 2000-2003

Table 7.11-9 presents estimated employment for the construction phase per well, for five wells (or approximately one years activity over the period 2003 to 2013) and for the total potential of 48 wells (or approximately ten years of activity in total). At an estimated level of about 7,100 person days for five wells, or one years activity, at 25%, northerners would be employed for about 1,775 person days per year for a period of ten years, equivalent to eight full time jobs per year. The cumulative impact however should be somewhat higher, as training brings more northerners to the skill levels required. This of course will depend on the availability of labour, particularly skilled or high school educated labour which will be needed for about 75% of the jobs.

Table 7.11-9 Construction Employment

	1 Well		5 Wells	48 Wells
	Person days	**Elapsed time, days**	**Person days**	**Person days**
Seismic	n/a	n/a	n/a	500
Drilling, completion and testing	204	20	1,020	9,792
Well site facility and gathering line	516	24	2,580	24,800
Central battery	n/a	n/a	3,500	7,000
Total person days	**720**	**n/a**	**7,100**	**42,092**
Total person years	**22**	**n/a**	**32**	**191**

Source: Paramount estimates, 2003

Production operations employment will remain limited, although some increase over the present two teams of three people each is expected. Employment will reflect the number of producing wells at any given time, but could reach two teams of six people each.

The benefit to northerners of employment over the 10 year construction phase is considered positive, medium-term but seasonal, and although perhaps not of high consequence in the context of the economy of the Northwest Territories, is of high consequence at the individual level. Operations phase employment is so limited that it is considered to be of negligible consequence, except to the individuals employed.

7.11.5.3.2 The Potential for Contracting Opportunities for Northern Businesses

As for employment as described above, Paramount would continue to implement its undertakings as outlined in the Benefits Plan and Update in relation to enhancing the potential for awarding procurement and services contracts to northern businesses. The implemention of the Benefits Plan is summarized in Paramount's Annual Reports.

- The distribution of "Project Updates" to potentially directly affected communities, governments and regulators. The updates provide information on upcoming requirements for goods and services. This information allows northern businesses to plan and prepare should they wish to bid and/or to contact primary contractors to offer services.

- The distribution of Contractor Profile forms to potentially directly affected communities, government and northern businesses. The form provides the opportunity to interested northern businesses and/or their alliance companies to make themselves known to Paramount, outlining their qualifications, experience and safety records. With the information, Paramount and its contractors are able to proactively contact specific northern businesses in order to encourage or assist them to submit bids on upcoming work.

- Equal opportunity contracting. Although committed to contracting for goods and services on competitive principles, the above measures are intended to facilitate the participation in bidding by northern businesses, particularly those located in potentially directly affected communities, such that they are able to compete. Paramount also holds its primary contractors to adhere to the Benefit Plan Principles. Further, training in oil and gas sector skills for prospective employees, not all of whom may be directly hired, enhances the skill base that can be accessed by northern businesses in their pursuit of service contracts. Finally, with developing competitiveness in the north, these businesses have been invited by Paramount to participate in bidding on contracts in Alberta and British Columbia.

It must be noted however that although opportunities are being opened through the above measures, there are constraints to the capacity of northern businesses to respond that are outside the control of Paramount. The economic base of the Northwest Territories is comparatively small. In boom times, as all large project developers are formally committed to maximizing the use of northern businesses, there can be significant competition. The evidence of the recent past has been that northern businesses have not necessarily had the physical plant and/or available labour to take advantage of all opportunities, and do not necessarily choose to provide services to Paramount (as a comparatively small, seasonal operator) on a priority basis. Further, as a comparatively new industry in the area, for many specialized oil and gas sector tasks the experience and expertise is not yet fully developed in the north, and must be accessed from elsewhere in Canada.

Over the period 1999 to 2003, which generally coincides with the recent surge in economic growth in the Northwest Territories, Paramount has been able to award in the order of 20% by value of its procurement contracts to northern businesses. As experience with the oil and gas sector is gained in the project area, and should activity in the mining and oil and gas sectors slow, this figure could rise.

Table 7.11-10 presents data on costs for construction and operations per well, for five wells (or about one year's activity over the period 2003 to 2013) and for the total potential of 48 wells. At 20%, northern businesses and their alliance companies would win about $30 million in contracts, with almost all of this over the 10 year construction phase at a level of close to $3 million per year. The cumulative impact however should be somewhat higher, as Paramount becomes known to be repeating on an annual basis similar activities. Such patterns reduce uncertainties, enable better planning, provide experience and make Paramount a more attractive partner for northern businesses.

Table 7.11-10 Construction and Production Costs

	1 Well	5 Wells	48 Wells
Seimic	n/a	n/a	1,400,000
Drilling, completion and testing	$1,350,000	$6,750,000	64,800,000
Well site facility and gathering line			
materials	170,000	850,000	8,160,000
services	255,000	1,275,000	12,240,000
Central battery			
materials	440,000	2,200,000	21,120,000
services	660,000	3,300,000	31,680,000
Total Construction	**$2,875,000**	**$14,375,000**	**139,400,000**
Total Production	30,000[a]	150,000[a]	6,000,000[a]
Grand Total Per Year (5 wells only)	**n/a**	**$14,525,000**	**n/a**

[a] Total production costs for the 1 and 5 well scenarios considers gas wells only. For the 48 well scenario, the cost figure considers gas wells, oil wells, gathering, and battery.
Source: Paramount estimates, 2003

The benefit to northern businesses over the 10 year construction phase is considered positive, medium-term but seasonal, and although perhaps not of high consequence in the context of the economy of the Northwest Territories, is of high consequence at the level of the individual business and moderate consequence at the local level. Operations phase procurement is so limited that it is considered to be of negligible consequence.

7.11.5.3.3 The Potential for Benefits to the Economy of the Northwest Territories

Increased employment and participation by businesses in the project benefit not only those employees and businesses, but also the Northwest Territories as a whole. The employment and procurement impacts described in the above sections are further increased through induced economic impact – as payments of wages and for goods and service contracts are made, the people who receive these in turn spend money elsewhere in the economy, creating yet more jobs and income. Lower unemployment, capacity building in the workforce, investment and the fiscal benefits of increased income and other tax payments of employees, businesses and the beneficiaries of induced economic impact will all contribute to economic growth and government revenues.

The benefit to the economy of the Northwest Territories, particularly over the 10 year construction phase when the largest employment and procurement activity occurs, is considered positive, long-term and of low consequence however taking into account the need to diversify the economy, broaden the skill base of its population, and spread economic activity throughout the territories, the economic consequence is considered moderate.

7.11.5.3.4 Continued Accessibility to Resources for Traditional Economic Activity

As described in Section 7.10 on Traditional Harvesting, the project area is remote from the potentially directly affected communities and therefore difficult to access. The terrain makes movement within the area difficult during winter and virtually impossible during the summer. The area is acknowledged as not being particularly well endowed, relative to areas of easier access, with traditional economic activity resources. There are however two trappers who do use the area in winter, who are regularly advised of the start up of activity over the winter season, will continue to be compensated for any demonstrable loss, and have the opportunity for continued employment by the project.

Environmental mitigation will ensure that impacts on wildlife, fish and plants is minimal, should at some time in the future people do wish to begin to use the area for traditional economic activity, however this is considered unlikely by residents of Kakisa, Fort Providence and the Hay River Dene Reserve given the distances to the project area on the one hand, and the proximity to their homes of alternative resources on the other.

The impact of the project to 2023 on access to resources for traditional economic activity is considered of negligible consequence. With only two trappers potentially affected, and these compensated for demonstrable loss financially and potentially through employment, at the individual level mitigation has turned the potential negative impact into a positive benefit in the long-term.

7.11.5.3.5 Retention of Traditional Skills and Values

As described for the Application Case, in the previous section, the extent to which traditional skills and values have and can be retained over time is a result of a very large number of variables, few of which can be attributable to the project specifically. The Cameron Hills project would not significantly restrict access to land used in traditional activity. It is located far from established communities. Employment during construction is short-term and seasonal, affording opportunity to pursue traditional activities. There is very limited employment during productions operations. Employment practices emphasize cross cultural understanding and cross cultural training is provided.

However, the project will represent a more sustained stimulus to social change than the Application Case, particularly over the 10 year construction phase. To the extent that efforts to increase the representation of northerners on the workforce, and of northern businesses which employ northerners in procurement of goods and services, are successful, the project will contribute to providing formal sector employment over a comparatively long period of time. Not only may the project pull individuals out of a more traditional way of life for the short winter construction season, it will provide training that will position people to find other formal sector employment for other parts of the year. Full and/or part time employment in the formal sector, and the wages this brings, also creates the potential for changes to value systems.

Individuals will of course make their own livelihood and lifestyle choices; the project only provides opportunity and capacity building for participation in the formal labour force. Such opportunity is offered in a context of cross cultural understanding and respect for differences, but is nevertheless an opportunity to move out of traditional activity, and into a different culture. People's rights to make and be supported in their choices is articulated in such documents as the Social Agenda (Social Agenda Working Group 2002) and Common Ground (RWED 2000a), however such choices may contribute to the intergenerational unease, some sense of alienation from tradition, reduced integrity of traditional economic systems and social cohesion and the cultural change that is already ongoing.

On the other hand, seasonal employment does leave time for the pursuit of traditional activity, and there is some suggestion that the income from wage employment can be important to purchase of transport and other goods to facilitate this activity. Economic, political and cultural autonomy and self reliance is also a function of access to a diversifying resource base, particular insofar as other forces of change, outside this project, cannot be avoided completely.

The impact of the project to 2023 on retention of traditional skills and values is considered of low consequence, given the scale and complexity of other forces at work in society. It has the potential to be both negative and/or positive, depending upon evolving decision making by government and individuals. Any impact, since it is an impact of cultural change, would be long-term and continue beyond the life of the project.

7.11.5.3.6 The Potential for Area Population Increases and Associated Impacts

Again, as described in the Application Case, the project is remote from population centres and offers only short-term winter employment to a workforce that will be temporarily housed on site. In the absence of other economic stimuli in the potentially directly affected communities, it is unlikely that significant numbers of people would move into the area in response to work, either from Paramount, its contractors or providers of goods and services, during a construction season of two to three months of the year. The prospect of regular, year in year out construction employment may however encourage residents who have left the area to return at least semi permanently. Without a significant population increase, there are not significant associated impacts. Barring an emergency medical visit to Hay River, nor will the workforce use the social, physical or recreational infrastructure of the potentially directly affected communities, the closest of which (Enterprise) is 100 km away by road.

Even over the most active period, during construction, the potential for the project to stimulate migration to the potentially directly affected communities is considered to be negligible, with the possible exception of the return to the area of some residents, which would be considered a positive impact of low consequence.

7.11.5.3.7 Health and Safety of Project Workforces

Paramount will continue to adhere to health and safety standards, implement health and safety programs and staff training, and require its contractors to do the same. An on the job zero tolerance alcohol and drug policy will continue to be applied. First aid on site, with airlifts to Hay River or Alberta in the event of emergency will continue to be the model for medical care throughout the life of the project. It is arguable that with time, health and safety will improve over that during the implementation of the Application Case, with experience on the part of management and labour as to what site specific health risks are, although over a ten year construction phase, when most people are employed on site, total accidents will certainly have the potential to increase over the one year Application Case.

Finally, the Application Case demonstrated that air emissions of existing and planned well site operations (approximately 30 wells in total) were below concentrations with the potential to impact human health. Should all 48 new wells be developed, as the new wells come into production and old wells close, the total number of wells is expected to remain about constant, thus there would not be significant impacts on human health of the project workforce for reasons of air quality.

Potential impacts on health and safety of the workforce are of negligible over the life of the project, however in the unlikely event of an emergency, there is some potential for an impact of high consequence at the individual level.

7.11.5.3.8 The Potential for Impacts on Community Wellness

In addition to the potential for erosion of traditional skills and values and in migration, particularly construction projects have the potential to affect a very broad range of parameters of community wellness. Increased disposable income of workers resident in nearby communities and large workforces of predominantly single out of area men with access to those communities and their populations are the primary sources of such potential impacts as public safety and security, prostitution, public health and drug and alcohol abuse. Employment outside the community takes people away from their families with potential negative impacts on particularly children, but also spouses.

The Government of the Northwest Territories has over the recent past been aggressive with government policies and programs intended to address social challenges experienced across the territories. Funding for community wellness, education, health, nutrition, child health, small business development and other programs, as well as incentives to increase the participation of northerners in resource development projects, have contributed to improvement in a range of socio-economic parameters. The large increases in income and educational achievement also have a positive impact on social parameters.

The positive trend overall is a product of personal choice, government support to communities and economic development. It is extremely difficult to isolate the effect, whether positive (enforcing the overall trends) or negative (constraining the overall trends) of a single project in this context. The ongoing effort to monitor the impact of the large diamond mines on small communities and Yellowknife is in its early days, but has not yet been able to identify any statistical link between the mines and either positive or negative trends in social stability, community wellness, economy or cultural wellbeing indicators, with the possible exception of increases in household income (GNWT 2002b).

The out of area workforce, present on site for a few months only during the construction phase and remote from potentially directly affected communities will have minimal interaction with the area population. There is more potential for negative impact when workers return to their homes, whether these be in the project area, elsewhere in the Northwest Territories or in the rest of Canada. While negative behaviours on site can be controlled to some extent by Paramount (through an on the job zero tolerance for drugs and alcohol policy for example), there is no such control when workers leave the site for their homes. However, taken in the context of extensive programming to assist people with problem behaviours on the one hand, and the clear social benefits that result from employment and training, it is expected that the net impact may be positive rather than negative.

Potential impacts on the range of community wellness parameters during the project are expected to be predominantly positive and long-term, but of low consequence except at the individual level.

7.11.5.4 Monitoring

Paramount maintains employment and procurement records, works with its contractors to do the same, and supplies this information on an annual basis in compliance with requirements of the Benefits Plan and Update.

Safety data is collected and analyzed in a continuous effort to improve health and safety performance.

Ongoing consultation with communities, and with the two trappers potentially affected by the project, ensures that as issues arise, they can be dealt with in a fair and timely way.

Given that the project is not expected to have a significant negative impact on traditional land use, traditional skills and values, population, or community wellness, and given the extensive consultation process that is able to bring to the table issues as they do arise, Paramount does not propose to implement monitoring of community socio-economic parameters. Should routine data collection analysis on the part of the Government of the Northwest Territories, its departments and agencies and/or the communities themselves suggest that negative trends in any community wellbeing parameters are occurring as a result of the project, these will certainly be brought to Paramount's attention and dealt with through the consultation process.

7.11.5.5 Summary

The cumulative effects assessment considers that the project will bring significant economic benefits to the Northwest Territories, particularly to those people who find employment as a result of the project, and to those businesses that benefit from procurement of goods and services by the project. The small scale and remoteness of the project, the absence of any other foreseen development in the project area, the social benefits of increased employment and income and the initiatives of both the project and the Government of the Northwest Territories to assist people to manage change are the primary factors suggesting that negative impacts of the project will be of low to negligible consequence overall. Table 7.11-11 presents a graphic summary of impact classification.

Table 7.11-11 Residual Impact Classification for Socio-economics

Parameter	Direction	Magnitude	Geographic Extent	Duration	Consequence[a]
Application Case					
Northern employment	positive	medium	individual	short-term	high
Northern procurement	positive	medium	local and regional	medium-term	moderate
Northern capacity	positive	medium	individual, local and regional	long-term	moderate
Economic benefit to NT	positive	low	regional	medium-term	low to moderate
Resource accessibility	negative	negligible	individual and local	medium-term	negligible
Traditional values	negative to positive	low	individual and local	long-term	negligible
Population increases	negative and positive	negligible	local	short-term	negligible
Workforce health and safety	negative	low	individual	short to long-term	low
Social services and infrastructure	negative	negligible	local	short-term	negligible
Planned Development Case					
Northern employment	positive	medium	individual	medium-term	high
Northern procurement	positive	medium	local and regional	medium-term	moderate
Northern capacity	positive	medium	individual, local and regional	long-term	moderate
Economic benefit to NT	positive	low	regional	long-term	low to moderate
Resource accessibility	negative	negligible	individual and local	long-term	negligible
Traditional values	negative to positive	low	individual and local	long-term	low
Population increases	negative and positive	negligible	local	medium-term	negligible to low
Workforce health and safety	negative	low	individual	short to long-term	low
Social wellness	negative and positive	low	individual and local	long-term	low

(a) The complexity of potential social impacts and the uncertainty around decisions of potentially affected people and communities result in socio-economic impacts being assessed only qualitatively.

7.12 AESTHETICS

While Aesthetics were not specified in the ToR, they are included here as a topic of public interest.

7.12.1 Environmental Setting

With the Environmental Setting being established at circa 1960, it is assumed that the Cameron Hills was in a natural condition, undisturbed by human industrial activities. Aerial survey work completed by Colosimo 1968 and Lines 1969, describe the Cameron Hills as barren and open, with a few pine ridges and spruce growth on the northern edge; and, having very thin cover, with a lot of the area being burnt over, with willow growth found along small streams. These authors noted that the country to the west of the plot appeared to be better covered with tree growth, but the whole of the top of the Cameron Hills is rough, with deep gorges cut by small streams.

7.12.2 Spatial and Temporal Boundaries

The spatial boundary for the aesthetics assessment is comparable to the boundary used by socio-economics, and incorporates viewsheds where the Cameron Hills might be expected to be viewed from. For example, views from the western shores of Tathlina Lake were evaluated due to the concentrated use of this area by local communities. Other vantage points included Alexander Falls and Highway 35 near Indian Cabins.

The temporal boundaries consider the time frames for the various development cases outlined during the introduction to this section, and extend until 2013.

7.12.3 Potential Impacts

Completion of the project components is predicted to affect the natural aesthetics (e.g., clearing of trees) of the area in a cumulative manner, as each phase of the development proceeds. The effects are expected to result primarily from the creation of linear, cleared areas within a natural mosaic of vegetation types (e.g., jack pine stands, black spruce stands). The brief periods of flaring during the well evaluations would add a different disturbance (i.e., the flare) to the aesthetics of the area, and would likely be most noticeable at night. The effect, or perceived effect on aesthetics that will result from the project components is an individual issue that is expected to vary. Further, the impacts are minimized as the project proceeds through the various development cases, by utilizing existing disturbance corridors to the maximum extent practical.

7.12.4 Baseline Case

The highest point of land in the SDL is approximately 820 m above sea level (masl), and is located in the northeast corner of the lease. From there, topography generally slopes to the southwest dropping to elevations between 600 and 760 masl in the west and southwest corner of the SDL. Currently, the highest structure in the SDL is wellsite I-10 at 810 masl. Assuming a maximum stack height of 12.5 m, this wellsite and its associated structures would not likely be visible from the lowland areas surrounding the Cameron Hills. For example, when a person is standing on the shores of Tathlina Lake where the elevation is 280 masl, it is expected that they will not be able to see anything located on the other side of an 800 masl ridge, due to the 620 m elevation change in conjunction with the distance separation.

7.12.5 Application Case

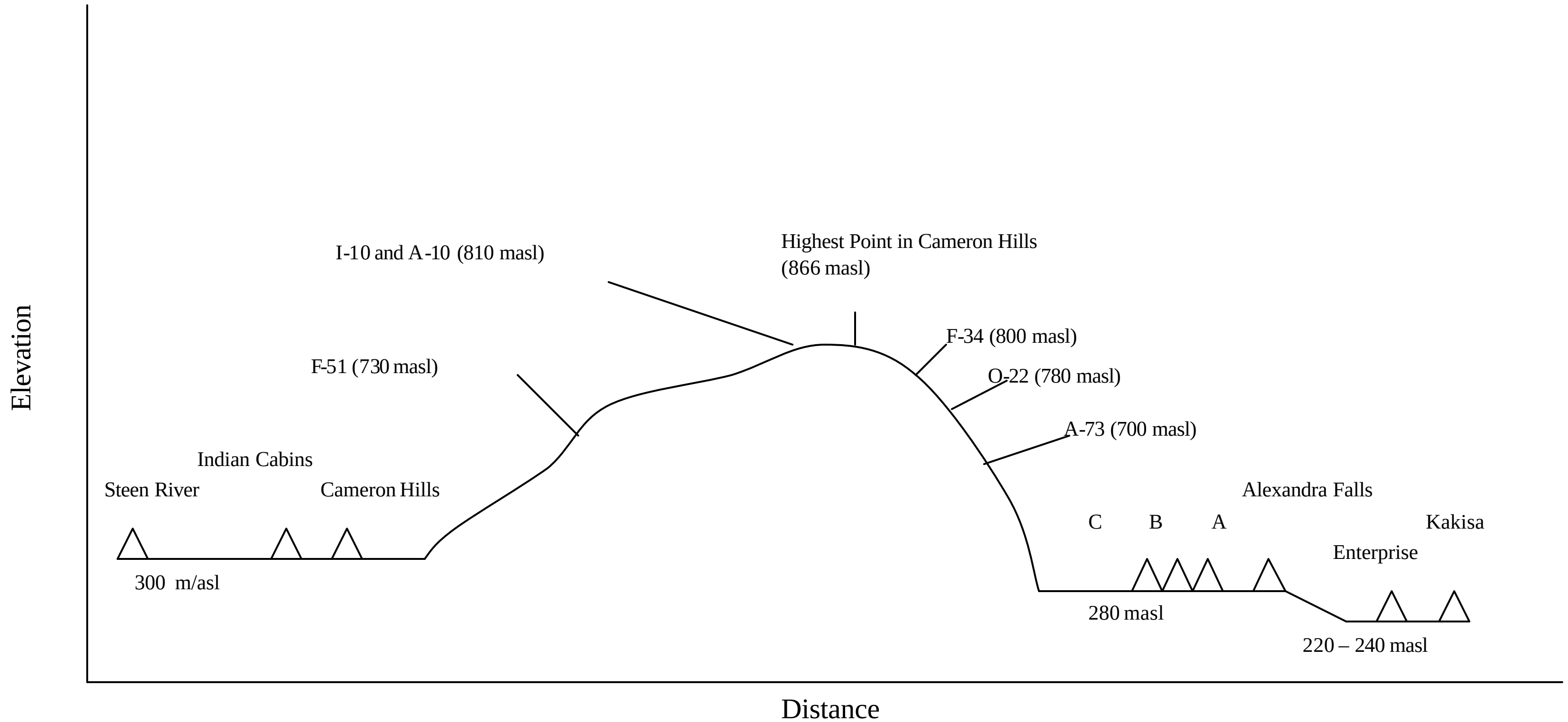
Elevations for the five proposed wellsites under the current Application Case range from 690 masl (F-38) to 745 masl (L-46), none of which are higher than existing wellsite I-10 (810 masl). Because the north ridge of the Cameron Hills is typically 840 masl, it is not likely that any of the wellsites or associated flare stacks would be visible from vantage points in lowlands north of the Cameron Hills, even if stack heights were built to 20 m (i.e., battery). The east side of the Cameron Hills between the Application Case area and Highway 35 (in Alberta), shows a typical elevation of approximately 800 masl. Again, it would be not likely that the wellsites or any associated structures would be seen from the east. To the south, the closest community to the proposed project is Indian Cabins. Existing wellsite F-51 is the closest structure in the SDL to Indian Cabins and is approximately 27 km from the community and 430 m higher in elevation. The closest wellsite (N-36) under the current Application Case will be 41 km away. Because of the distance, topography, and forest cover in the region, it is not likely that any existing wellsites or any wellsites under the Application Case will be visible from Indian Cabins or along Highway 35. Table 7.12-1 and Diagram 7.12-1 show the elevation and distance from points of interest to the closest associated structure in the SDL. The highest point in the Cameron Hills and the highest existing structure are included to provide a reference point and provide perspective.

Table 7.12-1 Distance and Elevations

Source	Closest Structure to Source in SDL	Elevation (m/asl)			Distance from Source (m)		
		Source	Structure in SDL	Difference in Elevation	To Closest Structure in SDL	To Highest Disturbed Point in SDL (I-10)	To Highest Point in Cameron Hills
Indian Cabins	Wellsite F-51	300	730	430	27,000	41,750	52,750
Cameron Hills	Wellsite F-51	300	730	430	25,000	34,250	37,500
Steen River	Wellsite F-51	300	730	430	45,250	62,500	75,500
Alexandra Falls (Rest Area)	Wellsite O-22	280	780	500	79,000	77,500	60,000
Enterprise	Wellsite F-34	220	800	580	89,250	87,000	69,500
Kakisa	Wellsite F-34	240	800	560	80,250	87,000	71,500
Tathlina Lake West - A	Wellsite A-73	280	700	420	34,000	44,500	42,500
Kakisa River into Tathlina - B	Wellsite A-73	280	700	420	36,000	49,750	49,500
Cameron River Delta - C	Wellsite F-34	280	800	520	26,250	32,500	20,000

Highest Point in Cameron Hills = 866 m/asl
Highest Structure in SDL is Wellsite I-10 = 810 m/asl

Diagram 7.12-1 Elevation and Distance Separation for Project Components and Visual Vantage Points



7.12.6 Planned Development Case

The Planned Development Case includes construction of up to 48 wells and associated facilities that would be located north, east and southeast of the Application Case. Although some of the Planned Development Case wells would be located at approximately 810 masl (A-10, J-79, K-08, I-08 and M-78), none of them are located near ridges where they can be visible from Highway 35 or north of the project area around Tathlina Lake. For example, the highest planned wellsite in elevation is A-10 at 810 masl. It is situated approximately 15 km south of the north ridge on the Cameron Hills and about 30 m lower in elevation. The south shore of Tathlina Lake is approximately 17 km north of the ridge and 560 m lower in elevation. It would not be possible to view wellsite A-10 because of the topography. Diagram 7.12-1 shows wellsite A-10 for comparison of distance and elevation with other associated features. Communities and viewpoints to the east of Cameron Hills along highway 35 such as Indian Cabins would have similar topographical restrictions. Where topography may not block the view of planned structures in the SDL, distance, vegetation and forest cover most likely will. This would be the case when viewing planned wellsite B-72 from the Steen River area. Although the slope gradient is not as extreme as those sites to the east and north, the wellsite is approximately 47 km away and there is dense vegetation and forest cover to impede viewing the site.

7.12.7 Residual Impact Analysis

Again, changes in aesthetics is an individual issue and related to personal issues and perceptions. Table 7.12-2 provides the changes in the amount of disturbance related to clearing, which is expected to result in the largest potential effect to the natural aesthetics of the terrestrial CESA. This was done to provide a quantitative reference to this component of the assessment. As shown in Table 7.12-2, the levels of disturbance resulting from the Baseline Case is approximately 2.0% of the terrestrial CESA, and the incremental changes resulting from the Application Case is only 0.1%, and from the Planned Development Case is only <0.1%. This means that the total disturbance, relative to the Environmental Setting, will be 2.2% if the Planned Development Case is developed as planned. From a visibility perspective, the extent of the disturbance is expected to be more visible from the air, and when directly over the development, as compared to being on the ground.

As discussed in previous sections, Paramount has presented a “best case scenario” from their development perspective. However, the final development will depend on drilling success, and may be quite different than that presented.

Table 7.12-2 Habitat Disturbance Within the CESA for the Development Cases

	Environmental Setting Case		Baseline Case		Application Case		Planned Development Case	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Cumulative Disturbed	0.0	0.0	1,918	2.0	1,946	2.0	2,093	2.2
Cumulative Undisturbed	96,229	100	94,311	98.0	94,283	98.0	94,136	97.8
Incremental Loss	n/a	n/a	1,918	2.0	28	<0.1	147	0.1

For this assessment we have classified the residual impacts related to changes in aesthetics, with the results provided in Table 7.12-3.

Table 7.12-3 Residual Impact Classification for Aesthetics

Parameter	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Environmental Consequence
Baseline Case							
Changes in aesthetics	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	high (+2)	low (+8)
Application Case							
Changes in aesthetics	negative	low (+5)	regional (+1)	long-term (+3	reversible (-3)	high (+2)	low (+8)
Planned Development Case							
Changes in aesthetics	negative	low (+5)	regional (+1)	long-term (+3)	reversible (-3)	high (+2)	low (+8)

The Planned Development Case has been rated as being of low environmental consequence due to the remote location of the project, the use of existing disturbance corridors to the maximum extent practical, and the reported low level of public use of the project area. In comparing the Planned Development Case with the Environmental Setting, the magnitude is rated as low, as the change is only 2.2% of the CESA.

The geographical extent of the Planned Development Case is classified as regional because the changes to aesthetics are only detectable within (i.e., when on a disturbed area), or from above, the CESA. The regional extent for the Environmental Setting is considered the same, to allow comparison of the changes.

The duration of the effects to aesthetics are considered to extend beyond the length of the project, until revegetation has occurred and is therefore, long-term.

The clearing of the trees, that has created the linear disturbances to the natural aesthetics is considered to be reversible, because regrowth of the vegetation is expected to occur. This is evidenced by vegetation growth noted on previously disturbed, older areas (e.g., airstrips and seismic lines) in the project area. The length of time required for regrowth is expected to vary, depending on the soil quality and vegetation type disturbed.

The frequency of the effect is rated as high, because once the clearing occurs, the disturbance on developed areas is expected to persist until decommissioning is complete, the area is not subjected to operational disturbances (e.g., ATV traffic), and revegetation can occur.

7.12.8 Summary

Impacts to aesthetics have been classified as low, for the Baseline Case, the Application Case, and the Planned Development Case. This is primarily due the small percentage of disturbed area resulting from the development, and the use of existing disturbance corridors once they are created, to the maximum practical extent, for subsequent access and facilities. This low classification also relates to the remote location of the SDL within the Cameron Hills, the lack of permanent access, and the distance to vantage points where viewing could occur. As such, it is not expected that observations of the Cameron Hills Project could occur from the ground, at the vantage points identified.

7.13 SUMMARY – ENVIRONMENTAL CONSEQUENCE AND SIGNIFICANCE RATING

Air Quality

Air quality environmental consequences are classified as negligible to low for the Planned Development Case. The use of mitigation measures such as choking well flow rates, and using propane or sweet gas fuel at wells and facilities during production will allow the project to meet the Air Quality Standards.

Aquatic Resources

The environmental consequences of effects on water resulting from the Planned Development Case are predicted to be negligible or of no impact. Impacts on surface water hydrology are predicted to be negligible or inapplicable (no predicted impact) because of limited, seasonal withdrawals from waterbodies. Surface water quality is expected to be protected by the use of mitigation practices such as activity only during frozen conditions, the maintenance of undisturbed buffer zones at waterbodies, and the use of proven site-specific crossing methods and mitigation. The production operations phase, which includes all-season site access by ATV and water withdrawal to develop winter access routes, are predicted to have a low environmental consequence because of the small amount of disturbance at a local point, that will end when the project is complete. Groundwater effects are predicted to be negligible in the Planned Development Case due to adherence to mitigative measures such as approved drilling waste storage, testing and disposal methods, and spill prevention and emergency response plans. Therefore, groundwater is expected to be protected.

Terrestrial Resources

Environmental consequences are predicted to be negligible to low for the terrestrial environment in the Development Cases. Exploration and construction during winter is expected to protect soil, and disturbances can be reversed with mitigation. Vegetation loss, alteration, and fragmentation are predicted to result in negligible environmental consequence as a result of the Planned Development Case, because only 2.2% of the TSA will be cumulatively disturbed, relative to the Environmental Setting. This impact is considered reversible over time, with vegetation communities returning to comparable classes following decommissioning. Patch disturbance and edge effect are predicted to have a low environmental consequence, and maintaining connectivity within the landscape habitat is predicted to provide sufficient core area to support interior wildlife and vegetation species. This means that the biodiversity of the area is expected to be maintained.

Fish and Wildlife

Effects to fish and wildlife ranged from negligible to moderate as a result of the Planned Development Case. Direct habitat loss/alteration, barriers to movement, and increased predation/hunting/trapping of wildlife species resulted in negligible environmental consequence due to the small amount of clearing relative to the available habitat within the TSA. Sensory disturbance potential resulted in low to moderate environmental consequence for some wildlife species. However this impact is predicted to be local and short-term, occurring primarily during seismic survey activity, and during the winter when migratory bird species will not be in the area. Effects to fish and fish habitat are predicted to be negligible for the Planned Development Case, as predicted disturbance is estimated at no more than 0.13% of the potential habitat within the SDL, and restricted to areas of pipeline and/or access crossings.

Heritage Resources

Potential effects of the Planned Development Case on cultural and heritage resources are predicted to be of low environmental consequence. The potential discovery of heritage resources is considered low. Traditional harvesting in the project area, primarily represented by the trapping activities of only two individuals, is predicted to be negligibly effected. Effects have been minimized by ongoing discussions, use of existing disturbance corridors and limited cumulative disturbance to habitat.

Socio-Economics

Socio-economic assessment considers that the project will provide varied economic and social benefits at a large scale, as potentially effected communities are located 60 km or more from the project area. Based on the small scale and remoteness of the project, no foreseen additional local development, and the initiatives of both government and the developer to assist people to manage change, it is suggested that negative impacts of the project will be of negligible to low consequence.

Aesthetics

The cumulative impact to aesthetics is predicted to have a low environmental consequence resulting from the Planned Development Case, based on the remote location of the project and the distance and elevation separation between the limited vantage points and project components.

Overall Summary

The environmental consequence results from the assessment of the Planned Case Developments are summarized in Table 7.13-1. Of the 39 VEC parameters assessed, with respect to direction, four were rated as positive, three were rated as positive and negative, and 32 were rated as negative. The only high rating was predicted to occur as a positive consequence for northern employment. Only one VEC with a negative direction was rated as having a moderate consequence: caribou. This parameter relates to sensory disturbance to caribou which is considered to primarily occur during the seismic data acquisition phase and has an immediate duration (i.e., lasts up to only a few months in a winter). All of the remaining VECs were rated as having negligible to low environmental consequence. No VEC parameters were assessed as having a negative high environmental consequence.

Table 7.13-1 summarizes the analyzes presented for the specific disciplines, which considers the linkages outlined in Section 7.1, to predict the resulting environmental consequence that would result from the completion and operation of the Planned Development Case. Considering the results presented in Table 7.13-1, and that the assessed Planned Development Case represents a hypothetical worst case scenario, it is predicted that no significant negative environmental effects will result from the cumulative Paramount development in the Cameron Hills.

Table 7.13-1 Planned Development Case Residual Impact Classification Summary

Parameter	Direction	Environmental Consequence
Air		
1-hour SO_2[(a)]	negative	negligible
24-hour SO_2[(a)]	negative	negligible
Annual SO_2[(a)]	negative	low
1-hour NO_2	negative	negligible
24-hour NO_2	negative	negligible
Annual NO_2	negative	low
1-hour $H2_S$	negative	negligible
24-hour $PM_{2.5}$	negative	negligible
Acid Deposition	negative	low
Soil		
Soil disturbance	negative	low
Soil erosion	negative	low
Terrain		
Terrain disturbance	negative	low
Permafrost potential	negative	negligible
Surface Water		
Hydrology	negative	negligible
Water Quality	negative	negligible
Groundwater		
Groundwater Quantity	negative	negligible
Groundwater Quality	negative	negligible
Wildlife		
Moose	negative	negligible
Caribou	negative	negligible to moderate
Marten	negative	negligible to low
Forest Songbirds	negative	negligible to low
Fish		
Fish Habitat	negative	negligible
Fish Abundance	negative	negligible
Vegetation		
Wetlands	negative	negligible to low
Uplands	negative	negligible to low
Heritage Resources		
Heritage Resources	negative and positive	low
Traditional Harvesting		
Hunting	negative	negligible
Fishing	negative	negligible
Trapping	negative	negligible
Socio-Economics		
Northern Employment	positive	high
Northern Procurement	positive	moderate
Northern Capacity	positive	moderate
Economic Benefit to NT	positive	low to moderate
Resource Accessibility	negative	negligible
Traditional Values	negative and positive	negligible
Population Increases	negative and positive	negligible
Workforce Health and Safety	negative	low
Social Wellness	negative	negligible
Aesthetics		
Aesthetics	negative	low

8. CONTINGENCIES

This section addresses Section H of the MVEIRB ToR: This section pertains to potential changes to the development (e.g. changes to timing or alternative methods), caused by the environment (e.g. through extreme weather conditions, flooding, etc.), as well as malfunctions or accidents in the course of development activities.

8.1 EFFECTS OF ENVIRONMENT

This section addresses Section H-1 of the MVEIRB ToR: List and describe all effects that the environment may have on your development, including effects of global warming. Describe how the proposed development can be modified to address these effects.

This section pertains to potential changes to the development (e.g., changes to timing or alternative methods), caused by the environment (e.g., through extreme weather conditions, flooding).

8.1.1 Description of Effects

8.1.1.1 Presence of Hydrocarbons

If there were no hydrocarbons present in the geological structures under the Cameron Hills, Paramount would not be there. The fact that the geology of the area supports pools of hydrocarbons is the primary reason that Paramount has explored, developed, and wishes to continue to develop the Cameron Hills reserves.

8.1.1.2 Seasonal Weather

Because the Cameron Hills area is wrought with presence of bogs and drainages, access is difficult other than on frozen ground. Winter weather makes it feasible to construct a winter access to allow vehicles and heavy equipment into the area.

8.1.1.3 Natural Environment

The natural environment of the Cameron Hills, including air, terrain, soils, wildlife, vegetation, water, and fisheries are all factors in determining what must be done to capture the hydrocarbon for use by society, and also dictated the nature of mitigative measure taken in the process of developing and reclaiming project components. The distribution and degree of these sensitivities affect the planning (i.e., project layout) and mitigative measures undertaken to minimize the potential for negative impacts.

8.1.2 Changes to the Development

This section addresses Section D-2 of the ToR. The existing environment plays an important role in the final development, and as such, has been considered in the early planning stages of all phases of the Cameron Hills project. The natural environment and systems of the Cameron Hills have affected the proposed project schedule, scope of work, construction methods, production methods, and mitigative and remedial measures. Further, the existing environment continues to affect the overall project on a daily basis, and is the primary consideration for on-going operations. The following paragraphs discuss the effects that the environment may have on the project.

8.1.2.1 Hydrocarbon Deposits

The hydrocarbon deposits that are being sought by Paramount, are hundreds of metres below the surface, which makes it necessary to complete seismic exploration to determine suitable locations for drilling. Once these locations are identified, drilling must occur to reach and evaluate the hydrocarbon reserves. Thus, the very nature of the resource dictates the types and levels of activity required to find, acquire, produce and transport the products. The drilling locations and the type of product from each well also affects the final configuration of pipelines and facilities.

8.1.2.2 Weather

The Cameron Hills is operated as a remote facility, primarily due to, lack of permanent roads. Access is primarily restricted to helicopters and ATVs in the unfrozen seasons, and the construction of ice and snow roads is required to transport vehicles and equipment into the project area during the winter months. This limits the timing of any activities (e.g., seismic, drilling, evaluation, pipelining and facility construction) that require the use of heavy equipment. Further, water bodies freeze during the winter, with many freezing to the bottom; these water bodies are typically not usable for winter access construction and/or drilling.

8.1.2.3 Terrain

Terrain affects soil erosion potential, as it relates to the portions of slopes that have been cleared for construction activities. As such, terrain is evaluated during the siting and routing process of the project so that sensitive areas can be avoided (this may require re-routing), or the appropriate mitigative measures be taken for that location.

8.1.2.4 Soil

The presence of bogs or fens affects the locations of wells and facilities because of their instability and sensitivity to disturbance Sites of impermeable soil are prime candidates for drill cutting disposal pits.

8.1.2.5 Permafrost

Permafrost affects the final development of wellsites, and facilities sites, and can affect pipeline construction and pipeline integrity. Permafrost can not be relied on to provide a stable long-term work surface so is avoided where all season work and access is required. Melting permafrost may place pipelines under stress, which could potentially cause a rupture and a release. Paramount’s mitigation measure is to provide heavy wall pipe resulting in low stress levels.

8.1.2.6 Hydrology

Paramount recognizes the importance of hydrological features such as wetlands, lakes, streams and rivers in the ecological integrity of the Cameron Hills. As such, these features are of primary consideration during any siting or routing of project components. Further, when these features have to be affected (e.g., pipeline crossing of a drainage, water withdrawal from a lake) mitigation plans are developed to minimize the disturbance during construction, but to also provide protection during operations (e.g., emergency shut-off valves for the aerial pipeline crossings). The lack of large and deep water bodies dispersed throughout the area also affects the project by limiting water source lakes for winter access construction and drilling. Most of the smaller water bodies freeze to the bottom, which forces Paramount to focus on the larger water bodies or potentially, water wells.

8.1.2.7 Vegetation

Vegetation affects the project, primarily as it relates to avoidance of habitat types that have a high potential to support listed plant species. Typically, these areas are also sensitive due to hydrological and/or terrain issues as well (e.g., fens, exposed slopes)

8.1.2.8 Wildlife

As discussed for vegetation, wildlife affects the project components by generating mitigation plans that provide for minimizing disturbance to sensitive habitat types (e.g., denning habitat on eskers, nest trees) and during sensitive life stages such as breeding and over-wintering. The overall project design is intended to minimize the impact to wildlife habitat so that the carrying capacity of the region is not compromised.

8.1.2.9 Fisheries

Fish and fish habitat are recognized as an important component of the environment. The location of fish bearing or potential fish habitat affects the siting of wells and facilities, routes of pipelines, and the construction methods and timing windows that are appropriate. In addition, water withdrawal for winter access construction and drilling must consider the potential drawdown effects to over-wintering fish and fish habitat, and as such, some water bodies may not be available for use.

8.1.2.10 Storms

The Cameron Hills is a plateau, and as such, it could be expected that this area is more exposed to extreme weather conditions (e.g., lightning) than the Hay River lowlands to the east. As such, all production facilities have been designed with lightning protection equipment.

8.1.2.11 Global Warming

A growing body of evidence is suggesting that the global climate system is changing (IPCC 2001). This change in the system may be due to variations in natural processes such as solar activity, earth's orbit and volcanic activity as well as anthropogenic activity. Increases in the greenhouse gases (GHGs) carbon dioxide (CO_2) and methane (CH_4) over the last 150 years have occurred as a result of increased human activity. Global temperatures have also risen over the last 150 years. However, scientists are not absolutely certain that the earth's climate will continue to warm. This is due to the complex interactions and feedback systems involving the earth, the atmosphere and polar ice sheets. Some effects may enhance warming while others may decrease it. Regional changes are also expected.

8.2 EFFECTS OF MALFUNCTIONS

This section addresses Section H-2 of the MVEIRB ToR: List and describe foreseeable malfunctions and how you will be dealing with those.

The reader is also referred to Section 3.3, Operations for description of normal activities and potential malfunctions and accidents.

Paramount is committed to ensure that its employees and contractors are trained to understand and comply with all applicable regulations, company standards, procedures and acceptable industry practices, to protect the health and safety of the general public, employees and others, on worksites owned and/or operated by Paramount; and prevent adverse effects to the environment potentially resulting from corporate activities. This is supported by the careful selection of qualified, experienced contractors with proven safety records.

Paramount has in place, an Environment Health and Safety Committee of the Board of Directors, as well as a similar committee for the managers and officers. The tenet of Paramount's environmental policy is as follows:

> *"Paramount Resources Ltd. "Paramount" is committed to protecting the environment, maintaining public health and safety, and to compliance with all applicable environmental laws, regulations and industry standards. Paramount will do all that it reasonably can to*

ensure that sound environmental practices are followed in all of its operations and activities."

The Committee is guided by a specific set of principles to ensure that the policy is supported. These principles apply to all employees and contractors of Paramount and are designed to make certain that all applicable environmental laws, regulations and standards are complied with. Paramount monitors all activities and makes reasonable efforts to ensure that companies who provide services to Paramount will operate in a manner consistent with its environmental policy.

As with projects of this nature, there is an inherent potential for accidents or malfunctions to occur, either from mechanical failure or human error. For example, some potential accidents include:

- a fuel or lubricant spill or leak from vehicles and/or equipment;
- a blow-out during drilling;
- a drilling fluid spill during drilling;
- the flare stack could fall over due to high winds or failure of the guy wires;
- human error related machinery or vehicle operation (e.g., driving over the pipe);
- pipelines could leak or rupture and an inadvertent release could occur; and,
- automatic emergency shutdown equipment could fail.

Available accident statistics for the oil and gas industry in Alberta are thought to be indicative of the nature and frequency of foreseeable malfunctions for Paramount's undertakings in the Cameron Hills. Categorically the statistics are as follows:

8.2.1 Blowout and Uncontrolled Well Incidents

According to the AEUB Field *Surveillance Provincial Summary, January – December 2002*, a total of 13, 193 wells (including spuds and re-entries into existing wells) were drilled in 2002. Six blowouts and 78 kicks occurred during drilling operations, for an incident rate of 0.6%. While during completions, a total of five blowouts and two blows occurred, for an incident rate of 0.05%. All incidents were brought under control. Paramount requires that all rig supervisors, tool pushers, and drillers hold valid blow out prevention certificates as per AEUB Guides 36 and 37. This is in excess of the NEB requirements listed in the Canada Oil & Gas Drilling Regulations.

The potential for incidents related to drilling in the Cameron Hills area is very low, as Paramount's extensive drilling experience in this region has provided significant data around which to design drilling, completion and well evaluation programs.

8.2.2 Pipeline Leaks and Ruptures

Malfunctions during operations of oil and natural gas pipelines are also expected to be infrequent. Based on data collected by the Alberta Energy and Utilities Board (AEUB) between 1988 and 2000, the probability of a natural gas pipeline either leaking or rupturing was calculated to be 10.7×10^{-4} incidents per km of operating pipeline per year. Corrosion (e.g., internal, external, and girth/filet weld) was the cause of leaks in 89% of cases. External forces (e.g., construction, third-party damage, and earth movement) were the cause of ruptures in 83% of cases. Third-party damage was the cause of 80% of cases. Furthermore, the probability of an incident is generally related to pipeline size (i.e., the smaller the pipeline, the greater the risk).

8.2.3 Facility Malfunctions

As part of their inspections of production facilities in 2002 the AEUB found approximately two-thirds of the production facilities that were inspected were rated as being were 'satisfactory' (64%), while one-third were 'unsatisfactory' (36%). The most common 'minor' problems were related to gas measurement, housekeeping, signage/security, and storage requirements. The most common 'major' problems were off-lease sour gas emissions, inadequate secondary containment, and inadequate/incomplete spill clean up.

A summary of the AEUB's industry wide spill data is presented in Table 8.2-1.

In 2002, there were 470 liquid spills at facilities, which translates to a rate of 0.02% given that 23,985 oil and gas facilities were in operation in 2002. The majority of spills were due to equipment failure (112), operator error (77), and tank overflow (44) (AEUB 2002).

Table 8.2-1 Percentage of Spills by Operation Phase, Alberta

Source of Release	Year		
	2000	2001	2002
Pipeline	32.5	35.5	35.2
Facilities	32.5	30.5	30.5
Wells	26.0	25.5	25.3
Miscellaneous/Unknown	9.0	8.5	9.0

Based on information provided in personal communication with Bill Wiley (AEUB), August 19, 2003.

Most spills were of low significance. Approximately three-quarters of these spills (1,111) were low-volume and contained on lease, while approximately one-quarter were mid- to high-volume and of a nature that posed a threat of a serious environmental and public impact (308 and 26, respectively) (AEUB 2002).

No information on the accident rate or malfunctions was available relevant to flaring during well evaluations or for field seismic operations.

Paramount has experienced accidents or malfunctions that have resulted in minor, inadvertent releases to the environment. All spills were reported to the NT spill report line. Table 8.2-2 provides details on the spills that occurred within Cameron Hills in 2003. The spills have been localized, cleaned-up immediately, with no long-term effects to the environment expected, and none of these have resulted in human injury. As such, Paramount is confident that the techniques and equipment used (e.g., blowout prevention) are safe when the appropriate precautions, safety measures, inspections and response procedures are in place. Although there is the potential for a high magnitude incident such as human injury, with the safety measures in place, the condition of the equipment and the experience of the crews minimizes the potential to the point where it is not considered significant.

Table 8.2-2 Spills Resulting from Paramount Activities in the Cameron Hills 2003

Date	Location	Environmental Issue/ Concern	Background	Remedial Actions Required	Predicted Environmental Effect
January 9, 2003	1 km north of Cameron River	Hydraulic oil spill (0.023 m^3)	An O-ring on the hydraulic spool of a D6H dozer failed, spilling 23 litres of hydraulic oil on the ground.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
March 6, 2003	D-49 lease	Engine oil spill (0.005 m^3)	A seal on the oil pump failed on a D65 dozer, spilling 5 litres of engine oil on the ground.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
February 15, 2003	H-03	Oil spill (0.001 m^3)	The power steering line broke, resulting in 1 litre of oil spilling on the ground.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
January 16, 2003	J-37	Hydraulic oil spill (0.023 m^3)	An O-ring on the hydraulic spool of a D6H dozer failed, spilling 23 litres of hydraulic oil on the ground.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
March 3, 2003	H-03	Diesel spill (0.006 m^3)	An operator overfilled the vehicle tank, resulting in 5 litres of diesel fuel spilling on the ground.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
March 7, 2003	H-03	Methanol spill (0.03 m^3)	A 400 barrel methanol tank with some methanol left inside, spilled 30 litres when it was being set on pilings.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
April 5, 2003	H-03	Glycol/water 50/50 mix (0.001 m^3)	Loose packing of a valve on the heat medium system caused 1 litre to spill on the ground.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
April 8, 2003	Cameron Hills	Oil spill (0.04 m^3)	An operations subcontractor spilled 0.04 m^3 of oil on the ground.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
April 17, 2003	Cameron Hills	Oil spill (0.15 m^3)	Safety device failure.	The contaminated ice, snow and soil were cleaned-up and stored in an environmental container for disposal.	None.
April 18, 2003	H-03	Oil spill	Pipeline leak on the C-74 and K-74 lines outside the inlet separator building.	Support at P/L anchors was reviewed for all new construction completed in 2002/3 season.	None.

Paramount relies on the implementation of formal plans and training to primarily prevent incidents and provide guidelines to onsite personnel in the event of an unplanned event. The formal plans exist as:

- the Task Competency Manual which guides the production operator in his/her day to day activities;
- an Emergency Response Plan (ERP), which deals with liquid Spills, fire fighting, and inadvertent releases (e.g., emergency shut-off valves); and
- corporate safety manual which deals with human injury (e.g., health and safety plans, vehicle incidents, and minor incidents.

Safety of the workforce and the environment is the primary concern of all teams involved, with check measures in place to ensure compliance with the appropriate health and safety regulations.

Paramount will utilize AEUB Guide 60 (Upstream Petroleum Industry Flaring Guide) during well evaluations. This guide outlines volume criteria, H_2S content criteria, well test requirements, well test volume criterion review and temporary well test facilities.

The contractors used to complete the seismic, drilling, well evaluations and operations must have safety training and certification, as well as approved health and safety plans and procedures. Further, the equipment and the set-up of it is to be checked for safety on a routine basis by the contractor's safety supervisor.

Paramount has been proactively addressing issues related to spills, through increased audits and training. As activities continue within the Cameron Hills, Paramount anticipates the types and magnitude of spills resulting from vehicle and construction equipment, as presented in Table 8.2-2, to be reduced. With the automatic safety systems that are built in, the inspection schedules, and the immediate and appropriate response to spills, the impacts to the environment have been localized, contained, and remediated to the satisfaction of the regulatory agencies, with no long-term impact to the environment expected. Paramount will continue to promote safety and environmental responsibility to its staff and contractors/subcontractors to further limit the potential of future incidents.

8.3 KYOTO ACCORD

This section addresses Section H-3 of the MVEIRB ToR: Describe how Canada's obligations under the Kyoto Accord may impact on the proposed development and how these obligations may be dealt with.

The Kyoto Protocol (KP) was intended to establish an international framework for greenhouse gas (GHG) emission reduction targets.

Prior to ratification of the KP in December, 2002, the Federal Government issued a document entitled "Climate Change Plan for Canada: Achieving our Commitments Together" (November 2002). The document outlined a 3 step plan for achieving the 240 MT reduction target as follows:

- Current Actions (e.g., innovation and technology investments, infrastructure investments, partnership).
- New Actions (e.g., fuel efficiency, sound agriculture and forestry practices, emissions trading, targeted measures).
- Remaining 60 MT Actions (to be determined).

There has been great concern expressed by the oil and gas industry regarding the implications of the KP for operations and investment of capital in Canadian exploration and development. To allay these concerns and to bring more certainty to the issue, the Prime Minister of Canada has recently submitted a letter to the Canadian Association of Petroleum Producers (CAPP) outlining specific principles that the Canadian Government is committed to. In summary they included:

Targets for new projects will be based on best practice of existing projects using similar technology, and will be locked-in for ten years from start-up.

Post-2012 policy will not make oil and gas uncompetitive, and industry will be involved in the development of post-2012 national targets.

Paramount's Cameron Hills project will continue to use best available technology and will rely on the following to guide operations past 2012:

- emissions trading;
- application of new technology to reduce GHG emissions; and
- continue the production of natural gas to displace the use of coal around the globe.

9. MONITORING, EVALUATION AND ADAPTIVE MANAGEMENT

This section addresses Section J of the MVEIRB ToR: Where the DAR identifies an impact and/or a mitigation measure it should also discuss how this will be monitored, if necessary, and how management practices may be adapted over time to ensure the long-term effectiveness of mitigation measures.

Paramount has integrated engineering requirements, environmental considerations, traditional knowledge and community consultation information into the design of their Cameron Hills Project. This process has been followed to:

- identify and minimize conflicts with environmental sensitivities during the planning phase;
- collect information and address community concerns and traditional land use;
- collect seismic data to maximize drilling success;
- utilize existing disturbance corridors to the maximum extent practical for access/flowlines;
- use environmentally responsible construction, drilling and evaluation techniques;
- design and construct appropriate, efficient and safe gathering systems and facilities;
- design appropriate emergency response plans and spill response plans;
- train operators in erosion monitoring recognition and response;
- include environmental considerations during routine inspections;
- design and implement a revegetation, permafrost and access monitoring program;
- design and implement a wildlife monitoring program (i.e., winter track counts, wildlife sighting cards); and,
- continue community consultation to discuss environmental issues and employment opportunities.

Through the above process, the project has focused on maximizing the success of the development, while minimizing the cumulative effects of the various phases as they proceed. Information that is collected during the assessments, inspections and monitoring programs is documented and evaluated by Paramount to determine if remedial actions are required. Paramount's monitoring programs are discussed below and summarized in Table 9.6-1.

9.1 RE-VEGETATION AND PERMAFROST

Paramount designed and implemented a five-year revegetation and permafrost monitoring program, as well as third party access for the gathering system and Transborder Pipeline. Implemented in the fall of 2002, the data was collected and the first report submitted in September 2002 (Golder 2002a). The revegetation component was designed to evaluate germination success and establishment of seeded species, encroaching native and non-native species and observations on competition between seeded and native species, and observations on erosion control. The plots were located on four seeded slopes and on three unseeded slopes. Transects were established to evaluate cover percentages of vegetation. Limited revegetation was noted during the first growing season, primarily related to the past winters contruction, and the need to reseed later in the summer, due to lost seeds (i.e., washed away) from the initial seeding. The rate of seed application has been increased to 30 kg/ha for application to erosion prone slopes on the gathering system, as per recommendations by Andrew Forbes (DIAND Land Use Inspector).

Permafrost monitoring consisted of measuring depth to permafrost and qualitatively describing physical attributes related to permafrost changes (e.g., subsidence, ponding, slumping) on twenty permanent transects. Permafrost was noted in various combinations of the plot locations on most of the transects, with no permafrost located in nine of the twenty transects. Trench subsidence was noted on 12 of the 20 transects.

9.2 ACCESS

The access monitoring, conducted by the operators at the battery, noted only four people on quads on the access, on May 4, 2002 (Golder 2002a). No other evidence of use of the pipeline corridor for access was noted. In addition, the winter road is monitored by a locked gate and/or manned gate.

The revegetation, permafrost and access monitoring data presented above, is the first year, or baseline condition, to which the subsequent year’s data will be compared.

9.3 WILDLIFE

Paramount designed and implemented a wildlife monitoring program in the winter of 2002/2003 (Golder 2003). This represented the first year of a 5-year program that uses winter track counts to assess the relative abundance, species richness and habitat use by wildlife, on and along, the gathering system and Transborder Pipeline. Three zones were delineated within the system to provide comprehensive representation of the four primary habitat types encountered (pine, mixedwood, riparian and black spruce bog). Transects were established on the ROW, adjacent to the edge of the ROW, 150 m from the ROW, and 250 m from the ROW. The data analysis indicates that habitat type and distance from the ROW have an effect on the amount of use by wildlife. In general, wildlife continue to use the ROW, but tends to use it less than the undisturbed habitat types in all areas. This is the first year of data collection and the results are considered to be baseline. The remaining surveys are expected to provide additional data to allow Paramount to further elucidate the effects of the pipeline ROW on habitat use by wildlife in the Cameron Hills, and changes occur over time.

9.4 EROSION

Most significantly, when erosion concerns were noted during the spring of 2002, immediate action was taken to rectify the problem (i.e., water management on and across the ROW). Paramount was successful in addressing the concerns and stopping the localized erosion. These efforts are ongoing, primarily using hand tools to make incremental improvements in the summer months and leaving heavy equipment to do the remainder of the work in the winter.

Paramount completed a survey of the gathering system and Transborder Pipeline ROW to identify areas of concern and develop appropriate mitigation options (Golder 2002a). In total, 91 locations were identified where additional mitigation work was recommended. Paramount completed almost all of the suggested work during the winter of 2002/2003 when the required heavy equipment could be moved in on the winter access. The remaining measures will be completed in a few days once the winter access is reopened this fall.

Paramount operators inspect the wells, flowlines, pipeline and facilities on a regular basis, and have been trained in recognizing erosion situations, and how to initially respond to these situations to minimize disturbance. As such, they are aware of the normal condition of the ROW and it is expected that they will readily recognize issues that need to be addressed. With the frequency of inspections, Paramount is confident that any concerns will be noted quickly, and responded to in a timely manner.

9.5 FISH

Paramount collected information on ice thickness, water depth, and dissolved oxygen and temperature of the water column, at the withdrawl point on the water source lakes used in the winter of 2002/2003. This information was shared with DFO (Bruce Hanna, DFO, Yellowknife).

9.6 CONSTRUCTION TECHNIQUES

The need to amend the construction of pipeline risers was motivated by two accidental spills resulting from failure of pipe at anchor blocks. The revised technique emphasizes even support of the pipe and care against over excavation.

Based on the above, Paramount has, and continues to monitor the environmental conditions related to their leases and ROWs in the Cameron Hills. The information that is collected is processed, and evaluated in relation to past experiences, so that improvements can be achieved through adaptive management.

Paramount plans to continue with the above discussed monitoring programs for four more years, to collect data that they trust will provide answers to specific environmental questions relevant to the Cameron Hills. As these data provide insight or trends (e.g., is the grass seed mixture that was applied growing well) related to environmental processes that affect the success of reclamation efforts on the ROWs and leases, Paramount will continue to evaluate the information and adapt their actions appropriately to optimize their efforts.

9.7 MODELLING

Paramount has completed air quality dispersion modelling to assist them in designing their project to ensure compliance with the NT Air Quality Guidelines. As the project moves ahead into the Planned Development Case, air modelling will be utilized for planning purposes when the project is changed from that presented.

Table 9.6-1 Summary of Paramount's Monitoring Programs, Cameron Hills

Type of Monitoring	Timing
Radiography and Welding	14 days after construction radiographic and welding inspection reports per Sec 58
Engineering Compliance	30 days after facilities placed in service – letter of compliance
Noise	Prior to construction – baseline; 30 days after commencement of operations – survey (NEB); within 60 days of project commencement a noise survey (MVLWB) – revised to 30 days after operations commencement; subsequent surveys if there are changes
Wildlife	Twice per winter commencing 2003 and ending in 2007. After 2005, data to be reviewed and if warranted, monitoring terminated (ongoing timing to be dependent on continued construction). Wildlife sighting cards are filled out routinely.
Inhibitor	3 months after operations commencement (inhibition program data per Sec 58)
ROW Re-vegetation, Permafrost and Access	6 months after commencement of operations. Annual basis for 5 years afterwards (NEB); Annually by Oct. 1 (MVLWB) (Ongoing timing to be dependent on continued construction)
Heritage	6 months after commencement of operations (NEB); within 30 days of project commencement (MVLWB) – revised to 6 months after operations commencement Completed during construction
Cathodic Protection	30 days after cathodic protection installation – send confirmation of cathodic protection per Sec 58
Pipeline Integrity	No requirement for submission date but target 6 months past operations commencement per Sec 58
Environmental Training	No requirement for submission date but target 6 months past operations commencement – for Employees re environmental practices
Goods and Services, Employment and Training	Annual
Air Modelling	Significant changes to the Planned Development Case will prompt air modelling to assure the NT Air Quality Standards are met.
Fish	Ice thickness, water depth, temperature, and dissolved oxygen levels were measured at Lake 1 and 3 extraction points in 2003 drilling season.
Erosion	Routine duties of the production operators and production superintendent include ROW surveillance.
Access	Access point near Indian Cabins is monitored when the winter access is active.

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FIGURES

APPENDIX I

TRACKING CONSULTATION DOCUMENTS

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2000				
May 10	Hay River Reserve Chief Pat Martel, Band Council members, Band members	Discuss Paramount's recent field activity	Recent flow testing and how it will influence our future activity at Cameron	None required
May 15	DIAND, Brenda Becker & Stephen Trainer	Discuss land tenure	Licence of Occupation for access roads at Cameron	None required
May 25	NEB – Terry Baker, Chris Knoechel	Discuss pending plans at Cameron	Development Plans	None required
May 26	Hay River Reserve, Chief Pat Martel, Al Mailo	Discuss access routes and community participation	All season road access route, and requested Band participation in picking the route. Provided an overview of all potential activity over the next couple of years	None required (Community representatives participated in the route selection)
May 31	MVL&WB, Ken Weagle	Discuss pending plans at Cameron	Review portions of the approved Oil Development Plan and the associated environmental information, Reviewed existing land tenure	None required
June 1	Northern Oil & Gas Directorate - Mimi Fortier	Discuss pending plans at Cameron	Reviewed the development options at Cameron, benefit plan requirements and consultation requirements	None required
June 5	MVL&WB - Ken Weagle	Discuss pending plans at Cameron	Reviewed all development options, determine a land-use permitting procedure (i.e. one for drilling, one for seismic, and one for gathering system. Determine which communities to consult with	None required
June 7	MVEIRB - Heidi Klein	Discuss pending plans at Cameron	Left a message which was returned indicating MVEIRB had discussed upcoming project with MVL&WB	None required
June 7	DFO - Karen Ditz	Discuss pending plans at Cameron	Left a message	None required
June 9	Hay River Reserve, Al Mailo	To hire a community member	Utilizing a community member for environmental study to work with WOES	None required
June 14	DIAND - Andrew Forbes	Discuss pending plans at Cameron	Outline pending project at Cameron	None required
June 15	GNWT - Doug Matthews	Discuss pending plans at Cameron	Left message	None required
June 15	Gerry Hordel, RWED Hay River	Discuss pending plans at Cameron	Environmental information	None required
June 15	Bas Oosenbrug, RWED	Discuss pending plans at Cameron	Environmental information	None required
June 15	Chris Carlisle, NWT Environment, Fort Smith	Discuss pending plans at Cameron	Environmental information	None required
June 16	NEB - John Korec, Chris Knoechel, Tod Collard	Review overall project approach	Land use permit, water licence, environmental screening process and requirements, project timelines	None required
June 16	Hay River Reserve – Al Mailo & Doug Cardinal	Discuss Paramount approach to community consultation	Reviewed Paramount's procedure in awarding Environmental contract	Discuss approach to Community Consultation with project team.
				Arrange meeting for review of Hay River Band services with Construction and Drilling

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2000				
June 16	Hay River Reserve – Al Mailo & Doug Cardinal	Review Hay River Band services	Drilling & Facility Dept met to determine services availability.	None required
June 20	MVL&WB - Ken Weagle	Consultation Requirements	Determine which communities to consult with for LUP (Kakisa, Hay River Reserve, Enterprise) and inform Hay River community	None required
June 20	Northern Oil & Gas Directorate - Walter Isotalo	Consultation Requirements	Determine consultation requirements - Hay River community, Hay River Reserve, Enterprise, Kakisa, Trout Lake, Fort Providence	Send letter to Mimi Fortier for confirmation with cc to MVL&WB, NEB, and communities
June 21	Hay River Reserve - Al Mailo	Project & employment update	Discuss Traditional Study and open house	Have Chief confirm open house date and contact person for TK study.
June 22	Kakisa - Chief Lloyd Chicot	Project Overview	Overall project scope, open house in Kakisa, general info on job opportunities	None required
June 22	RWED, Doug Matthews	Project Update	Project scope & timelines	Ensure Ray Case with Wildlife division is contacted
June 23	Enterprise, Town Administrator	Project Update	Overall project scope and Paramount's history in area	Information to be forwarded to Mayor
June 23	Hay River - Mayor Jack Rowe	Project & employment update	Overall project scope	Arrange meeting in Hay River
June 23	GNWT Chuck Parker	GNWT contacted by Enterprise community	Enterprise seeking information on industry plans in the area	Contact Enterprise – involve in July public consultation sessions
June 23	Fort Providence Greg Nyuli	Message left by Greg – call returned and message left by Paramount		
June 26	Dene Tha, Chief Ahnassay	Update on the Cameron Hills project	Present status & pending project	None required
July 4	Hay River Reserve, Chief and Al Mailo	Update on Cameron project	Open House	Determine date for open house
July 5	Hay River Reserve, Al Mailo	Discuss open house dates and TK study	Open House & TK Study	Determine Dene person to assist with TK
July 6	Fort Providence, Chief	Update on Cameron project	Land ownership issues and equity position, employment opportunities	Arrange Open House
July 7	Kakisa, Sub – Chief Julian Landry	Open House	Discuss Open house dates	Attempt to determine a date for an open house in Kakisa
July 11	Kakisa, Band Manager Ruby Landry	Review Project	Date for open house. Review project	Continue open house discussions to determine date
July 11	Fort Providence, Chief and Greg Nyuli	Open house	Set date for open house and Chief & Council meetings	None required
July 12	RWED, Minister Joe Handley	Project overview	Discuss Paramount's Cameron hills history and proposed project	Continue to update
July 13	NEB Jim Fox	Request for meeting	Requested a meeting with NEB staff to review project	None required
July 14	MVL&WB, MBEIRB, DFO, RWED, DIAND	Project overview	Describe project and application process with regulators. Existing tenure	Continue discussions with regulators
July 17	Kakisa, Band Manager	Open House date	Continue to evaluate an appropriate time for an open house Unable to	Continue to contact community

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2000				
			proceed with July 18 date	
July 18	Fort Providence Chief & Council	Open House	Meeting with Chief and Council. Open house	Continue consultation
July 18	Roy Fabian, Agnes Cardinal, Hay River Dene Band	Traditional Study	Review approach to acquiring traditional information - determine process	None required
July 18	Liza Gallagher, RWED Forestry Dept	Cameron Hills Project	Discussed origins of West Point First Nations	None required
July 18	Doug Lamelice, Hay River Cultural Institute	Cameron Hills	Importance of land to Elders, future generational respect for the land	None required
July 19	Hay River - Mayor and Council, Chamber of Commerce, Community of Enterprise, RWED	Cameron Hills Project	Review all phases of the project, requirements and job opportunities	Continue to communicate with Town on contract opportunities
July 19	Hay River Reserve Chief and Council	Cameron Hills Project update.	Project update, job opportunities, TK study	Continue consultation. Continue TK study
July 19	Hay River Reserve Open House	Cameron Hills Project	Review all phases of the project, requirements and job opportunities	None required
July 19	Val Bonnes, Oil & Gas coordinator Dene Tha'	Cameron Hills project	Reviewed project	Arrange flight with band members
July 19	Kakisa, Sub Chief Julian Landry	Cameron hills project	Concerned with other bands claiming Cameron Hills as their traditional land	Continue participation with TK study
July 20	NEB Team	Cameron Hills project overview	Present project to NEB staff, discuss environmental scope and timing/schedule requirements, etc	None required
July 24	Kim Morton, Alberta Fish and Wildlife, High Level	Cameron Hills project overview	Caribou map and environmental information	None required
July 25	Chris Carlisle, NWT Environment, Fort Smith	Project Update	Environmental information	None required
July 25	George Low, DFO, Hay River	Project overview	Fisheries information	None required
July 26	Kakisa, West Point First Nation, Hay River Community	Project Update	Project update, continue to evaluate open house requirements, discuss next steps	None required
July 27	Jack Rowe, Mayor Hay River	Prior Meeting review	Review project, bidding opportunities, community support of project	None required
July 31	Baptiste Metchooyeah, Trappers Liaison & Consultation Coordinator - Dene Tha'	Project Update	Review project, discuss landscape, trapping, hunting and fishing knowledge	Arrange flight of area
July 31	West Point, Chief Karen Thomas	Project Update	Does West Point want an open house? Chief to discuss with Council and advise Paramount accordingly	None required
July 31	Roy Fabian, Hay River Reserve	Cameron Hills Project	Review difficulty in acquiring TK information because of land claims	None required
July 31	Mr. Metchooyeah, Trappers Liaison and Consultation Coordinator Pierre Bassa, Elder	Discussed use of project area by First Nations people; game species present; fisheries; trapper use; traditional trails or migration routes. The project area is utilized primarily for moose hunting. Other game harvested includes some caribou. Trapping takes place primarily in the spring (May-June) for beaver and muskrat. Other furbearers harvested include mink (weasel), martin, fisher, lynx, the occasional wolverine and wolf. Black bear is present although not			

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2000				
		utilized as much. Some commercial fishing has taken place at Bistcho Lake. Other lakes that support fish populations (northern pike, walleye and perch) include Thurston Lake (TP 126, RG02-W6M), Beaty Lake (TP125, RG01-W6M) and an unnamed lake in TP126, RG21-W5M. The majority of lakes in the area are too shallow to support anything but minnows (i.e., dace and stickleback). The area is used periodically to collect blueberries under pine canopy, swamp cranberry in the muskegs and wild onion along the riverbanks (notably the Cameron River). Mr. Metchooyeah indicated that caribou move through the area and in particular along the Cameron River. A trappers cabin (not in use) is located in 60°10' and 117°30'. No concerns regarding the project were noted.		
Aug 1	Mimi Fortier, Wayne Greenall, INAC	Project Review	Project overview, benefit plan approach	None required
Aug 1	Valerie Bonnes, Oil and Gas Liasion Pierre Modeste, Elder	Discussed traditional land use; game species; trapping; access. Indicated that the project area is not occupied due to the distance from major rivers in the area. Main activities include hunting for moose and furbearer trapping including martin, fisher, mink, beaver and lynx. Ms. Bonnes expressed a concern regarding impacts to creeks during construction. She is concerned that creeks will be altered or blocked. Ms. Bonnes also expressed a concern regarding flare stack emissions.		
Aug 2	Arthur Martel, Communications Officer	Mr. Martel expressed concerns regarding the treatment of trappers due to oil and gas activity and expressed concerns related to creek crossings. Mr. Martel accompanied biologists and archaeologists in aerial reconnaissance and ground work, and was involved with vegetation assessment, soil characterization, timber evaluation, wildlife observations, and heritage resource investigation. As well, traditional land use and general environmental conditions were discussed.		
Aug 3	Greg Nyuli, Fort Providence	Cameron Hills Project	Availability of GIS coordinates, Fort Providence expectations	None required
Aug 10	MVL&WB Yellowknife staff	Cameron Hills Overview	Review Cameron project history, surface tenure, determine next steps for applications	None required
Aug 11	Al Helmer, RWED, Hay River	Cameron Project	Trappers information	None required
Aug 16	Dennis Strang, Trapper	Cameron Project	Review project	None required
Aug 21	Doug Matthews, RWED	Paramount NWT Operations	Project update, benefits agreement, employment & training opportunities and community expectations	None required
Aug 25	GNWT Metis Nation President George Morin	Paramount Deh Cho Activity	Reviewed Paramount's operations, goods & services requirements	Provide a Cameron Hills project update
Aug 28	Fort Providence, Community Development Corp. Doug Bryshun	Acquire goods & services information	Reviewed the Cameron Hills potential goods & services requirements	None required
Aug 28	National Energy Board staff	Review Cameron Hills Project	Review the regulatory process associated with the proposed project	None required
Aug 29	National Energy Board Staff	Review Cameron Hills Project	Review the regulatory process associated with the proposed project	None required
Aug 30	Kakisa, Chief Lloyd Chicot	Review Open House opportunities	Review various methods for Paramount and Kakisa representatives to meet (i.e. in Kakisa, in Calgary)	None required
Aug 30	Kakisa, Sub-Chief Julian Landry	Benefits associated with Cameron Hills Project	Reviewed potential benefits to Kakisa from Paramount's Cameron Hills project; jobs, training, goods & services	None required
Aug 30	Dene Tha, Randy	Cameron Hills	Reviewed goods & services	None required

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2000				
	Renauer	Pipeline	opportunities	
Aug 31	Fort Providence, Chief Ron Bonnetrouge	Cameron Hills Project Update	Reviewed opportunities arising form project. Discussed the potential of a coordinated approach with multiple communities	None required
Sept 1	Chief Lloyd Chicot, Kakisa	Follow-up to meeting proposal	Paramount offered again to bring Chief to Calgary or for Paramount to come to Kakisa.	None required
Sept 1	Northern Oil & Gas Directorate, Wayne Greenall	Benefit Plan update	Discuss benefit plan status	None required
Sept 1	Fort Providence, Community Development Corp., Doug Bryshun	Acquire goods & services information	Reviewed the Cameron Hills potential goods & services requirements, and additional information that may be submitted to the community regarding project costs	None required
Sept 5	Doug Matthews, RWED	Paramount NWT Operations	Project update, benefits agreement, employment & training opportunities and community expectations	None required
Sept 7	Dene Tha' First Nation, Stanley Celapree	Cameron Pipeline	Hire a Dene Tha representative to participate in environmental information gathering	None required
Sept 9 to 12	Arthur Martel	Cameron Hills Projects	Mr. Martel accompanied biologists to complete aerial reconnaissance and ground work for wildlife observations, soil characterization and habitat type confirmation. Traditional land use of this area was discussed.	None required
Sept 12	GNWT, Minister Joe Handley	Cameron Hills Project update	Community expectations	None required
Sept 14	Fort Providence, Doug Bryshun	Cameron Project Job opportunities	Community expectations	None required
Sep 15	Baptiste Matchooyeah	Cameron Hills Projects	Accompanied the archaeologists on an over flight of the pipeline route, and assisted in ground investigations. Traditional land use of the area was discussed.	None required
Sep 16 to 17	James Martel	Cameron Hills Projects	Mr. Martel accompanied the archaeologists on an over flight of the pipeline route, and assisted in ground investigations. Tradtional land use of the area was discussed.	None required
Sep 20	Fort Providence, Chief, council & community members	Cameron Hills project	Goods and service opportunities, training opportunities , investment opportunities	None required
Sep 21	Kakisa, Julian Landry	Cameron Hills project	Land claims	Additional meeting requested
Sep 21	Hay River Res., Chief, council & community members Trout Lake, Chief Dennis Deneron	Jobs & training	Update on goods and service opportunities, consultation process	Community Liaison position needs further clarification
Sep 22	Kakisa, Julian Landry	Cameron Hills project	Review project and community issues	Letter to Grand Chief requested by Kakisa. Flyover of Cameron Hills scheduled for Oct 12th.
Oct 4	West Point, Ken Thomas	Cameron Hills Project	Consultation process Expressed concern on their	Ken Brink to follow up with Jim Thomas

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2000				
		Traditional Knowledge Study	traditional lands	
Oct 5	Hay River Reserve, Chief Martel & Al Mailo	Review consultation approach and project	Reviewed Paramount's & Hay River Reserve's consultation expectations and employment & goods and service opportunities.	Continue to review employment opportunities
Oct 6	West Point First Nation, Chief Karen Thomas and Administrator	Review Cameron Hills project	Reviewed Paramount's Community Liaison function. Review in detail the Paramount project.	None required
Oct 12	Kakisa – Chief Lloyd Chicot, council members and other community members – Alan Landry not available as previously planned	Cameron Hills Project	Helicopter flyover of Cameron Hills region – discussed drilling and testing plans, potential pipeline and facilities project, timing etc.	None required
Oct 14	West Point First Nation, Chief Karen Thomas	Cameron Hills project	Reviewed the consultation process	None required
Oct 14	Kakisa, Chief Chicot and Elder Leon Strierre	Discuss Kakisa perspective on the land	Discuss the importance of fishing to the community, and the traditional land claims by other bands	None required
Oct 14	Fort Providence, Grey Nyuli	Review Cameron Hills project	Review Fort Providence efforts in working with other bands and the Band's & Metis support for the project	None required
Oct 16	Kakisa, Alan Landry	Paramount's consultation process	Kakisa recommended they take a leading aboriginal roll in the Cameron Hills area	None required
Oct 17	Hay River Dene Reserve, Acting Chief Frank Fabian	Review Cameron Hills Project	Reviewed the Cameron Hills project. Discussed efforts being made to have several bands work together	Attend multi-band meeting if requested
Oct 17	West Point First Nation, Chief	Review Cameron Hills project	Reviewed best way for Paramount to work with the band	None required
Oct 17	Kakisa, Alan Landry	Cameron Hills Project	Review employment opportunities and consultation with other bands	None required
Oct 19	Kakisa, Chief, Council and Elders Council	Review Cameron Hills project	Reviewed Kakisa's Dene values including hunting, fishing and trapping. Reviewed project maps including the oil & gas process. Reviewed goods & service contracting opportunities	Paramount Management invited to Kakisa.
Nov 1	Kakisa, Chief and 4 council	Review Cameron Hills project	Senior members of Paramount met at Kakisa to review Paramount's proposed projects.	None required
Nov 2	Hay River Dene Band	Review Cameron Hills project	Presentations were given regarding Paramount's Cameron Hill projects.	None required
Nov 3	Ft. Providence Dene Band, Chief & Economic Development	Cameron Hills project	Discussed working together on the Cameron Hills projects, as well as working together with West Point, Hay River and Kakisa bands.	None required
Nov 3	West Point First Nation, Chief		Discussed working together on the Cameron Hills projects.	None required
Nov 4	Ft. Providence Dene Band, Economic Development	Cameron Hills project	Discussed timing issues and opportunities that the Cameron Hills projects could present.	None required
Nov 5	Kakisa Chief, elder council and council members	Cameron Hills Projects	Discussed methods to work together to provide the best possible benefits to the band. Awareness of	None required

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2000				
			protecting the environment and mitigative measures for each phase of the proposed projects	
Nov 6	Ft. Providence Dene Band, Greg Nyuli	Cameron Hills projects	Discussed how best to proceed to help every community involved with this project	None required
Nov 6	Ft. Providence Metis Association, James Christie	Cameron Hills projects	Discussed the Cameron Hills projects.	None required
Nov 7	Kakisa, Band Manager	Cameron Hills Projects	Discussed a proposal letter that was to be drafted by the Chief regarding the Cameron Hills projects.	Review Proposal
Nov 7	Hay River Reserve - Al Mailo	Cameron Hills projects	General meeting to determine the best way to work together.	None required
Nov 8	Hay River Dene Band, West Point, Ft. Providence Dene Band, Ft. Providence Metis	Cameron Hills projects	To confirm our commitment to work together and develop a plan.	None required
Nov 11	West Point First Nation, Chief	Cameron Hills project	Discussed timing issues around working together.	None required
Dec 17	West Point First Nation, Chief	Cameron Hills projects	Discussed the Cameron Hills projects	None required
Dec 18	Kakisa, Chief	Cameron Hills Projects	Discussed the Cameron Hills projects and Kakisa's proposal to Paramount, flow testing, seismic project.	None required
Dec 18	Ft. Providence Dene Band, Greg Nyuli; Michael Vandell, Resource Management Board	Cameron Hills projects	Discussed the current geophysical and flow testing operations proposed for the Cameron Hills.	Review services again
Dec 19	Kakisa, Allan Landry	Service contracts and consultation	Kakisa's vision of how contracts should be awarded for services. Kakisa would prefer that Paramount deal with Kakisa first.	None required
Dec 21	Kakisa,	Project update	Attempted but unable to locate either Chief of Allan Landry to notify them of regulatory approval to proceed with road opening and subsequent bid opportunity	Continue to consult
Dec 21	Ft. Providence Dene Band, Greg Nyuli; Hay River, Shirley Lamellas & Doug Cardinal; West Point First Nation, Chief	Service requirements	Discussed work opportunities. Mr. Cardinal said he had two snow cats already in the area that would be available.	None required

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2001				
Jan 4	Kakisa, Allan Landry	Cameron Hills projects	Discussed Kakisa's claim to the land, and potential meeting with Paramount management in Kakisa on 17th.	Arrange a meeting date
Jan 5	Kakisa	Land claim	Left message with Band office indicating Paramount would be sending response to Kakisa proposal and asked for an agenda for proposed Jan 17 meeting	Arrange a meeting date and agenda
Jan 8	Kakisa	Cameron Hills projects	Called Band Office and left a message for Allan Landry	Arrange a meeting date and agenda
Jan 11	Fort Providence, Chief; West Point First Nation, Chief	Cameron Hills projects	Met with Chiefs and brought them up to date on what was happening with the Cameron Hills project.	None required
Jan 12	Fort Providence, Chief Ron Bonnetrouge; West Point First Nation, Chief; Hay River Reserve Chief Pat Martel	Cameron Hills projects	Reviewed the entire regulatory process for all Cameron Hills projects.	None required
Jan 13	West Point First Nation, Chief	Cameron Hills projects	Brief update meeting.	None required
Jan 15	Kakisa	Cameron Hills projects	Called Band office for Chief and/or Julian, left message	Arrange a meeting date and agenda
Jan 15	West Point First Nation, Chief	Cameron Hills projects	Updated Chief on Paramount's activities.	None required
Jan 15	Hay River Reserve, Al Mailo	Cameron Hills projects	Discussed how communities might proceed in working together with Paramount	None required
Jan 15	Enterprise, Norm McCowan	Cameron Hills projects	Updated Nom McCowan on Paramount's activities	None required
Jan 17	Kakisa	Cameron Hills projects	Called Band office for Chief and/or Allan Landry, left message with receptionist	None required
Jan 18	Fort Providence, Chief; Community Development Corp., Doug Bryshun	Cameron Hills projects	Discussed possible opportunities, short and long term, with potential services for the Cameron Hills projects.	None required
Jan 19	West Point First Nation, Chief	Cameron services	Discussed timing issues and potential service required this winter.	None required
Jan 19	Hay River Reserve, Shirley Lamalice	Traditional knowledge	Discussed the history of the reserve.	None required
Jan 22	Kakisa	Cameron Hills projects	Called Band office, Chief and A. Landry not available, left message.	None required
Jan 22	RWED, Mike Mageean	Cameron Hills projects	Met with Mike. Since he meets with various bands weekly, he would like to get together with Paramount on a more regular basis in order to help us get going on our projects.	None required
Feb 6	Hay River Reserve, Chief	Traditional knowledge	Trapping at Cameron Hills	None required
Feb 6	Hay River Reserve, Chief Fort Providence, Chief Westpoint, Chief	Cameron Hills projects	Review project, communities have no concerns with Paramount's project.	None required
Feb 6	Enterprise Mayor and Administrator	Cameron Hills projects	Review project, no concerns.	None required
Feb 7	Hay River Reserve, Chief, Al	Cameron Hills projects	Review project.	None required

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2001				
	Mailo			
Feb 8	Hay River Reserve, Chief, Al Mailo	Traditional knowledge	Review trapping map.	None required
Feb 9	Hay River Reserve, Al Mailo	Traditional knowledge	Traditional lands discussion.	None required
Feb 9	Fort Providence, Chief, Greg Nyuli	Cameron Hills projects	Review community challenges.	None required
Feb 10	Westpoint, Chief	Cameron Hills projects	General project discussion.	None required
Feb 12	Hay River, community representative	Cameron Hills projects	Project update.	None required
Feb 12	Enterprise, Town Administrator	Cameron Hills projects	Project update.	None required
Feb 15	Hay River Reserve, Al Mailo	Cameron Hills projects	Community support of Paramount project.	None required
Feb 18	Westpoint, Chief	Cameron Hills projects	Review testing program.	None required
Feb 19	Hay River Reserve, Chief, Al Mailo	Cameron services	Review testing program and bids.	None required
Feb 20	DIAND, Chuck Williams	Cameron Hills projects	Review project.	None required
Feb 21	Hay River Reserve, Roy Buggins	Traditional knowledge	Review trapping in area.	Review trapping claim
Feb 22	Hay River Reserve, Roy Buggins, Cynthia James	Traditional knowledge	Review trapping and Hay River Reserve TK study.	Review trapping claim
Feb 22	Kakisa, Alan Landry	Cameron Hills projects	Kakisa concerned that Paramount conducting field operations. Attempted to acquire specific environmental concerns.	Continue attempts at acquiring specific concerns.
Feb 23	Hay River Reserve, Roy Buggins	Traditional knowledge	Review fur records.	Review trapping claim
Feb 23	DIAND, Andrew Forbes	Cameron Hills projects	Review project.	None required
Feb 24	Hay River Reserve, Roy Buggins	Traditional knowledge	Review project.	Review trapping claim
Feb 24	Westpoint, Chief	Cameron Hills projects	Project update.	None required
Feb 25	Hay River, community representatives	Cameron Hills projects	Project update.	None required
Feb 26	Hay River Reserve, Chief	Cameron employment	Review challenges with local suppliers.	None required
Feb 28	DIAND, Chuck Williams	Cameron Hills projects	Project update.	None required
Mar 1	Kakisa, Henry Landry	Cameron employment	Review environmental monitor responsibilities	None required
Mar 2	Kakisa, Henry Landry	Cameron employment	Review environmental monitor responsibilities	Follow-up on responsibilities
Mar 4	Kakisa, Alan Landry	Cameron services required	Review equipment service issues.	None required
Mar 6	Kakisa, Alan Landry	Cameron Hills projects	Project update.	None required
Mar 6	Westpoint, Chief	Cameron Hills projects	Project update.	None required
Mar 7	Kakisa, Alan	Cameron Hills	Review proposed meeting date and	None required

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2001				
	Landry	projects	agenda.	
Mar 8	Kakisa, Alan Landry	Cameron Hills projects	Project update	None required
Mar 8	RWED, Mike MaGeean	Cameron Hills projects	Project review, oil & gas training.	None required
Mar 9	Kakisa, Henry Landry	Cameron employment	Environmental review and responsibility discussion.	Follow-up on responsibilities
Mar 10	Kakisa, Alan Landry	Cameron employment	Review environmental employment position	None required
Mar 12	Kakisa, Alan Landry	Training	Review training options.	Follow-up on training options
Mar 19	Kakisa, Alan Landry	Training	Paramount would be willing to bring one or two people to Calgary for training in safety and related courses.	None required
Mar 19	Kakisa, Alan Landry	Cameron Hills Project	Discussed the environmental monitor position in Cameron Hills. Arrange a mutually acceptable meeting time. Review timing for proposed Community/Paramount meeting.	None required
Mar 22	Kakisa, Alan Landry	Training	Concurred that safety training for two people was a good idea and inquired when it might happen.	Determine an appropriate training time.
Mar 23	Kakisa, Alan Landry	Cameron Hills Project	Discussed the importance of getting daily reports in from the community. Environmental monitoring provided by a member of Kakisa..	None required
Mar 29	Kakisa, Ruby Landry	Cameron Hills Project	Informed Kakisa that Paramount's winter project is complete and the local environmental monitors have completed their employment with Paramount.	None required
Apr 3	Hay River Reserve, Al Mailo	Cameron Hills Project	The band is working hard to get the abattoir site ready for business with the Dene Directional Company.	None required
Apr 3	Hay River Reserve, Roy Buggins	Cameron Hills Project	Discussed missing traps and gas and suggested we fly out to the area in question, and it was agreed that we should bring along Chief Pat Martel.	None required
Apr 4	West Point, Chief Karen Thomas	Cameron Hills Project	Project update	None required
Apr 5	Fort Providence, Chief Ron Bonnetrouge	Cameron Hills Project	Left a message with the Chief’s secretary asking her to call in order to update her on our project.	None required
Apr 5	DIAND, Chuck Williams	Cameron Hills Project	Project update	None required
Apr 10	Fort Providence, Chief Ron Bonnetrouge; Kakisa, Chief Lloyd Chicot	Cameron Hills Project	Left message regarding timing for a general meeting to discuss the business opportunities and Benefit Plan	None required
Apr 23	Hay River Reserve, Al Mailo	Cameron Hills Project	Discussed timing for a meeting to present Paramount’s business proposal and Benefit Plan with the community.	None required
Apr 23	Kakisa, Chief Lloyd Chicot	Cameron Hills Project	Left another message regarding a meeting to discuss the business proposal and Benefit Plan	None required
Apr 25	RWED, Mike Mageean	Cameron Hills Project	Made arrangements to speak with Mike regarding expected work in the upcoming year.	None required

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2001				
Apr 26	Kakisa, Alan Landry	Cameron Hills Project	Tried to arrange a date for a meeting with Paramount.	None required
May 2	RWED, Mike Mageean	Cameron Hills Project	Discussed the following years work proposal.	None required
May 2	Hay River Reserve, Shirley Lamalice	Cameron Hills Project	Met with Shirley Lamalice and she asked about the water study conducted in Cameron Hills. Informed her that Drew Forbes would be the person to contact.	None required
May 2	Hay River Reserve, Roy Buggins	Cameron Hills Project	Arranged to take a trip to Cameron Hills in the next couple of days.	None required
May 3	Hay River Reserve, Al Mailo and Chief Pat Martel	Cameron Hills Project	Pat would be interested in flying out to Cameron Hills tomorrow to locate Roy Buggins's frame tent and cabin.	None required
May 4	Hay River Reserve, Chief Pat Martel	Cameron Hills Project	Flew over the Cameron project where Roy has his damage claim. Then flew to our camp to show Chief Pat Martel what it looks like. Walked around and explained what all the facilities were used for. Flew over our crossing of the Cameron River and Chief Martel had no concerns with how the crossings were done.	None required
May 5	Kakisa, Alan & Ruby Landry, and community members	Cameron Hills Project	Reviewed business proposal and Benefit Plan.	None required
May 5	Hay River Reserve, Roy Buggins	Cameron Hills Project	Spoke with Roy and agreed to meet him at the Alberta border to talk about his issue some more, he was not there.	None required
May 6	Hay River Reserve, Al Mailo	Cameron Hills Project	Reviewed Paramount's business proposal and Benefit Plan, he said he would discuss the documents with Chief Pat Martel after their council meeting and have Paramount in again to explain the documents in more depth to the Chief.	None required
May 7	Fort Providence, Community Development Corp. Doug Bryshun	Cameron Hills Project	Reviewed Paramount's business proposal and Benefit Plan that I faxed to Chief Ron Bonnetrouge and himself.	None required
May 7	Fort Providence Metis Association	Cameron Hills Project	Faxed a copy of the business proposal and Benefit Plan to band office.	None required
May 7	West Point, Chief Karen Thomas	Cameron Hills Project	Discussed the business proposal and Benefit Plan in detail.	None required
May 8	Kakisa, Alan Landry, Mel Benson	Cameron Hills Project	Met in Hay River. Paramount requested specifics on Kakisa's issues.	None required
May 9	Kakisa, Alan Landry	Cameron Hills Project	Met with Alan and their oil and gas consultant Mel Benson	None required
May 10	Fort Providence Band	Cameron Hills Project	Chief Bonnetrouge or Doug Bryshun are to call me regarding comments on the business proposal	None required
May 10	West Point, Chief Karen Thomas	Cameron Hills Project	Met with Chief Karen Thomas, but she had not reviewed the business proposal. Reviewed with her again.	None required

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2001				
May 15	Kakisa, Alan Landry	Cameron Hills Project	Meeting pertaining to the proposed Cameron Hills Oil and Gas Development, review Kakisa's environmental questions, proposed a follow-up meeting for mid-July.	None required
May 17	Enterprise, Mayor Winnie Cadieux and Assistant SAO Genevieve Clarke	Cameron Hills Project	Reviewed Benefit Plan	None required
May 17	Fort Providence, Community Development Corp Doug Bryshun	Cameron Hills Project	Discussed Benefit Plan	None required
May 18	Fort Providence, Michael Vandell, Resource Management Board	Cameron Hills Project	Discussed Benefit Plan	None required
May 22	Hay River Reserve, Al Mailo	Cameron Hills Project	Reviewed Benefit Plan	None required
May 22	West Point, Chief Karen Thomas	Cameron Hills Project	Reviewed Benefit Plan	None required
May 23	Enterprise, Mayor Winnie Cadieux and Assistant SAO Genevieve Clarke	Cameron Hills Project	Reviewed Benefit Plan	None required
Jun 7	RWED, Rafe Smith	Forestry	Review timber licence holders in project area	None required
Jun 7	Hay River Reserve, Al Mailo	Cameron Hills Project	Reviewed issues relating to the Deh Cho voting to support the proposed pipeline agreement.	None required
Jun 8	AENV, Dave Moyles	Wildlife	Review latest ungulate surveys	None required
Jun 11	AENV, Kim Morton	Wildlife	Review updated key wildlife issues	None required
Jun 12	Kakisa, Ruby Landry	Cameron Hills Project	Discussed Benefit Plan	None required
Jun 18	Hay River Reserve, Al Mailo	Cameron Hills Project	Discussed Benefit Plan	None required
Jun 19	Hay River Reserve, Cynthia James	Cameron Hills Project	Review Benefit Plan	None required
Jun 21	Fort Providence, Community Development Corp. Doug Bryshun	Cameron Hills Project	Conference with Doug Bryshun and councilors from Ft. Providence regarding business proposal and Benefit Plan.	None required
July 3	Kakisa, Chief Lloyd Chicot	To confirm a meeting date for further communication and consultation with Kakisa Band	Confirmed with chief Lloyd Chicot that Paramount people will meet with Kakisa band at noon on July 17th at the Kakisa band office.	None required
July 4	Hay River Reserve, Al Mailo and Cynthia James	Cameron Hills Project	Dicussed Benefit Plan	None required
July 10	Kakisa, Julian Landry	Agenda for July 17 meeting	Review proposed agenda. Julian requested an alternate meeting date, as he could not attend on the 17th.	None required
July 18	Kakisa, Chief Lloyd Chicot	To plan the Kakisa Paramount	Paramount offered to fly Kakisa's environmental consultant from Calgary to Ft. Providence for the	None required

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2001				
		meeting for July 19th, 2001	meeting on July 19 on Paramount's charter. Chief Chicot informed Paramount that their environmental consultant would not be attending the meeting.	
July 18	Ft. Providence, Doug Bryshun, Executive Director	Planning and discussing issues for tomorrow's meeting in Ft. Providence	Discussed opportunities for the community to get involved in the Cameron Hills project,	None required
July 18	West Point, Chief Karen Thomas	Planning for a meeting on Friday July 20th, 2001	Discussed Paramount issues in the Cameron Hills and opportunities for West Point First Nation	None required
July 19	Kakisa, Council, Elders, & community members	Review environmental issues	Kakisa s ummarized consultation and economic issues. A list of environmental issues was presented to Paramount	Paramount to respond to list of environmental questions. Paramount and Kakisa to initiate meetings with elders and other community members with traditional knowledge
July 19	Fort Providence, Chief, Council, Metis, & community members	Review projects	Reviewed projects, summarized environmental mitigation and goods and service opportunities.	Continue with reviewing local goods and services
July 31	Kakisa, Wayne Simba, Acting Chief	Facilitate gathering traditional environmental knowledge	Aboriginal and culturally significant information that can be shared as well as how best to inform elders of Paramount's project.	Meet with elders.
Aug 8-10 This was a three day stay out on the land at Tathlina Lake	Kakisa, Chief Lloyd Chicot, Margaret Leishman, Daniel Chicot, Gabe Chicot, Leon St. Pierre	To meet with these elders and chief to gain traditional knowledge of the Kakisa area as it relates to Paramount's Cameron Hills project	• Archaeological and culturally significant information • Key moose and caribou hunting areas • Berry picking sites • Water shed information and uses • Traditional names • Travel routes • Trapping areas	Maintain good environmental practices.
Aug 13	Kakisa, Margaret Leishman	To gain more knowledge about the Kakisa area and the people and uses of the land in the past.	Discussed what foods were eaten and the way the people traveled and used the land between Kakisa and Tathlina lake. Traditional uses of animal parts and plants were also discussed.	None required.
Aug.24	Kakisa Band Margaret Leishman	To gain traditional Knowledge Information	Materials used to construct homes and seasonal travel and reasons for travel and supplies purchased in Ft. Prov.	None required
Sept. 21	Ft. Providence and Hay River Band people	Discuss project and employment opportunities on the Cameron Hills Project	All aspects of the proposed Cameron Hills project and services that may be required.	None Required
Oct 1	Fort Providence, Doug Bryshun		Emails between Paramount's geophysical Manager and Doug, discussing the seismic contract and pending jobs associated with this winter's proposed seismic	

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2001				
Oct. 13,14	Ft. Providence Band councilors Wayne Vandell and Mike Vandell	Discussing traditional Knowledge and explain the LU application for 2D seismic in the Cameron Hills	Traditional Knowledge in the Cameron Hills area and explaining the new application for 2D seismic and access for drilling	None required
Oct.17	Chief Lloyd Chicot Kakisa Lake	To explain the new Land Use application for seismic and set up a meeting with Mervin Simba for trapping information	Provided Chief Chicot with a map showing the new 2D seismic being applied for and explained the length, width, location and other aspects of the proposed seismic project.	None required
Oct. 18	Hay River Dene Band. Cynthia James	Present and explain 2D seismic application in Cameron Hills and attempt to obtain more Traditional Knowledge Information	Complete 2D seismic project being applied for and letter of request for traditional knowledge information	Attend next band council meeting, hopefully Oct. 24, 2001
Oct. 24	Hay River Reserve Trapper. Roy Buggins	To settle outstanding damage claim for lost gas and traps	Discussed moose and caribou on the Cameron Hills plateau. Roy said nobody hunts up there because it is too hard to get a big load down the hills. Signed damage release for lost traps.	None required
Oct. 24	Hay River Band Chief Pat Martel and Band Council	Was invited to give an update on Paramount's activities in the Cameron hills and discuss Traditional Knowledge Issues	Gave update on Paramount's activities. Handed out recent update and discussed timing and employment opportunities. Stressed the need to get a list of companies and services that are ready to work this winter from the band.	Obtain list of services from the Hay River Dene Band.
Oct. 25	Hay River Dene Band Cynthia James, Economic Development Person	To discuss the possibility of getting the band's list of services as soon as possible because Paramount is needing to get bid information ready	Discussed and explained the urgency in getting a list of the companies available through the band. Cynthia said she should have the information by tomorrow. The availability of Traditional Knowledge was also discussed and Cynthia said the band wanted Paramount to help fund Greenpipe on an ongoing basis to gather this information. She said she would be writing Paramount a letter to this effect.	Contact Cynthia to get list of services provided by the Hay River Dene Band by tomorrow.
Oct. 25	West Point First Nation, Chief Karen Thomas	To give and discuss Paramount's project update, give copy of contractor profile and find out what companies Westpoint has for work this winter.	Discussed Paramount's proposed project in detail. Chief Thomas told me what services they had and who they work closely with. We also arranged to get together with some elders to discuss Traditional Knowledge issues.	None required

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2001				
Oct. 25	Ft. Providence Dene Band .Councilor, Mike Vandell and Economic Development person Doug Bryshun	To set up a meeting with Mike and the Resource Management Board to discuss Traditional Knowledge and to get updated Services list from Doug Bryshun	Discussed need for getting bid information out and Doug will fax me the latest updated services list they have. Mike and I discussed Traditional Knowledge issues and will be getting together with the resource management board by Monday.	None required
Oct. 26	Kakisa Chief Lloyd Chicot Wayne Simba, (councilor for band)	To discuss Paramount's update on the project	Fully discussed the scope of the project that Paramount plans for this winter and what employment opportunities there may be. Also talked about problems with working together with the other communities and traditional land issues. Discussed getting some more Traditional Knowledge information from Mervin Simba and Annie Chicot	None required
Oct. 26	Kakisa Annie Chicot Elder	To discuss Traditional Knowledge issues around the Cameron Hills	Discussed life on the land around Tathlina Lake when she was a girl and where they fished, hunted moose and trapped	None required
Oct. 27	Fort Providence. Albert and Caroline Bonnetrouge	To discuss Traditional Knowledge from the Cameron Hills area and explain what Paramount is planning to do on top of the plateau.	Discussed who used to live around the Tathlina Lake area and where Albert and Caroline used to travel to trap and fish. Put some details on a map to be included in Paramount's TK study.	None Required
Oct. 29	Ft. Providence Chief Sam Gargon and the Resource Management Board Joachim Bonnetrouge, Mike Vandell, Ted Landry, Michel Landry, Pricilla Canadian,	To explain and present Paramount's latest update on our proposed project in the Cameron Hills and Gather Traditional Knowledge information	Fully explained what Paramount is proposing to do in the Cameron Hills this winter and the employment opportunities. Received permission to look at the Traditional Knowledge information that is held by the Resource Management Board making sure to note that the information is not complete. Met with councilor, Mike Vandell after meeting to review maps in his office.	None Required
Oct.31	Kakisa Margaret Leishman	To discuss traditional knowledge issues	Discussed minor changes to the traditional knowledge report made by Ken Brink subsequent to the Tathlina Lake trip with Kakisa elders in August	None required
Oct.31	West Point First Nation Chief Karen Thomas, Joe Cayen, William Michell, John Cayen, James Cayen and Jim Thomas (Elders)	To discuss the proposed plans from Paramount's activities in the Cameron Hills and to gather traditional knowledge from these elders	Paramount's activities where fully explained and all questions where answered. Traditional Knowledge issues were discussed and much was recorded on a map of the Cameron Hills area	None required
Nov.1	Kakisa Band Manager Ruby Landry	To discuss what services or companies Kakisa would like to see employed by Paramount this winter	Discussed issues going on with the band that are limiting to getting everything done efficiently. Discussed what companies the band is affiliated with to do work	None required

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2001				
Nov.2	Kakisa Mervin Simba trapper	To discuss his trapline in the Cameron Hills and plot on a map where he travels and to gain TK information from him	Discussed Paramount's proposed project and its opportunities. Discussed and plotted Mervin's trapline on a map. Discussed where he travels and other TK information	None required
Nov.4	Hay River Dene Band Chief Pat Martel	Discuss how the four communities are working together and the urgency in getting Hay River Band's services list to Paramount for bidding purposes	Discussed how the four communities, West Point, Hay River, Kakisa and Ft. Providence Bands are working together. Also discussed the urgency to get the list of the services offered by the Hay River Band as soon as possible as Paramount needs to get their bidding information ready and does not want to leave people out.	Get services list from the Hay River Dene Band
Nov. 6	Kakisa Ruby Landry(Band Manager) E-mailed Chief Lloyd Chicot	To make sure band has updated Contractor Profile forms to qualify any company services on Paramount's bid lists for work in the Cameron Hills	Discussed with Ruby the urgency of getting any companies on side and made aware of the Contractor Profile Questionnaire to qualify working on Paramount's Cameron Hills Projects	None required
Nov. 6	Hay River Dene Band Economic development people Cynthia James and Al Mailo	To make sure band has updated Contractor Profile forms to qualify any company services on Paramount's bid lists for work in the Cameron Hills	Discussed with Cynthia James and Al Mailo the urgency of getting any companies on side and made aware of the Contractor Profile Questionnaire to qualify working on Paramount's Cameron Hills Projects. Picked up additional contractor information at the band office and a service list of the companies that the band owns and companies that the band is affiliated with.	None required
Nov. 6	West Point First Nation Band Office Administrator, Becky and e-mailed Chief Karen Thomas	To make sure band has updated Contractor Profile forms to qualify any company services on Paramount's bid lists for work in the Cameron Hills	Discussed with Becky to pass on message to Chief Karen Thomas as well as e-mailed Chief Thomas. The urgency of getting any companies on side and made aware of the Contractor Profile Questionnaire to qualify working on Paramount's Cameron Hills Projects. I also told them that I would call their preferred contractor to inform them of the qualification process. I did this as well.	None Required
Nov. 6	Fort Providence Dene Band. E-mailed Doug Bryshun, economic development person for band. Talked to and e-mailed the Resource Development Board. Pricilla Canadian, and e-mailed Mike Vandell. Mike is band councilor as well.	To make sure band has updated Contractor Profile forms to qualify any company services on Paramount's bid lists for work in the Cameron Hills	Discussed with Pricilla Canadian the urgency of getting any companies on side and made aware of the Contractor Profile Questionnaire to qualify working on Paramount's Cameron Hills Projects. Pricilla and Mike Vandell were also e-mailed. Pricilla also faxed me Traditional Knowledge notes that were taken from a meeting with Albert and Caroline Bonnetrouge on Oct.27th at their camp in Fort Providence.	None required

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2001				
Nov. 26	Kakisa Julian Landry, (Oil and Gas Director for Kakisa band)	To confirm and attend meeting scheduled for today, tomorrow and Wednesday with the Kakisa band members to review a simplified version of Paramount's Environmental Assessment for the Cameron Hills projects	Julian Landry said the meeting could not take place as they had other meetings and a couple of council members were out of the community. Julian was told that Ken Brink had a simplified copy of the Environmental Assessment for Paramount's Cameron Hills project, a letter for him from Paramount's Calgary office, a letter from Golder and Associates outlining the direction of flow of the Cameron River and a draft copy of the Traditional Knowledge study prepared for review.	Call Julian Landry on Wednesday Nov. 28th, 2001.
Nov. 26	Hay River Dene Band Chief Pat Martel	To give a draft copy of the Traditional Knowledge study to the chief and discuss current events in general.	Discussed that Paramount would welcome any comments on the Traditional Knowledge study that was given to Chief Martel. Also discussed how the other bands are trying to work together.	None required
Nov. 27	Fort Providence Dene Band Councilor and chair of Resource Management Board, Joachim Bonnetrouge	To give Joachim a copy of the Traditional Knowledge study that was prepared for review and comments.	Reviewed the Traditional Knowledge study and the attached Map. Joachim said he was impressed and looked forward to reviewing the study in more detail over the next few days	None required
Nov. 29	West Point First Nation. Chief Karen Thomas	To deliver a copy of the Traditional Knowledge study to be review for comments	Briefly discussed the Traditional Knowledge study and requested any further comments to be noted on the copy	None required
Nov. 29	Kakisa Band Chief Lloyd Chicot	To provide a copy of the Traditional Knowledge study, a letter for Julian Landry, a letter from Golder and Associates outlining the flow of the Cameron River and a simplified version of Paramount's Environmental Assessment	Provided Chief Chicot copies of the listed items and explained that any comments on the Traditional Knowledge study are welcome. Also discussed with Chief Chicot that the simplified copy of Paramount's Environmental Assessment was intended, as discussed previously, to be presented at a meeting and not to be just read. If presented by Ken Brink, the reasons for why certain mitigative measures were made in project scope could be given. Chief Chicot was also informed that it was hoped that the simplified Environmental Report could still be presented instead of just being reviewed by their lawyers in absence of the reasoning behind certain mitagative measures	None required
Dec 12	West Point Chief Karen Thomas. Kakisa Chief Lloyd Chicot. Fort Providence Chief Sam Gargon	Notified chiefs that Paramount will be suspending it's Cameron Hills operations until they have some certainty in	Discussed that Paramount needs more certainty before spending more money on the Cameron Hills project.	None required

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2001				
		getting their regulatory approvals		
Dec. 18	Tri Council Meeting in Ft. Providence. Chief Sam Gargon MLA Mike McLeod Albert Laferty and councilors	To gather input from the community with regard to our Traditional Knowledge report.	Discussed where Paramount is with its application process and the Traditional Knowledge report.	None required
Dec. 18	Chief Lloyd Chicot	To gather input on what comments the community has on our TK report.	Chief Lloyd Chicot said the draft TK report is being passed around to community members. Chief Chicot also said the band office is closed until Jan 2nd or 3rd.	None required
Dec.19	Dennis Strang (Cameron Hills trapper)	To get his input regarding the draft TK study for the Hay River Community	Dennis Strang reviewed the TK study and stated that it was right on and his trapping routs were accurate.	None required

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2002				
Jan. 14	Chief Karen Thomas West Point First Nation	To discuss accuracy of TK study and to set up a workshop to discuss a proposed Wildlife Harvesting Compensation Protocol	Discussed the Traditional Knowledge Study that Chief Thomas has had to review since last month. We also discussed that the last week in January should be a good time for a workshop to exchange ideas on developing a Wildlife Harvesting Protocol	None required
Jan. 15	Ft. Providence Chief Sam Gargon, Deh Gah Gotíe First Nations Executive Director- Norman McCallum, Doug Bryshun, and Albert Laferty,	To discuss the possibility of having a workshop in the last week of January to gather information to establish a Wildlife Harvesting Protocol.	The members present at this meeting were very supportive of having a workshop to develop a Wildlife Harvesting Protocol on January 29th or 30th. We also discussed the Traditional Knowledge Study and Chief Sam Gargon said he did not dispute any of the information. Albert Laferty had not read the study at this time but wished to see it. Employment opportunities were discussed as well if Paramount proceeds with it's projects this year	None required
Jan 16	Hay River Reserve Band Council with Chief Pat Martel	To arrange a workshop to get started developing a Wildlife Harvesting Protocol.	It was agreed that we could have a workshop to design a Wildlife Harvesting Protocol at the Hay River Reserve Band Office, large boardroom on January 29th and 30th. Traditional knowledge was also discussed. We agreed to talk later about how to work together so Paramount could acquire new information in the future	None Required
Jan. 17	Chief and Council at Ft. Providence	To give an update to the Band on Paramount's operations and to see if a Wildlife Harvesting Protocol Workshop is OK to have in Hay River on Jan. 30 and 31st.	Council and Chief were informed of the work that should be coming up and they thought it was a good idea to get started on the Wildlife Harvesting Protocol and agreed with Jan.30th and 31st as good dates for a meeting. Chief Sam Gargon said it would be good to keep Joachim Bonnetrouge informed on the issues, as he would be a good person to participate.	None required
Jan. 21	Hay River Reserve Shirley Lamalice, Band Administrator	To set up notices for a Workshop to discuss forming a Wildlife Harvesting Protocol with the local bands for Jan. 30th and 31st	Discussing what should be on the Workshop notices and who are the best people to come to workshop. Suggested as many leaders as possible for the first meeting and then get as many trappers for later meetings once we establish a framework for the protocol with the communities.	None required
Jan. 24	Julian Landry Kakisa	To talk about meeting planned for Jan. 29th in Kakisa to Discuss the Wildlife Harvesting protocol	Julian asked for confirmation in writing that Paramount would be attending the meeting at Kakisa on January 29th. Confirmed that Shirley Maaskant and Ken Brink would attend on Jan. 29th at 2:00 PM.	None Required
Jan. 29	Kakisa Chief, council and elder council,	To discuss the proposed Wildlife Harvesting Protocol	Kakisa community members, Kakisa's solicitor and consultant Mel Benson, Minister Antoine and staff, MVEIRB Joe Acorn, DIAND, and a video crew also attended the meeting. Kakisa seemed to feel the commitment by Paramount to form a Wildlife	Re addressing legal issues with Kakisa's lawyers

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2002				
			Harvesting Protocol opened the door to negotiate issues covered in the Benefit Plan, the community investment plan and issues dealt with in the regulatory process. We discussed all issues that Kakisa wished with the exception of legal issues, as Paramount was not represented by councel. We advised that we could not speak on traditional claim issues. We also informed Kakisa that Paramount would continue consult with all effected communities and not just them.	
Jan. 29	Fort Providence Band Chief Sam Gargon	Wildlife Harvesting Protocol Workshop planned in Hay River for tomorrow and Jan. 31st.	Chief Sam Gargon wished to cancel the proposed workshop in Hay River and thought that it may work to let Kakisa take a lead role in the discussions for the Wildlife Harvesting Protocol only	None required
Jan. 30	Hay River Trapper Roy Buggins	To give notice to Roy about Paramount's proposed activity and to see if there were any concerns with his trapline	Explained what Paramount was proposing for activity in the area. Roy said he had no traps in the area and only asked that if it was possible we could help in getting a road plowed to his proposed cabin site in the Cameron Hills	None required.
Jan. 30	Hay River Reserve Chief Pat Martel	To discuss Wildlife Harvesting Protocol.	Ken Brink explained the Wildlife Harvesting commitment by Paramount was a separate issue than what some of his member's thought that Paramount wanted to discuss. The Protocol was getting mixed up with trying to gather more traditional knowledge.	None required
Jan. 30	Hay River Reserve, band office worker Sandra	She phoned to give me a message from Cynthia James, economic development officer.	Sandra explained that she was instructed to tell from the band that any further contact with the Hay River Band was to be done through Cynthia James and this included setting up any meetings with the band council.	None required
Jan. 31	Kakisa Chief Lloyd Chicot	To give a notice to Mervin Simba (trapper) that Paramount would be starting its operations in the Cameron Hills in the near future.	Chief Lloyd Chicot said he would make sure that Mervin Simba received the letter of notice.	None required
Jan. 31	Hay River Reserve Trapper, Roy Buggins	Give Roy a notice in writing that Paramount plans to start up its operations in the Cameron Hills	Ken Brink met with Roy and discussed what Paramount is planning to do in the Cameron Hills this winter. Roy said there is no problem with him because he has no traps in the area but he would appreciate any assistance in getting a road plowed to his cabin site in the Cameron Hills. We should be plowing right by his chosen site and that we would get back to him when the road is open.	None required
Jan 31	Roger Akinneah, Registered Trapper (Line 2816)	To continue open communication with Trapper issues	Joanne contacted Roger, who is affected by the portion of Cameron Hills line from 5-24-126-22 W5M and North. Spoke to nephew, George, as Roger will be in and out through out the day, briefly explained the issue and	

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2002				
			asked that Roger return the call	
Feb. 1	Hay River trapper Dennis Strang	To give Dennis Written notice that Paramount intends to start working on its project in the Cameron Hills	Told Dennis about Paramount's proposed operations in the Cameron Hills. Dennis said that he was not going to be trapping in that area this winter and there were no problems or conflicts with him.	None required
Feb. 7	Hay River Band Office worker, Sandra	To confirm that the chief, council and Cynthia James had received a fax sent on Feb. 5th from Paramount requesting a meeting with them to discuss pipeline services opportunities	Sandra confirmed that the chief, council and Cynthia had received the fax requesting a meeting but had no answer if they wanted to meet yet.	None required
Feb. 13	Kakisa Finance Administrator Anita Chicot	To discuss invoicing for services on Paramount project	Talked with Anita at the band office and it was agreed that the Heritage and Environmental Monitors would be invoiced through the band to be covered by WCB. Invoices sent in will include signed daily tickets or reports attached as backup for work performed	None required
Feb. 20	Hay River band Chief Pat Martel and INAC representative Chuck Williams	To discuss how to provide best opportunities for band to get work	Chief Pat Martel was informed that he was told by band staff to have all communication with the band go through Cynthia James and that some employment opportunities may have been lost due to the band not responding to calls for services from Paramount's prime contractor. Chief Martel informed Paramount to either call him or Chuck Williams or that we could still set up meetings directly through Shirley Lamalice in the future.	None Required
Feb. 21	Kakisa Ruby Landry	To discuss Heritage and Environmental Monitor issues	Arranged with Ruby that signed time tickets or reports will be faxed to her so that she has proper information to do her invoicing to Paramount. Ken Brink and Ruby will keep in contact if there are any problems. Ken will talk to Monitors when out on site to see how things are going.	None required
Mar. 1	Kakisa, Hay River Reserve, Fort Providence West Point First Nation, Regulatory and Government Departments		Paramount submitted draft Wildlife Harvesting Protocol to the communities, regulatory and government departments	None required
Mar. 4	Hay River Dene Band Chief Pat Martel	To try to plan a trip for the chiefs to travel out to see the project in the Cameron Hills	Chief Martel would like have other chief come with on the trip and we will keep trying to work out a good time to make a trip to the Cameron Hills. Chief Martel also said that a person from Paramount's pipeline company did phone him as promised regarding services.	Community Chiefs, Chuck Williams and Ken Brink to keep trying to arrange a trip
Mar. 4	Hay River Band Trapper Roy Buggins	To discuss clearing snow for his new cabin by Paramount's project site in the	Roy Buggins contacted Paramount and would like to go out to the Cameron Hills when we go on Wednesday to look at the site where he wants to build a cabin. He also requested to have the snow cleared if	Ken Brink to talk with DIAND inspectors for permission

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2002				
		Cameron Hills	we have a machine in the area because it is a lot to shovel by hand. Paramount agreed to take him out to the site and would talk to DIAND inspectors to see if it was OK to take a machine off the right of way to clear the snow for him.	
Mar. 6	Hay River Reserve Trapper Roy Buggins	To help him get snow cleared on his new cabin site near Paramount's A-73 wellsite and discuss any trapping concerns he has.	Roy and Ken Brink met with DIAND land use inspector to make sure it was OK for Paramount to clear unused portion of seismic line for Roy to locate cabin material while the winter road was in. Land use inspector looked at location with Ken and Roy and said it would be OK to clear snow as seismic line is held under disposition to Paramount already. Roy also has no traps in the project area and is pleased that we could help him out.	None required
Mar. 8	Ft. Providence Employment Person Shirley Gargon	To see if laborers were available to work in the Cameron Hills project and to determine why a slashing crew had quit on the seismic project	Shirley indicated that laborers are available to work and contacted Pillar Oilfield Project's person to make the arrangements. Ken Brink inquired if Fort Providence knew why the slashing crew on the seismic project had quit. Shirley felt this happened because of the hourly rate of pay they were getting from the northern subcontractor. Shirley indicated the people had been hired through her office and had been used to getting more money in the past for the same job.	None required
Mar. 9	Kakisa Elder Fred Simba Heritage Monitor on Paramount project site	Project Update	As per Fred, the people were very good on the project and doing a good job keeping things clean and talking to him about things. Fred had seen quite a few lynx but has found no sign of any old campsites or where people used to live on the project site. Fred indicated it would be good to see the site in the fall when there is less snow. Fred was happy at camp and wanted to stay until Paramount was finished with the project.	None Required
Mar. 11	Kakisa Allan Landry	To attend the project site and meet with Allan Landry	Allan mentioned that he was displeased with the project being allowed to start up this year and wished the project had been delayed longer to allow their community to capture more employment opportunities. Ken Brink reminded Allan that he has met with him and the chief and band on many occasions to discuss job opportunities on Paramount's proposed project this winter.	
Mar. 12	Kakisa, Hay River Reserve, Fort Providence West Point First Nation, Regulatory and Government Departments		Paramount submitted draft Wildlife Harvesting Plan to the communities, regulatory and government departments	None required
June 5	Recreation Coordinator, Al Hay River Reserve	To arrange a workshop regarding Paramount's project to be held on the reserve	Booked the main boardroom at the band office and discussed how many people may attend.	None required
June 6	Chief Sam Gargan Ft. Providence Band	To reconfirm meeting for June 19th at the Hay River Reserve	Sam had not seen the notice of meeting letter that was faxed to him yet and asked Paramount to fax another one, which was done. He was not sure of his timing due to	None required

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2002				
			so many other meetings but mentioned that Doug Bryshun should attend	
June 6	Ft. Providence Band Mike Vandell, Councilor	To discuss upcoming meetings on June 18th & 19th and issues that relate to the community	Discussed the upcoming meetings and how to best get the issues out on the table. It was discussed that Paramount and the communities may have different expectations. The meeting agenda was faxed to Mike	None required
June 6	Chief Pat Martel Hay River Dene Band	Discussed meeting on June 19th and to confirm Pat received the notice.	A very brief discussion to confirm the meeting	None required
June 10	Hay River Reserve Shirley Lamalice and Angela	To confirm the meeting scheduled on June 19th,	Discussed the timing and arranging for lunch to be provided and billed to Paramount. A draft agenda will be available to look at by tomorrow	None required
June 11	Hay River Dene Band. Angela at main desk	To tell Angela that another copy of the Open House Notice, June 18th and the Draft Agenda for the June 19th Workshop had been faxed.	As per Angela, she will get everything distributed and assured there would be a flip chart available for the main boardroom at the band office for the June 19th workshop	None required
June 11	Kakisa Band Chief Lloyd Chicot	To inform the band about the Open House and Workshop and to gain input on the agenda	Chief Chicot said he would pass on the information.	None required
June 11	West Point Firs t Nation Kelly, Band Secretary	To inform the band that the information on the Open House and Workshop would be faxed	As per Kelly, Chief Thomas is away until Monday and would receive the information then.	None required
June 11	Ft. Providence Dene Band Band Secretary	To inform the band that the information on the Open House and Workshop would be faxed	As per the Band Secretary, Chief Sam Gargon was currently out of the office and would receive the information when he returned.	None required
June 12	Ft. Providence Dene Band Norm, Band Manager	To ask for input into the draft agenda that was sent to the band.	Norm indicated that Chief Gargon and Doug Bryshun should be in Hay River today. Paramount still waiting for input on the agenda.	None required
June 13	Ft. Providence Dene Band Mike Vandell, Councilor	To gain input for the agenda for the Workshop on June 19th, in Hay River.	Mike suggested some ideas that would help make the workshop more productive. Good facilitation equals a Good Meeting. Mike clearly sees that some of the issues regarding the communities' expectations need to be addressed immediately.	None required
June 14	Ft. Providence Dene Band Chief Sam Gargan	To gain input for the agenda for the Workshop on June 19th, in Hay River	Chief Gargan expressed that Paramount needs to make a better efforts in allowing the communities to invest in the project before their full focus and support will be given. This investment was discussed at a Nov. 8th, 2000 meeting in Hay River regarding Paramount's Community Investment Plan. Regarding the meeting and agenda, Chief	None Required

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2002				
			Gargan requested we speak to Doug Bryshun. Doug Bryshun and councilor, Mike Vandell would be attending the meeting in the Chief's absence. Chief Gargan also informed Kakisa to take the lead and try to make the best deal possible with Paramount as long as it involves all of the communities.	
June 14	Ft. Providence Band Business person Doug Bryshun	To discuss input into our June 19th workshop and agenda	Ft. Providence and Doug Bryshun will be attending the meeting and had no additional items for the current agenda	None Required
June 18	Representatives from the local communities; RWED and DIAND	Public Open House to discuss previous and proposed winter projects and for the public to meet Paramount	Reviewed the prior winters work, proposed 2002/03 activity and goods and service opportunities	None Required
June 19	Representatives from the K'atlodeeche First Nation; West Point First Nation; Fort Providence	Workshop - reviewed the completed 2001/02-winter project, the northern services utilized and the potential projects & northern services for the 2002/03 season	Representatives from the communities expressed their feelings on the northern services being utilized during these projects. Paramount suggested ideas on how northern services could be utilized. Paramount discussed the Community Investment Plan, Wildlife Harvesting Plan and the Aurora Research Permit. The communities requested time to review and will respond at a later date.	Paramount to provide a list of primary qualified suppliers and contractors to the communities. The Communities to meet before the end of July to discuss the Community Investment Plan and a go-forward plan on business and employment.
July 23	Allan Landry, Mandell Pinder, Alan Hollingworth	To discuss Ka'a'gee Tu First Nation expectations of Paramount	Viewed video on traditional land use by the community. Discussed business and community investment opportunities between Paramount and the Ka'a'gee Tu First Nation	Ka'a'gee Tu Frist Nation to submit a of letter of expectations followed by a proposed meeting Sept 6, 2002
July 26	Kakisa Band, Chief Lloyd Chicot, Anita Chicot		Discuss how to contact Fred Simba for his participation with Surveyors in picking out proposed wellsite locations and pipeline routes for the next winters project in the Cameron Hills	None Required
July 26	Hay River Dene Band, Roy Buggins, Chief Pat Martel		Arrange for Roy to participate with the surveyors and Paramount to assist in route, wellsite and pipeline selection for upcoming winter projects. Roy will be attending. Chief Martel supports Roy's participation as he is trapping in the area. Roy participated on the re-vegetation monitoring Sept 10, 11, 12 & 13.	None required

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2002				
Sept 5	Members of Ft. Providence, Hay River Dene Band, West Point First Nation, a facilitator, Steve Morrison		Workshop to develop a Wildlife Harvesting Compensation Plan	Continue discussions
Sept 6	Members of Ft. Providence, Hay River Dene Band, West Point First Nation, a facilitator, Steve Morrison		Workshop to develop a Wildlife Harvesting Compensation Plan	Continue to participate in discussions to reach consensus on a plan
Sept 6	Allan Landry, Louise Mandell, Alan Hollingworth	To discuss the expectations of the Ka'a'gee Tu First Nation	Reviewed and discussed the letter of expectations from the Ka'a'gee Tu	Respond in writing to Kakisa's letter
Oct 1	Paul Delorey, Jane Groenewegen, Owen Rowe, Robert Dean, Shawn Carter, Mike Maher, Dean McMeekin, Mike Mageean, Charlie Scarborough	To meet local government and business owner's from Hay River and discuss Paramount's projects	Reviewed the previous winter projects, financial investments and proposed 2002/03 projects. Discuss the goods and service opportunities and the bidding evaluation process. Discussed Paramount's current apartment and the possibility of opening an office in the local business area.	Contractor Profile was distributed to the Business Community to be completed and returned to Paramount
Oct 3	Doug Bryshun		Reviewed the proposed 2002/03 winter project scope and goods and service opportunities. Doug met with Paramount drilling personnel Oct 2 and will continue discussions with them, seismic and facilities departments. Paramount responded to the EDFNA Aug 27/02 letter regarding the CIP. It was recognized that some time would likely lapse in receiving a collective community response as two communities have new leaders. Paramount provided a brief update on the Wildlife Harvesting Compensation Plan.	Mitigation not required, discussions are on-going. Doug will send Paramount an updated list of Fort Providence services
Nov 6	West Point First Nation Ken Thomas		Ken was interested in an environmental monitoring position on Paramount's Cameron Hills project. He was not familiar with the permafrost, vegetation and wildlife monitoring plans that are approved for this project. I was discussed that Ken Brink will review these plans in the near future when Ken gets back from a break.	Discuss monitoring plans with Ken Thomas
Nov 8	K'atlodeeche First Nation Chief Roy Fabian		Met with Chief Fabian to congratulate him on being chief and to let him know that I (Ken Brink) was available in Hay River for any questions regarding Paramount's projects	None Required
Nov 8	K'atlodeeche First Nation EDO Cynthia James		Met with Cynthia and filled out a community checklist describing new Chief and council. Explained to Cynthia how Paramount is planning to track northern employment and training. Left an information sheet with Cynthia to list any alliance companies the HRR is associated with and what that relationship is. We also updated the list of available HRR owned or member companies.	Receive Alliance Company information for HRR

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2002				
Nov 13	West Point First Nation Band Secretary Wendy Cayen		Updated Chief and council information. Leon Cayen is acting chief and elections are to be held on Nov. 18th for all positions. Discussed what companies WPFN is aliened with.	None required
Nov 14	KFN Cynthia James		Met with Cynthia briefly and told her that the sooner Paramount can get the Alliance information the better it is for Paramount's managers to provide bidding opportunities to HRR alliances.	None Required
Nov 18	Karen Cooper Hay River ECE		Karen explained that her department will not be able to share a database on who is being trained or available for employment and their department would not fund an employment opportunity position for the Cameron Hills projects. Karen recommended posting short-term job opportunities on jobsnorth.com. Paramount arrived for the scheduled meeting of the Regional Petroleum Committee but it was cancelled again this morning without notice as it was on Friday.	Meet with ECE on Nov.19th to discuss employment for northerners
Nov. 18	Robert Dean, Stan Dean and Sons Ltd. Sean Carter, Carter Industries Ltd. Jack Rowe, Rowe's Construction Ltd. Roy Crowther, Kieth's Water Service Ltd.		Individual meetings were held with each company to discuss employment opportunities on the Cameron Hills project this winter. Also discussed were whom any of the companies have an alliance with and what training opportunities for northerners their company has provided.	None required
Nov. 18	Karen Thomas West Point First Nation		We have arranged to meet to review the Traditional Knowledge report that was created by Paramount from information gathered last winter from elders. The same elders will be invited that were involved in the initial gathering of TK information. Karen is to call Ken Brink when elders are all in Hay River and available to meet.	Meeting with West Point First Nation to review TK information
Nov. 19	Karen Cooper (ECE)/RWED Regional Petroleum Committee.		Employment of northern people was discussed. It was explained that ECE has a specific departmental directive that they cannot provide a database for employment purposes. Companies are to deal with the communities on an individual basis or use the web site, (jobsnorth.com) to post any employment opportunities they have. Paramount explained that with a short time frame to work, the Oil and Gas Industry needs to know who is available to go to work on a daily basis.	As ECE is unable to assist POU in the employment of northerners, POU will continue with their own efforts.
Nov. 19	Diana K'atlodeeche First Nation receptionist		Diana helped look for a form that was supposed to have been faxed to Paramount. The form was to outline whom the K'atlodeeche First Nation has alliances with. It was explained that bids for work will be going out right away and Paramount is trying to provide as many opportunities to Northern Communities as possible. The form was not found.	POU will keep communication with HRR on employment opportunities
Nov. 20	Chief Sam Gargan with Ft. Providence Dene Band Anita Chicot to arrange a meeting with Chief Lloyd Chicot		Discussed availability to have a meeting in the next two weeks to provide an update on Paramount's project.	None required

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2002				
Nov. 20	Chief Roy Fabian (K'atlodeeche First Nation)		Discussed availability to have a meeting in the next two weeks to provide the latest information on Paramount's project to Chief Fabian. Will talk again with Chief Fabian on Friday Nov. 22nd as he has meetings until then.	None Required
Nov. 22	Chief Sam Gargon		Discussed the nature of Paramount's proposed update meeting in Hay River, which is to provide a project update to northerners on this winters work.	None required
Nov. 22	John Bartlett Ft. Providence Resource Management		John informed Paramount of the pending Woodland Caribou Stewardship plan to monitor caribou in the Cameron Hills. E-mail was sent to Paramount outlining caribou project, funding and contact people. Alison dePelham, Ex Director of DCFN and Debbie Johnson RWED were informed by John that Ken Brink would be the contact person for POU as it relates to caribou issues in the Cameron Hills	
Nov. 26 & 27	Open House in Hay River		Posted, faxed or hand delivered notice of open house meeting at or with: ECE office, Town Hall, Northern Store, Hay River Reserve. Kieth's Water Service, West Clean, Stan Dean and Sons, Carter Industries, Rowes Construction, Mike Vandell, Hilda Sabourin, Bob Head. (all Ft. Providence) Chief Leon Thomas, Wendy Cayen and Gwen Cayen. (West Point First Nation). Chief Roy Fabien, Cynthia James, Shirley Lamalice, Ken Norn (Hay River Band) Winnie Cadieux and Genevieve Clark (Enterprise) Anita Chicot at band office, Kakisa, Mike Mageean (RWED)	None required
Nov 28	Open House in Hay River		Paramount representatives presented updated information on their proposed seismic, drilling and pipeline/facilities project for 2002/2003-winter season. Employment for northerners was the main focus, with no other concerns being raised by attendees. Paramount focused on employment and training opportunities for northern people. This also involves an emphasis to be put on any prime contractors or sub contractors to also focus on opportunities for northern employment and training. The outcome was clearly a better understanding of the project and what employment opportunities were available.	None required
Dec. 6	Trappers, Dennis Strang and Roy Buggins		Dennis and Roy are the only trappers identified as utilizing the Cameron Hills project area. Personal notification was provided outlining the proposed startup of activity on Paramount's winter project. They both have no concerns.	Inform Roy Buggins when road opens
Dec. 6	Shawn Carter		Discussed mobilization and equipment needs. Ongoing employment and training opportunities for northern people were discussed.	None Required

Date	People Contacted	Purpose	Issues Discussed	Mitigation
2002				
Dec. 11	Hay River, West Point, Ft. Providence and Kakisa Bands		Informed all bands that Paramount has started its winter project in the Cameron Hills and how to best reach Paramount during the Christmas holiday period if there are any concerns. Employment opportunities and timing of work were explained to each band.	None required

Date	People Contacted	Issues Discussed	Mitigation
2003			
Jan 10	Northern News Services (Business Editor) Thorunn Howatt	Spent the day with Thorunn in the Cameron Hills reviewing and describing the various Paramount projects and focusing on the northern employment that is taking place as a result.	None required
Jan 14	Hay River Band Roy Buggins (trapper)	Met with Roy at his cabin in Cameron Hills. Reviewed the Paramount project, his role as environmental monitor and the associated reporting requirements.	None required
Jan 15	Mike Mageean RWED	Spent the day with Mike in the Cameron Hills to review all aspects of, and to meet the supervisors for the various Paramount projects. Employment and training opportunities were the focus of the day.	
Jan 16	Kakisa Fred Simba (trapper)	Fred indicated that starting his employment as heritage monitor in mid February is preferable to coincide with his other commitments	None required
Jan 17	Hay River Band Roy Buggins (trapper)	Met with Roy and gave him more information and forms as it relates to his environmental monitoring on Paramount's Cameron Hills project. Roy indicated everything was going well with the project.	None required
Jan 20	Carter Industries Ltd. Hay River	Picked up employment information on northern employees and training provided to northerners with their company.	None required
Jan 20	Keith's Water Services Ltd. Hay River	Met at their office and reviewed their northern employment and training as it applies to their working with Paramount.	None required
Jan 21	Kakisa Chief Chicot, Alan Landry	Paramount gave an update of their Cameron Hills project, reviewed the use of companies that are aligned with the Kakisa band and what employment and training has resulted from Paramount's use of these companies. Chief Chicot and Alan Landry confirmed that everyone from their community that wanted employment is working or lined up to go to work. Paramount requested to address confirmation of Traditional Knowledge already obtained and how best to proceed with the community on sharing more information. Paramount was invited by Chief Chicot to attend with himself and elders on a TK trip to Tathlina Lake in March of this year. Paramount will keep in communication with band office and Fred Simba to facilitate his employment as Heritage monitor again this year.	None required
Jan 21	Ft. Providence Bob Head (Manager, Digaa Enterprises Ltd.)	Reviewed employment and training opportunities and gave an update on Paramount's project in the Cameron Hills	None required
Jan 21	Ft. Providence Greg Nyuli (Assistant band manager), Shirley Gargan (Employment Officer) Mike Vandell (Band councilor and manager of land and resource board)	Paramount gave an update on their project in the Cameron Hills and reviewed employment and training opportunities. Paramount was told that the community has people employed in both of their camps at the project site and they just brought a rig worker out this morning. There will be safety training in the community next week for rig floor hands and heavy equipment operators and other potential employees to keep their tickets current. Updating and confirming existing TK information was discussed with Mike Vandell. We are to meet again on this issue.	None required
Jan 22	Westpoint First Nation Chief Thomas and Elders	Reviewed the TK report that was written last winter after meeting with Westpoint First Nations chief and elders. Confirmed with all community members present at the original TK meeting that the information in this report and map was accurate. Paramount gave Chief Thomas and community	None required

Date	People Contacted	Issues Discussed	Mitigation
2003			
		member an update on the Cameron Hills project and reviewed employment and training issues. Chief Thomas said they have employment through one of the local Hay River contractors that is aligned with their community.	
Jan 28	Kakisa, Band Manager- Ruby Landry	Hand delivered a letter of acceptance for attending a TK gathering trip to Tathlina Lake in March. Hand delivered a job description for a wildlife monitor to assist with the approved Wildlife Monitoring Plan associated with the Cameron Hills pipeline and gathering system. Ruby will give information to Chief Chicot in the morning.	None required
Jan 29	(EC&E)- Myreene Toben (RWED)- Mike Mageean	Met with Myreene and Mike at the seismic camp in the Cameron Hills to discuss employment opportunities with the upcoming recording crew activities. Reviewed the job description notices to be posted for seismic helpers. Discussed strategies to ensure the employment recruitment meeting in Hay River on Monday evening would be as successful as possible.	None required
Jan 30	(RWED Regional Biologist)- Deb Johnson	Met with Deb in Hay River to discuss many aspects of Woodland Caribou and their habitat requirements. Paramount expressed an interest to participate in any studies that are initiated in the Cameron Hills area. Paramount also offered logistical assistance and meals for caribou survey crews while in the area this winter.	None required
Jan 31	Kakisa Alan Landry	Reviewed the possibility of having George Simba from Kakisa assist in the wildlife track counts for Paramount's Wildlife Monitoring Plan. This approved plan is applicable to the Cameron Hills Gathering System and Transborder Pipeline. Alan Landry confirmed that George would be available starting February 4th, 2003.	None required
Feb 1-2	(EC&E)- Myreene Toben (Trace Energy)- Mike Maguire	A cumulative decision was reached between Trace Energy and EC&E regarding the wording for a recruitment meeting and job description notice. Paramount posted these notices in, and reviewed the employment opportunity with the leaders of all effected communities. The employment opportunity is for recording crew workers in the Cameron Hills.	None required
Feb 3	Kakisa Alan Landry	Made arrangements that Paramount would pick up George Simba in Kakisa tomorrow and bring him to the Cameron Hills to assist with the Wildlife Monitoring Plan. This would involve working and training with wildlife biologists from Golder Associates.	None required
Feb 3	(Food Town) Hay River Reserve owned company- Elida	Paramount assisted with some logistical problems regarding Paramount's Catering companies providing opportunities for placing food orders through this local company.	None required
Feb 3	(Trace Energy)- Mike Maguire and Stephen MenDuk. Twelve people from Hay River and Ft. Providence (Paramount)- Ken Brink	This was a recruitment meeting of Trace Energy held in Hay River to explain the project and hopefully employ at least twelve northern people to assist the recording crew. Paramount representative explained aspects of the project that people asked about. Six people met the criteria for employment with Trace and where to meet Trace representatives in the morning to go to work.	None required
Feb 4	(RWED)- Mike Mageean Kakisa- George Simba	Paramount's project and the Wildlife Monitoring Plan were explained to George Simba with Mike Mageean in attendance. Current aspects of Paramount's drilling program were explained to Mike Mageean including northern employment opportunities.	None required
Feb 11	Hay River Reserve- Les Norn	Paramount reviewed possible employment opportunities for Les Norn's Vacuum Truck.	None required

Date	People Contacted	Issues Discussed	Mitigation
2003			
Feb 12	(RWED)- Mike Mageean	Paramount personnel traveled to the Cameron Hills project site with Mike Mageean. All aspects of the current operations were discussed, including employment opportunities for northern personnel and services.	None required
Feb 14	Hay River Reserve- Chief Fabian, Cynthia James, (Economic Development Officer), Tina, (Food Town Representative)	Paramount reviewed the considerable efforts they have made through their Prime Contractor's catering companies to utilize the services of Food Town to provide the grocery needs to the camps in the Cameron Hills.	None required
Feb 19	(RWED)- Mike Mageean	Paramount personnel traveled to the Cameron Hills project site with Mike Mageean. All aspects of the current operations were discussed, including employment opportunities for northern personnel and services. Mike was asked for assistance in talking to the Hay River Band to emphasize the importance of the opportunity being provided to Food Town. The challenges regarding this service being competitive were discussed.	None required
Feb 20	Kakisa- Chief Chicot	Confirmed a March 10th trip with Paramount staff, himself and elders for TK knowledge gathering at Tathlina Lake.	None required
Feb 21	Kakisa- Chief Chicot	Reviewed employment issues and confirmed that the community was pleased with the availability of work for their people. Discussed the TK gathering trip to Tathlina Lake on March 10th and what activities would occur while out on the land. Chief Chicot was also invited to participate on a tour of the projects in the Cameron Hills on March 13th, 2003	None required
Feb 21	Ft. Providence- Chief Gargan	Paramount requested another opportunity to review the TK report that was drafted last year. Chief Gargan gave direction to talk with Joachim Bonnetrouge first and then approach him again if the report is acceptable to Joachim. Chief Gargan was invited to attend a Cameron Hills tour with Paramount on March 13th, 2003.	None required
Feb 24	Ft. Providence-Joachim Bonnetrouge	Discussed the TK report drafted by Paramount last year. Attempted to set a meeting date to proceed with more TK review in the near future. Joachim is busy for the next week or two. Paramount expressed their desire to incorporate as much of the TK for the Cameron Hills into their ongoing projects as possible.	None required
Feb 26	(RWED)- Mike Mageean	Paramount personnel traveled to the Cameron Hills project site with Mike Mageean. All aspects of the current operations were discussed, including employment opportunities for northern personal and services. Mike also met with the seismic managers at the camp. They are shutting down tomorrow. It was agreed that this operation was very successful in its attempts to employ northern services and individuals.	None required
Feb 27	Ft. Providence- Chief Gargan, Shirley Gargan (EDO), Councilors, Wayne Vandell and Johnas, Greg Nyuli.	Review of personnel issues relating to the Cameron Hills projects.	Continuing discussions are to be held
Feb 27	Kakisa- Chief Chicot	Talked with Chief Chicot and he is not sure if the scheduled March 10thTK gathering trip to Tathlina Lake will occur now.	None required
Mar 7	RWED Mike Mageean, Deb Johnson	Paramount's participation in helping out RWED with caribou surveys and fuel storage in the Cameron Hills. Present project operations were explained to Mike Mageean during trip to the Cameron Hills	None required

Date	People Contacted	Issues Discussed	Mitigation
2003			
Mar 10	Ft. Providence Band Mike Vandell, Wayne Vandell, John Bartlett	Discussed current employment issues, potential project tour and the Wildlife harvesting compensation plan.	None required
Mar 11	Ft. Providence Band Maggie and John Bartlett	Cameron Hill's tour cancelled by Ft. Providence. Reviewed the varying expectations for the unresolved Wildlife Harvesting Compensation Plan with John Bartlett.	None required
Mar 14	Hay River Reserve Roy Buggins (trapper)	Roy Buggins provided additional TK and verified information in the previous TK report. This information is of particular importance, it is the only known aboriginal Traditional Knowledge information from the NWT that shows any traditional use of the lands covered by Paramount's SDL on the Cameron Hills plateau.	Include new TK information in the K'atlodeeche First Nation and Hay River Traditional knowledge Study for the Cameron Hills
Mar 16	Hay River Dennis Strang	Dennis Strang provided additional TK and verified information in the previous TK report	Include new TK information in the K'atlodeeche First Nation and Hay River Traditional knowledge Study for the Cameron Hills
Mar 17	Hay River MLA, Paul Delorey. RWED, Mike Mageean	Entire Paramount project operations were explained to Paul Delorey and Mike Mageean during a day tour of the Cameron Hills project area. This tour also explained the considerable efforts made by Paramount to capture as many qualified northern employees and services.	None required
Mar 17	Wildlife Harvesting Plan	Paramount received written confirmation that the mitigation process continues to be on hold at the request of the Communities.	None required
Mar 18	Ft. Providence Band Administrator, Greg Nyuli. Ft. Providence Metis Nation President, Albert Lafferty	Paramount delivered letters requesting additional TK information, if available, and to invite any leaders or councilors on a tour of the Cameron Hills project site before vehicle access to the Cameron Hills ceases.	None required
Mar 20	Kakisa Margaret Leishman	Received TK information on how to determine when moose and porcupines are fat and ready to harvest.	Add information to existing TK study
Mar 21	Ft. Providence Band, Chief Gargan	Band council has declined to attend a tour of the Cameron Hills.	None Required
Mar 21	Hay River Reserve, Chief Fabian	Paramount requested any additional TK information, if available, to augment the prior study. Chief Fabian was invited to tour the Cameron Hills project area.	None required
Mar 24-25	Hay River Reserve, EDO, Cynthia James	Messages were left at Hay River Dene Band Office giving Cynthia James an open invitation to attend a trip to the Cameron Hills project site. Cynthia stated they are very busy and through band members working on the Paramount projects, they have an opportunity to find out what is happening up there.	None required
Mar 29	Hay River Band member and local Cameron Hills trapper; Roy Buggins	Talked with Roy Buggins regarding how Paramount has conducted its project from an environmental and northern opportunities perspective. Roy reported there has been no adverse effect to his trapping area and was quick to point out that he is the only person that has trapped the area where Paramount has its project in at least thirty years. Roy also said that he has seen the considerable effort that Paramount has put into getting Northern people involved with working on the project.	None required
Mar 30	RWED Deb Johnson	Discussed woodland caribou herd locations and where Deb has found caribou for her collaring program this winter. She said no caribou have been collared or spotted on the NT side of the Cameron Hills plateau.	

Date	People Contacted	Issues Discussed	Mitigation
2003			
		Deb said they have collared some caribou to the east and north of the plateau on the lowlands. Paramount offered to take her for a driven tour of the project site in the Cameron Hills before the winter road closes. Deb said she could not get away for a tour at this time. We agreed to keep up communications regarding woodland caribou issues in the area.	
Apr 24	Wildlife Harvesting Plan	Paramount received notification from the mediator that the Communities requested the Wildlife Harvesting Plan be put on hold.	
Jun 12	Hay River Band, Diane Tregidgo	Discussed the purpose and timing of an upcoming open house and workshop put on by Paramount and requested that it be held at the band office boardroom. Preliminary plans were put in place	None required
Jun 12	RWED, Mike Mageean	Environmental monitoring standards and northern training initiatives as they relate to the NT oil and gas industry. Mike was able to provide valuable input to Paramount regarding the upcoming open house and community workshop.	None required
Jun 16	EC&E. Colleen Proctor.	Discussed proposed standards for Environmental Monitors in the NT. Paramount informed Colleen that their committee should contact the Canadian Association of Petroleum Producers to get input from all oil and gas companies instead of just Paramount.	None required
Jun 20	Kakisa, Anita Chicot	When the best timing would be for a community open house in Hay River and to try to set up a time when Paramount's COO could meet with elders and Chief Chicot out on the land for a couple of days. The dates of July 14th and 15th where discussed for the Open house and Community workshop. Paramount told Anita they will confirm with other communities and let Anita know which of these dates will be chosen for the Open house and Community workshop	None required
Jun 20	Ft. Providence, Victor Constante	Arrangements for Open house and Community workshop in Hay River on July 14th and 15th, 2003	None required
Jun 20	Hay River Band Chief Fabian and Diane Tregidgo	Employment opportunities for the band and booked the boardroom at the band office for the upcoming Community workshop in July. Chief Fabian said he will be in Edmonton on the planned Workshop days but will arrange for band representatives to attend.	None required
Jun 20	Westpoint First Nation, Wendy Cayen	Arrangement for the upcoming Open house and Community workshop in July	None required
Jun 21	Ft. Providence Band John Bartlett	Availability to attend the upcoming Community workshop at the Hay River Band Office on July 15th.	None required.
Jun 26	Ft. Providence Band John Bartlett	Further discussion regarding Community workshop in Hay River on July 15th. The RWED, NT caribou study was discussed	None required
Jun 26	Ft. Providence Metis Albert Laferty	Information and invitation was given to Albert regarding the upcoming Open house and Community workshop in Hay River on July14th and 15th.	None required
Jun 27	Enterprise Hamlet Office	Notification and invitation to Open house in Hay River on July 14th.	None required
Jun 27	DIAND, Andrew Forbs and Norm McCowan	Notification and invitation to Open house in Hay River on July 14th.	None required
Jul 2	Marian Bennett. Working for EC&E on standardizing environmental monitoring in the NT	Paramount explained that EC&E should involve all of the oil and gas producers through the Canadian Association of Petroleum Producers in their environmental monitoring standardization.	None required
Jul 3	Kakisa Anita Chicot	Paramount confirmed we would be having the Open house and Community workshop in Hay River on July 14th and 15th.	None required

Date	People Contacted	Issues Discussed	Mitigation
2003			
Jul 3	Enterprise Vivian Cadieux, Enterprise Community Office	Confirmed dates for open house in Hay River and faxed notifications of the same.	None required
Jul 7	RWED Mike Mageean	Mike assisted Paramount in posting public notices for the July 14th Open house at locations throughout Hay River	None required
Jul 7	Total Book Keeping, Tracey Cross	Tracy assisted Paramount in faxing out the public notices for the July 14th Open house to approximately eighty five companies and Chamber of Commerce members in Hay River	None required
Jul 7	Hay River Band Shirley Lamalice, Band Administrator	Confirmed preparations and arrangements for the July 15th Community workshop to be held at the Hay River Dene Band boardroom.	None required
Jul 8	West Point First Nation Lucille Cayen	Confirmed that they would have representatives for the Community workshop on July 15 and made sure the band members knew they are all invited to the Open house on July 14th as well	None required
Jul 9	Kakisa Chief Chicot	Tentatively arranged with Chief Chicot to have a meeting with Paramount management on Monday July 14th at the band office or in Hay River. Chief Chicot will confirm before Monday	None required
Jul 9	Kakisa Chief Chicot Hay River Band Shirley Lamalice West Point First Nation Wendy and Lucille Cayen Ft. Providence Band Greg Nyuli, Mike Vandell, John Bartlett Ft. Providence Metis Nation Albert Lafferty	Faxed a copy of the draft agenda for the July 15th community workshop and open house notice for July 14th	None required
Jul 10	Kakisa Chief Chicot	Chief Chicot still hopes to be able to meet with Paramount on July 14th	None Required
Jul 10	Kakisa Alan Landry	Alan indicated he was not informed of the open house and community workshop in adequate time and would not attend. Alan expressed a desire to have a separate meeting with Paramount at a later date to discuss Paramount's project. Paramount agreed to arrange a later meeting date.	Arrange a meeting
Jul 14	DFO Larry Dow	Paramount managers met with Larry to review the Cameron Hills project	None Required
Jul 14	DIAND Norm McCowan	Paramount managers met with Norm to review the Cameron Hills project	None Required
Jul 14	Local Community Members	Paramount's past winter's project, the development for the upcoming winter and the proposed development for the next ten years was explained at an open house. The open house focused on: environmental mitigation, employment and training opportunities, traditional knowledge incorporation, timelines to complete annual projects, technical information regarding each specific phase of development and general benefits to the NT.	None Required
Jul 15	Community workshop at the Hay River Reserve The aboriginal communities of Ft. Providence, Kakisa, West Point and Hay River Reserve were invited to attend this daylong workshop.	Paramount's past winter's project, the development for the upcoming winter and the proposed development for the next ten years was explained at the workshop. A number of aboriginal business people chose to attend the previous days Open house in the town of Hay River. Representatives and/or band members from the Hay River Dene Reserve and Ft. Providence attended this workshop. The workshop focused on: environmental mitigation, employment and training	None required

Date	People Contacted	Issues Discussed	Mitigation
2003			
		opportunities, traditional knowledge incorporation, timelines to complete annual projects, technical information regarding each specific phase of development and benefits to the aboriginal communities attending the workshop.	
Aug 14	Kakisa Band Office	Left a message with the receptionist at the band office for Fred Simba to call regarding surveying assistance.	None required
Aug 19	Kakisa Fred Simba	Discussed Fred's availability to attend with surveyors in the Cameron Hills. Fred suggested that we should use George Simba instead and he would get George to phone Paramount.	
Aug 19	Kakisa Alan Landry	Paramount discussed their desire to have a trip on the land to Tathlina Lake with Chief Chicot, Elders and Paramount management this summer or fall. Paramount indicated that a trip of this nature could provide increased knowledge sharing and understanding between Paramount and the people of Kakisa. Alan indicated that he did not think this was a good idea.	None required
Aug 28	Kakisa	Arrangements were made for a Kakisa representative to participate in site and route selection. No community member chose to participate.	None required
Aug 28 – Sept 3	Hay River Band Roy Buggins (trapper)	Roy participated in site and route selection on 8 locations.	None required
Sept 2	Ft. Providence Band Chief Landry, Councilors Mike and Wayne Vandell, Band Manager, Greg Nyuli, Mike Mageean, RWED	Paramount representatives provided a comprehensive update on past present and expected future project development in the Cameron Hills. Employment and training initiatives were stressed as a high priority as we get closer to another winter's activity. Chief Landry and councilors agreed to keep Paramount informed on any new development with regard to an agreement for all of the local communities to work together with a possibility of having Kakisa taking a lead role on environmental issues only. It was stressed to Paramount that nothing is in place to give Kakisa any lead role until there is a signed agreement with all local communities.	None required
Sept 2	Kakisa Acting Chief, Alan Landry, Consultant, Joe Acorn, Elder Councilors, Mike Vandell INAC, Mike Mageean RWED	Paramount representatives met with Kakisa people at the Kakisa Band office. Paramount provided a comprehensive update on past, present and expected future project development in the Cameron Hills. Keeping up with ongoing communication was a key issue and it was suggested that more informal meetings could be held in the future to discuss particular issues instead of dealing with all expectations from Kakisa and Paramount at a few large meetings. Paramount pointed out that Ken Brink is the key contact with Paramount. Alan Landry expressed concern that Paramount had not informed Kakisa of numerous environmental problems that have occurred on the project site. Paramount pointed out that most of what he expressed as environmental problems with the regulators were in fact, mitigative measures that were completed with direction from INAC inspectors and not infractions. These measures were purely mitigative to prevent possible erosion. Alan Landry expressed a desire for Paramount to hire all of its monitoring personnel from Kakisa. Kakisa noted that they did not have a monitor available as previously arranged to attend with the wellsite and access scouting that started last Thursday, Aug 28th. In discussion regarding a pending agreement for all of the local communities to let Kakisa take a lead role, Alan Landry mentioned that this would extend further than just the environmental	None required

Date	People Contacted	Issues Discussed	Mitigation
2003			
		issues.	
Sept 8 – Sept 11	Hay River Band Roy Buggins (trapper)	Roy assisted Golder Associates in the Revegetation and Permafrost Study	None required
Sept 12	Kakisa Alan Landry	Alan and Paramount made final arrangements and confirmed that a flight to the Cameron Hills project area will occur on Monday September 15th. Alan confirmed that it would be himself and Pat Chicot attending with Paramount personnel on the flight.	None required

APPENDIX II

PERMAFROST GUIDELINES

PARAMOUNT RESOURCES LTD.

OPERATING GUIDELINES FOR PERMAFROST AREAS

PURPOSE: To outline the practices utilized for pipelining and associated work on permafrost sites.

GOAL: To perform the work outlined by the proponent in a manner that is considerate to the past, present and future environmental conditions of the area and within a viable operational budget.

DEFINITION: By strict definition, permafrost is simply a thermal condition of the earth; that is, earth material which remains below 0º C continuously for more than two years. Thickness of permafrost is a function of surface climate, thermal conductivity of the sediment and time. Disturbance can occur due to natural causes such as fire or heavy summer rains, which saturate soils and initiate slope failures. More commonly, disturbances are human-induced due to construction, off-road activities that physically disrupt the surface, or oil spills that alter its albedo. The relationship between climate and permafrost is not direct, but instead is mediated by the buffer layer consisting of the snow, vegetation and organic covers and soil. The interactions of the active layer and permafrost with the atmosphere, vegetation, biological hydrological, and geomorphic processes are complex. Simply stated, as the vegetation and organic layer decrease or are removed, the active layer thickens, and degradation of ice-rich permafrost occurs. Increases in vegetation and the organic layer result in less thaw and permafrost aggradation. Changes in snow cover and soil moisture further modify the response of the active layer to thermal changes at the ground surface and in the thawing soil layer. (Excerpts from Global Environmental Working Group).

PROCEDURE COMPONENTS

Utilize existing winter roads, cutlines and accesses wherever possible.
Ensure that all potential access routes are watered and groomed as snow roads.
No disturbance to vegetative cover or duff layer to occur except for actual pipeline alignment ditch area.
Where a PLA parallels an existing disposition (i.e., LOC), and when crossing permafrost, the PLA shall be reduced to a 12 m addition to the existing disposition.
Stockpiling of snow for low snow areas is recommended. Stockpiling should be in non permafrost areas.
Do not utilize bulldozers for clearing and brushing in permafrost area. Large diameter timber should be cut and removed, leaving the stumps in place if they are not in the direct path of access or pipeline.
Small timber can be rolled back at the time of trenching, with a hoe or tractor with a brush rake.
Minimal grading is desirable. Where possible, fill between stumps and hummocks with snow. Snow fills on the workside of the pipeline to fill the hummocks rather than blading them level with the surrounding area will reduce the disturbance to the insulating organic layer.
Utilize a hoe and ripper to rip frost only in the actual pipeline alignment area.
Ditch excavation should be performed with frost buckets and only disturb the insulating layer where required for pipe installation.
Ensure that all piping is prepared for installation and that the ditch is opened only for a limited time.
Backfill using a hoe and clean up bucket. To reduce the potential for pipeline subsidence, the spoil pile should be roached over the ditchline to allow for settlement and prevent surface water ponding and channelling. A 2" stub berm left in place on the spoil side will assist in the prevention of channelling.
The slash which had been rolled back at the time of ditching should be pulled back. Random spreading of the slash will provide erosion control as well as extra protection of the insulating organic layer.
Reclamation should be conducted immediately, although a percentage of seed will be lost to wildlife and runoff/weather.

Paramount employs construction supervisors who are experienced in northern construction practices and will do on-site visual inspections in order to identify areas of permafrost. If necessary, in order to confirm permafrost area size , probing may also be required.

The use of additional insulating and stabilizing materials on steep slopes could be considered. The use of woodchips as additional insulation may have merit; however, excerpts from various sources do not indicate a significant increase in value added.

In summary, the potential effects to the environmental condition of permafrost areas in pipeline and associated projects can be minimized through job planning, which includes measures to reduce intrusive work that may cause degradation of permafrost.

APPENDIX III

DETAILED EMISSIONS INFORMATION

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF TABLES

INTRODUCTION

This appendix provides detailed information regarding the emission sources included in the Baseline, Application and Planned Development Cases of the air quality assessment for the Cameron Hills Extension Project EIA.

BASELINE CASE

Tables III-1 through III -5 details the gas compositions included in the Baseline Case assessment. Where available actual gas compositions based on sampling have been used.

Table III-1 Gas Composition for the Battery Fuel Gas in the Baseline Case

Composition	Mole Percent [%][(a)]
H_2	0.15
He	0.07
N_2	1.59
CO_2	5.47
H_2S	1.50
C_1	88.62
C_2	1.38
C_3	0.69
IC_4	0.11
NC_4	0.24
IC_5	0.07
nC_5	0.06
C_6	0.06
$+C_7$	0.00

(a) Based on the gas analysis of a sample taken of the H-03 fuel gas on July 3, 2003. The measured H_2S content of 1.23% was conservatively increased to 1.5% H_2S for this assessment and the composition was normalized accordingly.

Table III-2 Oil and Water Tanks Vapour Composition in the Baseline Case

Composition	Mole Percent [%][(a)]
H_2	0.15
He	0.07
N_2	1.59
CO_2	5.47
H_2S	1.50
C_1	88.62
C_2	1.38
C_3	0.69
IC_4	0.11
NC_4	0.24
IC_5	0.07
nC_5	0.06
C_6	0.06
$+C_7$	0.00

(a) Based on the gas analysis of a sample taken of the H-03 fuel gas July 3, 2003. The measured H_2S content of 1.23% was conservatively increased to 1.5% H_2S for this assessment and the composition was normalized accordingly.

Table III-3 Gas Composition for Gas Wells N-28, C-50, H-58, A-73 and A-05 in the Baseline Case

Composition	Mole Percent [%][(a)]				
	N-28	C-50	H-58	A-73	A-05
H_2	0.27	0.26	0.00	0.01	0.10
He	0.07	0.07	0.07	0.08	0.08
N_2	1.69	1.50	5.06	1.61	2.06
CO_2	5.18	5.41	5.17	5.03	2.33
H_2S	1.36	1.50	1.36	1.50	1.23
C_1	88.64	88.41	85.61	89.18	91.30
C_2	1.48	1.51	1.44	1.33	1.52
C_3	0.72	0.72	0.69	0.69	0.74
IC_4	0.11	0.11	0.11	0.11	0.11
NC_4	0.21	0.24	0.25	0.25	0.23
IC_5	0.06	0.07	0.07	0.07	0.07
NC_5	0.06	0.07	0.07	0.07	0.07
C_6	0.05	0.06	0.06	0.06	0.07
$+C_7$	0.10	0.07	0.04	0.01	0.09

(a) From gas analysis of samples taken July 3, 2003.

Table III-4 Gas Composition for All Other Proposed and Existing Gas Wells in the Baseline Case

Composition	Mole Percent [%]
H_2	0.01
He	0.08
N_2	1.60
CO_2	5.00
H_2S	2.00
C_1	88.73
C_2	1.32
C_3	0.69
IC_4	0.11
NC_4	0.25
IC_5	0.07
NC_5	0.07
C_6	0.06
$+C_7$	0.01

(a) Based on the gas analysis of a sample taken of the A-73 well gas July 3, 2003. The measured H_2S content of 1.5% was conservatively increased to 2% H_2S for this assessment and the composition was normalized accordingly.

Table III-5 Gas Composition for Proposed and Existing Oil Wells Operating on Casing Gas in the Baseline Case

Composition	Mole Percent [%][(a)]
H_2	0.01
He	0.07
N_2	1.48
CO_2	4.85
H_2S	2.50
C_1	85.87
C_2	2.01
C_3	1.40
IC_4	0.30
NC_4	0.68
IC_5	0.23
NC_5	0.23
C_6	0.20
$+C_7$	0.17

(a) Based on the gas analysis of a sample taken from the H-03 group separator July 3, 2003. The measured H_2S content of 2.04% was conservatively increased to 2.5% H_2S for this assessment and the composition was normalized accordingly.

Table III-6 details the sources at the central battery included in the Baseline Case assessment. For the purpose of this assessment, the Baseline Case emissions are the emissions that would result from the fully approved capacities of these sources.

Table III-6 Equipment and Emission Assumptions for the Central Battery in the Baseline Case

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
5100 Texsteam Series Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• well gas	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-1)
	• gas flow	• 71 m³/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information
	• power source	• pneumatic	• Paramount design information
Low Pressure Flare	• gas flow	• 371 m³/d	• Paramount design information
	• fuel source	• 71 m³/d of fuel gas from the pneumatic pump • 250 m³/d and 50 m³/d vented gases from the oil tanks and water tanks respectively	• H-03 fuel gas normalized to 1.5% H_2S (see Tables III-1 and III-2)
	• flare stack height	• 15.0 m	• Paramount design information
	• flare stack diameter	• 0.203 m	• Paramount design information
	• NO_X emissions	• 0.0004 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.0148 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.287 kt/yr	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)
1 Heat Medium Heater	• maximum power output	• 0.25 MMBtu/hr	• Paramount design information
	• fuel source	• well gas	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-1)
	• fuel consumption	• 279 m³/d	• assumed fuel efficiency of 70%
	• fuel H_2S content	• 1.5%	• see Table III-1
	• NO_X emissions	• 0.0004 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.011 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.193 kt/yr	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
	• stack height	• 4.6 m	• Paramount design information
	• stack diameter	• 0.4 m	• Paramount design information
	• exit velocity	• 0.48 m/s	• based on 10 % excess air and exhaust temperature

Table III-6 Equipment and Emission Assumptions for the Central Battery in the Baseline Case (continued)

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
	• exit temperature	• 473 K	• Paramount design information
Waste Incinerator	• duty rating	• 0.5 MMBtu/hr	• Paramount design information
	• fuel source	• diesel fuel	• Paramount design information
	• fuel consumption	• intermittent source, not evaluated	• —
	• air emission	• intermittent source, not evaluated	• —
Inlet Header Skid	• air emissions	• not an emission source	• Paramount design information
Fuel Gas Scrubber	• air emissions	• not an emission source	• Paramount design information
3 – Oil Storage Tanks	• air emissions	• 250 m³/d captured and sent to the flare	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-2)
Corrosion Inhibitor Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
3 – Water Storage Tanks	• air emissions	• 50 m³/d captured and sent to the flare	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-2)
2 – Water Tank Heaters	• maximum power output	• 0.15 MMBtu/hr	• Paramount design information
	• fuel source	• well gas	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-1)
	• fuel consumption	• 167 m³/d	• assumed fuel efficiency of 70%
	• fuel H_2S content	• 1.5%	• see Table III-1
	• NO_X emissions	• 0.000267 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.00677 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.116 kt/yr	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
	• stack height	• 11.0 m	• Paramount design information
	• stack diameter	• 0.15 m	• Paramount design information
	• exit velocity	• 2.1 m/s	• based on 10% excess air
	• exit temperature	• 473 K	• assumed to be the same as the heat medium heater
Waste Oil Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
Lube Oil Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
4 – Methanol Storage Tanks	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
2 – Flare Knock-Out Drums	• air emissions	• captured and sent to the flare	• Paramount design information

Table III-6 Equipment and Emission Assumptions for the Central Battery in the Baseline Case (continued)

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
Turbine 1	• maximum power output	• 200 KW	• Paramount design information
	• fuel source	• well gas	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-1)
	• fuel consumption	• 3928 m³/d	• manufacturer's specifications
	• fuel H_2S content	• 1.5%	• see Table III-1
	• NO_X emissions	• 0.0086 t/d	• CCME Guideline for Stationary Combustion Turbines (CCME 1992)
	• SO_2 emissions	• 0.159 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 2.223 kt/yr	• U.S. EPA emission factors (U.S. EPA 1995)
	• Stack height	• 12.5 m	• Paramount design information
	• stack diameter	• 0.3 m	• Paramount design information
	• exit velocity	• 43.93 m/s	• based on 300% excess air
	• exit temperature	• 503 K	• Paramount design information
Turbine 2	• maximum power output	• 200 KW	• Paramount design information
	• fuel source	• intermittent not evaluated	• —
	• fuel consumption	• intermittent, not evaluated	• —
	• fuel H_2S content	• intermittent, not evaluated	• —
	• NO_X emissions	• Intermittent, not evaluated	• —
	• SO_2 emissions	• Intermittent, not evaluated	• —
	• GHG emissions (ECO_2)[(a)]	• Intermittent, not evaluated	• —
	• stack height	• 12.5 m	• Paramount design information
	• stack diameter	• 0.3 m	• Paramount design information
	• exit velocity	• Intermittent, not evaluated	• —
	• exit temperature	• Intermittent, not evaluated	• —
Treater Unit	• maximum power output	• 0.75 MMBtu/hr	• Paramount design information
	• fuel source	• well gas	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-1)
	• fuel consumption	• 835.81 m³/d	• assumed fuel efficiency of 70%
	• fuel H_2S content	• 1.5%	• Paramount design information
	• NO_X emissions	• 0.0013 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.034 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.578 kt/yr	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
	• stack height	• 4.88 m	• Paramount design information
	• stack diameter	• 0.61 m	• Paramount design information

Table III-6 Equipment and Emission Assumptions for the Central Battery in the Baseline Case (continued)

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
Treater Unit (continued)	• exit velocity	• 3.33 m/s	• based on firetube capacity of 4 MMBtu/hr, actual stack diameter of 24” and 10% excess air
	• exit temperature	• 473 K	• Paramount design information
Compressor	• maximum power output	• 634 hp	• Paramount design information
	• fuel source	• well gas	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-1)
	• fuel consumption	• 3956.6 m³/d	• manufacturer’s specifications
	• fuel H_2S content	• 1.5%	• Paramount design information
	• NO_X emissions	• 0.13 t/d	• manufacturer’s specifications
	• SO_2 emissions	• 0.16 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[a]	• 3.173 kt/yr	• U.S. EPA emission factors for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (U.S. EPA 1995; CAPP 2003)
	• stack height	• 18.29 m	• Paramount design information
	• stack diameter	• 0.46 m	• Paramount design information
	• exit velocity	• 12.27 m/s	• manufacturer’s specifications
	• exit temperature	• 514 K	• manufacturer’s specifications

(a) Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

Table III-7 presents detailed emissions information for the gas wells included in the Baseline Case assessment. Table III-8 presents the assumed stack heights for the line heaters associated with the gas wells discussed in Table III-7.

Table III-7 Equipment and Emission Assumptions for Gas Wells in the Baseline Case

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Gas Wells	• well gas composition	• the gas compositions at the gas wells N-28, C-50, H-58, A-73, A-05 were based on gas analysis • for all other gas wells a normalized A-73 gas composition was be used with 2% H_2S	• gas analysis (see Tables III-3 and III-4)
Line Heater	• maximum power output	• 0.50 MMBtu/hr	• Paramount design information
	• fuel source	• well gas	• gas analysis (see Tables III-3 and III-4)
	• fuel H_2S content	• N-28: 1.36%, C-50: 1.5%, H-58: 1.36%, A-73: 1.5% and A-05: 1.23% • 2% for all other gas wells	• —
	• fuel consumption	• N-28: 553.6 m³/d, C-50: 553.9 m³/d, H-58: 573.6 m³/d, A-73: 554.0 m³/d and A-05: 537.8 m³/d • 554.8 m³/d for all other gas wells	• assumed fuel efficiency of 70%
	• NO_X emissions	• 0.0009 t/d	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• N-28: 0.020 t/d, C-50: 0.022 t/d, H-58: 0.021 t/, A-73: 0.022 t/d and A-05: 0.018 t/d • 0.030 t/d for all other gas wells	• based on fuel consumption and composition
	• stack height	• see Table III-8	• —
	• stack diameter	• 0.152 m	• Paramount design information
	• exit velocity	• N-28: 6.65 m/s, C-50: 6.66 m/s, H-58: 6.89 m/s, A-73: 6.66 m/s and A-05: 6.46 m/s • 6.67 m/s all other gas wells	• based on 10% excess air
	• exhaust temperature	• 473 K	• Paramount design information
	• GHG emissions (ECO_2)[(a)]	• N-28: 0.385 kt/yr, C-50: 0.385 kt/yr, H-58: 0.386 kt/yr, A-73: 0.384 kt/yr and A-05: 0.374 kt/yr • 0.382 kt/yr for all other gas wells	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S.EPA 1995)
Thermo-electric generator	• maximum power output	• 54 Watts	• Paramount design information
	• fuel source	• propane	• Paramount design information
	• fuel H_2S content	• negligible	• —

Table III-7 Equipment and Emission Assumptions for Gas Wells in the Baseline Case (continued)

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Thermo-electric generator (continued)	• fuel consumption	• 2.9 kg/d	• Paramount design information
	• NO_X emissions	• 0.000013 t/d	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• negligible	• —
	• stack height	• 2.5 m	• Paramount design information
	• stack diameter	• 76 mm	• Paramount design information
	• exit velocity	• 0.4 m/s	• based on 30 % excess air and exhaust temperature
	• exhaust temperature	• 819 K	• Paramount design information
	• GHG emissions (ECO_2)[(a)]	• 0.003 kt/yr	• U.S. EPA emission factors (U.S.EPA 1995)
Building Heaters	• maximum power output	• 48,000 Btu/hr	• Paramount design information
	• fuel source	• propane	• Paramount design information
	• fuel H_2S content	• negligible	• —
	• fuel consumption	• 96,000 Btu/hr	• based on 50 % efficiency
	• NO_X emissions	• 0.000217 t/d	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• negligible	• —
	• stack height	• 3.5 m	• Paramount design information
	• stack diameter	• 76 mm	• Paramount design information
	• exit velocity	• 3.72 m/s	• based on 25% excess air
	• exhaust temperature	• 473 K	• assumption made by Golder
	• GHG emissions (ECO_2)[(a)]	• 0.053 kt/yr	• U.S. EPA emission factors (U.S.EPA 1995)
Methanol Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
2-5100 Texsteam Series Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• well gas	• gas analysis (see Tables III-3 and III-4)
	• gas flow to each pump	• 71 m³/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information
1000 gallon corrosion Inhibitor tank	• air emissions	• not expected to be an emission source	• Paramount design information
50 barrel corrosion Inhibitor tank	• air emissions	• not expected to be an emission source	• Paramount design information
Three phase separator	• air emissions	• not expected to be an emission source	• Paramount design information
2-1000 gallon propane tanks	• air emissions	• not expected to be an emission source	• Paramount design information
Flare knockout drum	• air emissions	• not expected to be an emission source	• Paramount design information
Flare	• gas flow rate	• 156 m³/d	• gas flow from pneumatic pumps and the 500 scf/d from instruments
	• gas source	• well gas	• gas analysis
	• flare stack height	• 12.2 m	• Paramount design information

Table III-7 Equipment and Emission Assumptions for Gas Wells in the Baseline Case (continued)

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Flare (continued)	• flare stack diameter	• 0.102 m	• Paramount design information
	• NO_X emissions	• N-28: 0.000149 t/d, C-50: 0.000149 t/d, H-58: 0.000144 t/d, A-73: 0.000149 t/d, A-05: 0.000153 t/d • 0.000149 t/d for all other gas wells	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• N-28: 0.00563 t/d, C-50: 0.00621 t/d, H-58: 0.00563 t/d, A-73: 0.00621 t/d, A-05: 0.00509 t/d • 0.00828 t/d for all other gas wells	• based on gas c onsumption and composition (see Tables III-3 and III-4)
	• GHG emissions (ECO_2)[(a)]	• N-28: 0.122 kt/yr, C-50: 0.122 kt/yr, H-58: 0.118 kt/yr, A-73: 0.121 kt/yr, A-05: 0.122 kt/yr • 0.121 t/d for all other gas wells	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)

(a) Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

Table III-8 Stack Heights for the Line Heaters at Gas Wells in the Baseline Case

Gas Well	Stack Height [m][(a)]
A-73	6.1
C-50	9.0
M-49	12.0
H-58	6.1
D-49	9.0
J-37	18.0
N-28	12.0
J-62	12.0
I-16	16.0
A-05	9.0
A-68	12.0
B-08	16.0
F-34	9.0
C-33	15.0

(a) A standard line heater stack height of 6.1 m was assumed. Stack heights associated with concentrations in excess of the NT standards were increased to comply with NT standards. Paramount is committed to retrofit any existing stacks to the heights listed above.

Table III-9 presents detailed emissions information for the oil wells included in the Baseline Case assessment. Table III-10 presents the assumed stack heights for the pumpjacks associated with the gas wells discussed in Table III-9.

Table III-9 Equipment and Emission Assumptions for Oil Wells in the Baseline Case

Equipment at Oil Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Pumpjack (gas engine)	• maximum power output	• 24.5 hp	• manufacturer's specifications
	• fuel source[a]	• H-03 group separator gas normalized to 2.5% H_2S for all wells except D-78. • sweet fuel gas was used at D-78.	• gas analysis (see Table III-5) • Paramount design information.
	• fuel consumption	• 7700 btu/hp-hr (139 m^3/d)	• manufacturer's specifications
	• fuel H_2S content	• well gas: 2.50% • sweet fuel: negligible	• —
	• NO_X emissions	• 0.000615 t/d	• manufacturer's specifications
	• SO_2 emissions	• 0.0094 t/d at all wells except D-78. • D-78 negligible	• based on gas consumption and composition
	• GHG emissions (ECO_2)[b]	• 0.118 kt/yr	• U.S. EPA emission factors for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (U.S. EPA 1995; CAPP 2003)
	• stack height	• see Table III-10	• —
	• stack diameter	• 0.051 m	• Paramount design information
	• exit velocity	• 25.11 m/s	• based on exit temperature, 6% excess air (from manufacturer's data) and 2 inch diameter stack
	• exhaust temperature	• 823.15 K	• Paramount design information
Chemical Dewaxing Tank	• air emissions	• not expected to be an emission source	• Paramount design information
Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• well gas	• Paramount design information
	• gas flow	• 71 m^3/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information
Flare	• gas flow rate	• 71 m^3/d	• gas flow from pneumatic pumps
	• gas source	• H-03 group separator gas normalized to 2.5% H_2S	• see Table III-5
	• flare stack height	• 9.1 m	• Paramount design information
	• flare stack diameter	• 76.2 mm	• Paramount design information
	• NO_X emissions	• 0.00007 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.0047 t/d	• based on gas consumption and composition
	• GHG emissions (ECO_2)[b]	• 0.058 kt/yr	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)

[a] The pumpjack at D-78 was assumed to operate on sweet fuel to ensure that the predicted ground-level concentrations of SO_2 would comply with the NT standards. Paramount is committed to using sweet fuel at this well should it be drilled and deemed to be successful.

[b] Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

Table III-10 Stack Heights for the Pumpjacks at Oil Wells in the Baseline Case

Oil Well	Stack Height [m][a]
G-21	4.0
L-47	8.5
I-10	3.0
L-44	3.0
B-25	3.0
C-19	4.0
H-72	4.0
F-03	3.0
F-73	4.0
H-03	4.0
I-73	3.0
M-73	4.0
C-74	3.0
D-78	3.0
I-74	3.0
C-75	3.0
K-74	3.0
F-75	4.0

[a] A standard pumpjack stack height of 3 m was assumed. Stack heights associated with concentrations in excess of the NT standards were increased to comply with NT standards. Paramount is committed to retrofit any existing stacks to the heights listed above.

Table III-11 presents detailed emissions information for the test satellite sources at H-04 included in the Baseline Case assessment.

Table III-11 Equipment and Emission Assumptions for the Test Satellite at H-04 in the Baseline Case

Equipment at H-04			
Equipment	**Parameter**	**Value**	**Source of Data**
Line Heater	• maximum power output	• 0.648 MMBtu/hr	• Paramount design information
	• fuel source	• well gas	• H-03 fuel gas composition normalized to 1.5% H_2S (see table III-1)
	• fuel H_2S content	• 1.5%	• —
	• fuel consumption	• 721.6 m³/d	• assumed fuel efficiency of 70%
	• NO_X emissions	• 0.00115 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.0293 t/d	• based on fuel consumption and composition
	• stack height	• 9.0 m	• Paramount design information
	• stack diameter	• 0.5 m	• Paramount design information
	• exit velocity	• 0.8 m/s	• based on 10% excess air

Table III-11 Equipment and Emission Assumptions for the Test Satellite at H-04 in the Baseline Case (continued)

Equipment at H-04			
Equipment	**Parameter**	**Value**	**Source of Data**
Line Heater (continued)	• exhaust temperature	• 473 K	• assumed by Golder
	• GHG emissions (ECO_2)[(a)]	• 0.499 kt/yr	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
Chemical Dewaxing Tank	• air emissions	• not expected to be an emission source	• Paramount design information
5100 Texsteam Series Pump	• power source	• electric	• Paramount design information
	• fuel source	• NA	• —
	• gas flow	• NA	• —
	• air emissions	• not expected to be an emission source	• Paramount design information
Flare	• gas flow	• 140 m³/d	• Paramount design information
	• gas source	• well gas • H-03 group separator gas composition normalized to 2.5% H_2S	• see Table III-5
	• flare stack height	• 9.1 m	• Paramount design information
	• flare stack diameter	• 76.2 mm	• Paramount design information
	• NO_X emissions	• 0.000141 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.0093 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.115 kt/yr	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)

(a) Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

APPLICATION CASE

The sources included in the Baseline Case were unchanged in the assessment of the Application Case. The Tables III-12 through III-14 details information used to model the five wells included as part of the Cameron Hills Extension Project.

Table III-12 Gas Composition for the Cameron Hills Extension Gas Wells

Composition	Mole Percent [%]
H_2	0.01
He	0.08
N_2	1.60
CO_2	5.00
H_2S	2.00
C_1	88.73
C_2	1.32
C_3	0.69
IC_4	0.11
NC_4	0.25
IC_5	0.07
NC_5	0.07
C_6	0.06
$+C_7$	0.01

(a) Based on the gas analysis of a sample taken of the A-73 well gas July 3, 2003. The measured H_2S content of 1.5% was conservatively increased to 2% H_2S for this assessment and the composition was normalized accordingly.

Table III-13 Equipment and Emission Assumptions for Cameron Hills Extension Gas Wells

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Gas Wells	• well gas composition	• A-73 well gas normalized to 2% H_2S	• gas analysis (see Table III-12)
Line Heater	• maximum power output	• 0.50 MMBtu/hr	• Paramount design information
	• fuel source(a)	• propane for the G-48 well • well gas for all other wells	• Paramount design information • gas analysis (see Table III-12)
	• fuel H_2S content	• negligible for propane • 2% for well gas	• —
	• fuel consumption	• 555 m³/d	• assumed fuel efficiency of 70%
	• NO_X emissions	• 0.0009 t/d	• U.S. EPA emission factors (U.S.EPA 1995)

Table III-13 Equipment and Emission Assumptions for Cameron Hills Extension Gas Wells (continued)

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Line Heater (continued)	• SO_2 emissions	• negligible for the G-48 well • 0.03 t/d for all other wells	• based on fuel consumption and composition
	• stack height	• see Table III-14	• Paramount design information
	• stack diameter	• 0.152 m	• Paramount design information
	• exit velocity	• 6.67 m/s	• based on 10% excess air
	• exhaust temperature	• 473 K	• Paramount design information
	• GHG emissions (ECO_2)[b]	• 0.397 kt/yr for G-48 • 0.382 for all other wells	• for well gas fired heaters, fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S.EPA 1995) • for propane fired heaters, U.S. EPA emission factors (U.S.EPA 1995)
Thermo-electric generator	• maximum power output	• 54 Watts	• Paramount design information
	• fuel source	• propane	• Paramount design information
	• fuel H_2S content	• negligible	• —
	• fuel consumption	• 2.9 kg/d	• Paramount design information
	• NO_X emissions	• 0.000013 t/d	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• negligible	• —
	• stack height	• 2.5 m	• Paramount design information
	• stack diameter	• 0.076 m	• Paramount design information
	• exit velocity	• 0.4 m/s	• based on 30 % excess air and exhaust temperature
	• exhaust temperature	• 819 K	• Paramount design information
	• GHG emissions (ECO_2)[b]	• 0.003 kt/yr	• U.S. EPA emission factors (U.S.EPA 1995)
Building Heaters	• maximum power output	• 48,000 Btu/hr	• Paramount design information
	• fuel source	• propane	• Paramount design information
	• fuel H_2S content	• negligible	• —
	• fuel consumption	• 96,000 Btu/hr	• based on 50 % efficiency
	• NO_X emissions	• 0.000217 t/d	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• negligible	• —
	• stack height	• 3.5 m	• Paramount design information
	• stack diameter	• 3 inches	• Paramount design information
	• exit velocity	• 3.72 m/s	• based on 25% excess air
	• exhaust temperature	• 473 K	• assumption made by Golder
	• GHG emissions (ECO_2)[b]	• 0.053 kt/yr	• U.S. EPA emission factors (U.S.EPA 1995)

Table III-13 Equipment and Emission Assumptions for Cameron Hills Extension Gas Wells (continued)

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Methanol Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
2-5100 Texsteam Series Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• well gas	• A-73 well gas normalized to 2% H_2S (see Table III-12)
	• gas flow to each pump	• 71 m³/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information
1000 gallon corrosion Inhibitor tank	• air emissions	• not expected to be an emission source	• Paramount design information
50 barrel corrosion Inhibitor tank	• air emissions	• not expected to be an emission source	• Paramount design information
Three phase separator	• air emissions	• not expected to be an emission source	• Paramount design information
2-1000 gallon propane tanks	• air emissions	• not expected to be an emission source	• Paramount design information
Flare knockout drum	• air emissions	• not expected to be an emission source	• Paramount design information
Flare	• gas flow rate	• 156 m³/d	• gas flow from pneumatic pumps and the 500 scf/d from instruments
	• gas source	• well gas	• A-73 well gas normalized to 2% H_2S (see Table III-12)
	• flare stack height	• 12.2 m	• Paramount design information
	• flare stack diameter	• 0.102 m	• Paramount design information
	• NO_X emissions	• 0.000149 t/d	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• 0.0083 t/d	• fuel consumption and composition
	• GHG emissions (ECO_2)[b]	• 0.121 t/d	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)

[a] The line heater at G-48 was assumed to operate on propane to ensure that the predicted ground-level concentrations of SO_2 would comply with the NT standards. Paramount is committed to using sweet fuel at this well should it be drilled and deemed to be successful.

[b] Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

Table III-14 Stack Heights for the Line Heaters at Cameron Hills Extension Gas Wells

Gas Well	Stack Height [m][a]
F-38	19.0
P-57	9.0
L-46	9.0
N-36	15.0
G-48	6.1

[a] Stack heights required to ensure the predicted ground level concentrations will comply with the NT standards.

PLANNED DEVELOPMENT CASE

Tables III-15 through III-20 details the gas compositions included in the Planned Development Case assessment. Where available actual gas compositions based on sampling have been used.

Table III-15 Gas Composition of the Battery Fuel in the Planned Development Case

Composition	Mole Percent [%] [a]
H_2	0.00
He	0.00
N_2	2.00
CO_2	0.00
H_2S	0.00 (4 ppm)
C_1	96.00
C_2	1.00
C_3	1.00
IC_4	0.00
NC_4	0.00
IC_5	0.00
NC_5	0.00
C_6	0.00
$+C_7$	0.00

[a] Based on Paramount Design Information. Estimated sweet fuel composition from the amine sweetening unit.

Table III-16 Amine Flash Gas Composition from the Amine Unit in the Planned Development Case

Composition	Mole Percent [%] [a]
H_2	0.00
He	0.00
N_2	0.00
CO_2	40.00
H_2S	10.00
C_1	50.00
C_2	0.00
C_3	0.00
IC_4	0.00
NC_4	0.00
IC_5	0.00
NC_5	0.00
C_6	0.00
$+C_7$	0.00

[a] Based on Paramount Design Information

Table III-17 Oil and Water Tanks Vapour Composition in the Planned Development Case

Composition	Mole Percent [%] [(a)]
H_2	0.00
He	0.00
N_2	2.00
CO_2	0.00
H_2S	0.00
C_1	96.00
C_2	1.00
C_3	1.00
IC_4	0.00
NC_4	0.00
IC_5	0.00
NC_5	0.00
C_6	0.00
$+C_7$	0.00

(a) Sweetened Battery fuel is used as blanket gas in the tanks

Table III-18 Gas Composition for Gas Wells N-28, C-50, H-58, A-73 and A-05 in the Planned Development Case

Composition	Mole Percent [%] [(a)]				
	N-28	C-50	H-58	A-73	A-05
H_2	0.27	0.26	0.00	0.01	0.10
He	0.07	0.07	0.07	0.08	0.08
N_2	1.69	1.50	5.06	1.61	2.06
CO_2	5.18	5.41	5.17	5.03	2.33
H_2S	1.36	1.50	1.36	1.50	1.23
C_1	88.64	88.41	85.61	89.18	91.30
C_2	1.48	1.51	1.44	1.33	1.52
C_3	0.72	0.72	0.69	0.69	0.74
IC_4	0.11	0.11	0.11	0.11	0.11
NC_4	0.21	0.24	0.25	0.25	0.23
IC_5	0.06	0.07	0.07	0.07	0.07
NC_5	0.06	0.07	0.07	0.07	0.07
C_6	0.05	0.06	0.06	0.06	0.07
$+C_7$	0.10	0.07	0.04	0.01	0.09

(a) From gas analysis of samples taken July 3, 2003.

Table III-19 Gas Composition for All Other Proposed and Existing Gas Wells Operating on Well Gas in the Planned Development Case

Composition	Mole Percent [%] [a]
H_2	0.01
He	0.08
N_2	1.60
CO_2	5.00
H_2S	2.00
C_1	88.73
C_2	1.32
C_3	0.69
IC_4	0.11
NC_4	0.25
IC_5	0.07
NC_5	0.07
C_6	0.06
$+C_7$	0.01

[a] Based on the gas analysis of a sample taken of the A-73 well gas July 3, 2003. The measured H_2S content of 1.5% was conservatively increased to 2% H_2S for this assessment and the composition was normalized accordingly.

Table III-20 Gas Composition for Proposed and Existing Oil Wells Operating on Casing Gas in the Planned Development Case

Composition	Mole Percent [%] [a]
H_2	0.01
He	0.07
N_2	1.48
CO_2	4.85
H_2S	2.50
C_1	85.87
C_2	2.01
C_3	1.40
IC_4	0.30
NC_4	0.68
IC_5	0.23
NC_5	0.23
C_6	0.20
$+C_7$	0.17

[a] Based on the gas analysis of a sample taken from the H-03 group separator July 3, 2003. The measured H_2S content of 2.04% was conservatively increased to 2.5% H_2S for this assessment and the composition was normalized accordingly.

Table III-21 Gas Composition for the Line Heaters at the Satellites in the Planned Development Case

Composition	Mole Percent [%][(a)]
H_2	0.15
He	0.07
N_2	1.59
CO_2	5.47
H_2S	1.50
C_1	88.62
C_2	1.38
C_3	0.69
IC_4	0.11
NC_4	0.24
IC_5	0.07
nC_5	0.06
C_6	0.06
$+C_7$	0.00

(a) Based on the gas analysis of a sample taken of the H-03 fuel gas July 3, 2003. The measured H_2S content of 1.23% was conservatively increased to 1.5% H_2S for this assessment and the composition was normalized accordingly.

Table III-22 details the sources at the central battery included in the Planned Development Case assessment. For the purposes of this assessment, the Planned Development Case emissions are the emissions that would result from the full capacities of these sources.

Table III-22 Equipment and Emission Assumptions for the Central Battery in the Planned Development Case

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
5100 Texsteam Series Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• battery fuel gas	• see Table III-15
	• gas flow	• 71 m³/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information

Table III-22 Equipment and Emission Assumptions for the Central Battery in the Planned Development Case (continued)

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
5100 Texsteam Series Pump (continued)	• gas flow	• 771 m³/d	• Paramount design information
Low Pressure Flare	• fuel source	• 71 m³/d of fuel gas from the pneumatic pump (4 ppmv H_2S) • 500 m³/d and 100 m³/d vented gases from the oil tanks and water tanks respectively (4 ppmv H_2S) • 100 m³/d from the amine flash tank (10% H_2S)	• Paramount design information • see Tables III-15, III-16 and III-17
	• flare stack height	• 15.0 m	• Paramount design information
	• flare stack diameter	• 0.203 m	• Paramount design information
	• NO_X emissions	• 0.0007 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.0265 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.600 kt/yr	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)
Heat Medium Heater	• maximum power output	• 0.25 MMBtu/hr	• Paramount design information
	• fuel source	• battery fuel gas	• see Table III-15
	• fuel consumption	• 260.7 m³/d	• assumed fuel efficiency of 70%
	• fuel H_2S content	• 4 ppmv H_2S	• Paramount design information
	• NO_X emissions	• 0.0004 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.0000 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.184 kt/yr	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
	• stack height	• 4.6 m	• Paramount design information
	• stack diameter	• 0.4 m	• Paramount design information
	• exit velocity	• 0.48 m/s	• based on 10 % excess air and exhaust temperature
	• exit temperature	• 473 K	• Paramount design information
Waste Incinerator	• duty rating	• 0.5 MMBtu/hr	• Paramount design information
	• fuel source	• diesel fuel	• Paramount design information
	• fuel consumption	• intermittent source not evaluated	• —
	• air emission	• intermittent source not evaluated	• —
Inlet Header Skid	• air emissions	• not an emission source	• Paramount design information
Fuel Gas Scrubber	• air emissions	• not an emission source	• Paramount design information

Table III-22 Equipment and Emission Assumptions for the Central Battery in the Planned Development Case (continued)

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
3 – Oil Storage Tank	• air emissions	• 500 m^3/d of vapours captured and sent to the flare	• see Table III-17
Corrosion Inhibitor Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
3 – Water Storage Tanks	• air emissions	• 100 m^3/d vapour captured and sent to the flare	• see Table III-17
3 – Water Tank Heaters	• maximum power output	• 0.15 MMBtu/hr	• Paramount design information
	• fuel source	• battery fuel gas	• see Table III-15
	• fuel consumption	• 156.4 m^3/d	• assumed fuel efficiency of 70%
	• fuel H_2S content	• 4 ppmv H_2S	• see Table III 15
	• NO_X emissions	• 0.00025 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.00000 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.111 kt/yr	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
	• stack height	• 11.0 m	• Paramount design information
	• stack diameter	• 0.15 m	• Paramount design information
	• exit velocity	• 2.1 m/s	• based on 10% excess air
	• exit temperature	• 473 K	• same as heat medium heater
Waste Oil Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
Lube Oil Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
4 – Methanol Storage Tanks	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
2 – Flare Knock-Out Drums	• Air emissions	• no air emission	• Paramount design information
	• maximum power output	• 200 KW	• Paramount design information
Turbine (Emergency only)	• fuel source	• intermittent not evaluated	• —
	• fuel consumption	• intermittent, not evaluated	• —
	• fuel H_2S content	• intermittent, not evaluated	• —

Table III-22 Equipment and Emission Assumptions for the Central Battery in the Planned Development Case (continued)

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
Turbine (Emergency only) (continued)	• NO_X emissions	• Intermittent, not evaluated	• —
	• SO_2 emissions	• Intermittent, not evaluated	• —
	• GHG emissions (ECO_2)[(a)]	• Intermittent, not evaluated	• —
	• stack height	• 12.5 m	• Paramount design information
	• stack diameter	• 0.3 m	• Paramount design information
	• exit velocity	• Intermittent, not evaluated	• —
	• exit temperature	• Intermittent, not evaluated	• —
Amine reboiler	• maximum power output	• 0.9 MMBtu/hr	• Paramount design information
	• fuel source	• battery fuel gas	• see Table III-15
	• fuel consumption	• 938.4 m^3/d	• assumed fuel efficiency of 70%
	• fuel H_2S content	• 4 ppmv H_2S	• see Table III-15
	• NO_X emissions	• 0.0015 t/d	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• 0.00001 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.663 kt/yr	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S.EPA 1995)
	• Stack height	• 6.1 m	• Paramount design information
	• stack diameter	• 0.25 m	• Paramount design information
	• exit velocity	• 4.04 m/s	• based on 10% excess air
	• exit temperature	• 473 K	• assumed by Golder
Treater Unit	• maximum power output	• 1.6 MMBtu/hr	• Paramount design information
	• fuel source	• battery fuel gas	• Paramount design information
	• fuel consumption	• 1668.3 m^3/d	• assumed fuel efficiency of 70%
	• fuel H_2S content	• 4 ppmv H_2S	• see Table III-15
	• NO_X emissions	• 0.0027 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.000018	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 1.179 kt/yr	• fuel consumption and composition for CO_2 emission and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
	• stack height	• 4.88 m	• Paramount design information
	• stack diameter	• 0.61 m	• Paramount design information
	• exit velocity	• 3.33 m/s	• based on firetube capacity of 4 MMBtu/hr , actual stack diameter of 24" and 10% excess air
	• exit temperature	• 473 K	• Paramount design information
2 – Compressors	• maximum power output	• 634 hp	• Paramount design information
	• fuel source	• battery fuel gas	• see Table III-15
	• fuel consumption	• 3701.9 m^3/d	• manufacturer's specifications

Table III-22 Equipment and Emission Assumptions for the Central Battery in the Planned Development Case (continued)

Equipment and Emissions at the Central Battery			
Equipment	**Parameter**	**Value**	**Source of Data**
2 – Compressors (continued)	• fuel H_2S content	• 4 ppmv H_2S	• see Table III-15
	• NO_X emissions • SO_2 emissions	• 0.13 t/d • 0.00004 t/d	• manufacturer's specifications • based on fuel consumption and composition
	• GHG emissions (ECO_2)[a]	• 3.151 kt/yr	• U.S. EPA emission factors for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (U.S. EPA 1995; CAPP 2003)
	• stack height	• 18.29 m	• Paramount design information
	• stack diameter	• 0.46 m	• Paramount design information
	• exit velocity	• 12.27 m/s	• manufacturer's specifications
	• exit temperature	• 514 K	• manufacturer's specifications
Generator	• maximum power output	• 650 KW	• manufacturer's specifications
	• fuel source	• battery fuel gas	• see Table III-15
	• fuel consumption	• 5207.6 m^3/d	• manufacturer's specifications
	• fuel H_2S content	• 4 ppmv H_2S	• Paramount design information
	• NO_X emissions	• 0.059 t/d	• manufacturer's specifications
	• SO_2 emissions	• 0.0001 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[a]	• 3.570 kt/yr	• U.S. EPA emission factors for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (U.S. EPA 1995; CAPP 2003)
	• stack height	• 6.25m	• manufacturer's specifications
	• stack diameter	• 0.305 m	• manufacturer's specifications
	• exit velocity	• 26.39 m/s	• manufacturer's specifications
	• exit temperature	• 891.15 K	• manufacturer's specifications

(a) Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

Table III-23 presents detailed emissions information for the gas wells included in the Planned Development Case assessment. Table III-24 presents the assumed stack heights for the line heaters associated with the gas wells discussed in Table III-23.

Table III-23 Equipment and Emission Assumptions for Gas Wells in the Planned Development Case

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Gas Wells	• well gas composition	• the gas compositions at the gas wells N-28, C-50, H-58, A-73, A-05 based on gas analysis • for all other gas wells a normalized A-73 gas composition will be used with 2% H_2S	• see Tables III-18 and III-19
Line Heater	• maximum power output	• 0.50 MMBtu/hr	• Paramount design information
	• fuel source	• propane for the G-48 well • sweet gas at H-17 • well gas for all other wells	• see Tables III-18 and III-19
	• fuel H_2S content	• G-48: negligible H-17: negligible N-28: 1.36%, C-50: 1.5%, H-58: 1.36%, A-73: 1.5% and A-05: 1.23% • 2% for all other gas wells	• Paramount design information • see Table III-18 and III-19
	• fuel consumption	• N-28: 553.6 m³/d, C-50: 553.9 m³/d, H-58: 573.6 m³/d, A-73: 554.0 m³/d and A-05: 537.8 m³/d • 554.8 m³/d for all other gas wells	• assumed fuel efficiency of 70%
	• NO_X emissions	• G-48: 0.0016 t/d • 0.0009 t/d for all other wells	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• G-48: negligible H-17: negligible N-28: 0.020 t/d, C-50: 0.022 t/d, H-58: 0.021 t/, A-73: 0.022 t/d and A-05: 0.018 t/d • 0.030 t/d for all other gas wells	• based on fuel consumption and composition
	• stack height	• see Table III-24	• Paramount design information
	• stack diameter	• 0.152 m	• Paramount design information
	• exit velocity	• N-28: 6.65 m/s, C-50: 6.66 m/s, H-58: 6.89 m/s, A-73: 6.66 m/s and A-05: 6.46 m/s • 6.67 m/s all other gas wells	• based on 10% excess air
	• exhaust temperature	• 473 K	• Paramount design information

Table I-23 Equipment and Emission Assumptions for Gas Wells in the Planned Development Case (continued)

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Line Heater (continued)	• GHG emissions (ECO_2)[(a)]	• G-48: 0.397 kt/yr N-28: 0.385 kt/yr, C-50: 0.385 kt/yr, H-58: 0.386 kt/yr, A-73: 0.384 kt/yr and A-05: 0.374 kt/yr • 0.382 kt/yr for all other gas wells	• for propane fueled heater, U.S. EPA emission factors (U.S EPA 1995) • for well gas fired heaters, fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S EPA 1995)
Thermo-electric generator	• maximum power output	• 54 Watts	• Paramount design information
	• fuel source	• propane	• Paramount design information
	• fuel H_2S content	• negligible	• —
	• fuel consumption	• 2.9 kg/d	• Paramount design information
	• NO_X emissions	• 0.000013 t/d	• U.S. EPA emission factors (U.S EPA 1995)
	• SO_2 emissions	• negligible	• —
	• stack height	• 2.5 m	• Paramount design information
	• stack diameter	• 76 mm	• Paramount design information
	• exit velocity	• 0.4 m/s	• based on 30 % excess air and exhaust temperature
	• exhaust temperature	• 819 K	• Paramount design information
	• GHG emissions (ECO_2)[(a)]	• 0.003 kt/yr	• U.S. EPA emission factors (U.S EPA 1995)
Building Heaters	• maximum power output	• 48,000 Btu/hr	• Paramount design information
	• fuel source	• propane	• Paramount design information
	• fuel H_2S content	• negligible	• —
	• fuel consumption	• 96,000 Btu/hr	• based on 50 % efficiency
	• NO_X emissions	• 0.000217 t/d	• U.S. EPA emission factors (U.S EPA 1995)
	• SO_2 emissions	• negligible	• —
	• stack height	• 3.5 m	• Paramount design information
	• stack diameter	• 76 mm	• Paramount design information
	• exit velocity	• 3.72 m/s	• based on 25% excess air
	• exhaust temperature	• 473 K	• assumption made by Golder
	• GHG emissions (ECO_2)[(a)]	• 0.053 kt/yr	• U.S. EPA emission factors (U.S EPA 1995)
Methanol Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
2-5100 Texsteam Series Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• well gas	• see Tables III-18 and III-19
	• gas flow to each pump	• 71 m^3/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information
1000 gallon corrosion Inhibitor tank	• air emissions	• not expected to be an emission source	• Paramount design information
50 barrel corrosion Inhibitor tank	• air emissions	• not expected to be an emission source	• Paramount design information

Table I-23 Equipment and Emission Assumptions for Gas Wells in the Planned Development Case (continued)

Equipment at Gas Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Three phase separator	• air emissions	• not expected to be an emission source	• Paramount design information
2-1000 gallon propane tanks	• air emissions	• not expected to be an emission source	• Paramount design information
Flare knockout drum	• air emissions	• not expected to be an emission source	• Paramount design information
Flare	• gas flow rate	• 156 m³/d	• gas flow from pneumatic pumps and 500 scf/d from instruments
	• gas source	• well gas	• see Tables III-18 and III-19
	• flare stack height	• 12.2 m (40 ft)	• Paramount design information
	• flare stack diameter	• 0.102 m (4 inches)	• Paramount design information
	• NO_X emissions	• N-28: 0.000149 t/d, C-50: 0.000149 t/d, H-58: 0.000144 t/d, A-73: 0.000149 t/d, A-05: 0.000153 t/d • 0.000149 t/d for all other gas wells	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• N-28: 0.00563 t/d, C-50: 0.00621 t/d, H-58: 0.00563 t/d, A-73: 0.00621 t/d, A-05: 0.00509 t/d • 0.00828 t/d for all other gas wells	• based on gas consumption and composition
	• GHG emissions (ECO_2)[(a)]	• N-28: 0.122 kt/yr, C-50: 0.122 kt/yr, H-58: 0.118 kt/yr, A-73: 0.121 kt/yr, A-05: 0.122 kt/yr • 0.121 t/d for all other gas wells	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)

(a) Expressed as tonnes of equivalent CO2 (includes methane and nitrous oxide).

Table III-24 Stack Heights for the Line Heaters at Gas Wells in the Planned Development Case

Gas Well	Stack Heights used in SO_2 Modelling [m]	Stack Heights used in NO_X Modelling [m]
A-73	6.1	6.1
C-50	9.0	9.0
M-49	12.0	12.0
H-58	6.1	6.1
D-49	9.0	9.0
J-37	18.0	18.0
N-28	12.0	12.0
J-62	12.0	12.0
I-16	16.0	16.0

Table I-24 Stack Heights for the Line Heaters at Gas Wells in the Planned Development Case (continued)

Gas Well	Stack Heights used in SO_2 Modelling [m]	Stack Heights used in NO_X Modelling [m]
A-05	9.0	9.0
A-68	12.0	12.0
B-08	18.1	16.0
F-34	9.0	9.0
C-33	15.0	15.0
F-38	19.0	19.0
P-57	9.0	9.0
L-46	9.0	9.0
N-36	15.0	15.0
G-48	6.1	6.1
H-04	15.0	6.1
G-18	18.0	6.1
E-22	18.0	6.1
H-26	15.0	6.1
M-72	15.0	6.1
B-72	15.0	6.1
E-67	12.0	6.1
J-79	12.0	6.1
E-68	12.0	6.1
A-10	6.1	6.1
K-09	6.1	6.1
A-19	12.0	6.1
K-08	6.1	6.1
I-08	6.1	6.1
H-17	6.1	6.1
M-07	6.1	6.1
D-06	18.0	6.1
A-06	15.0	6.1
H-05	15.0	6.1
I-75	18.0	6.1
A-04	15.0	6.1

[a] A standard line heater stack height of 6.1 m was assumed. Stack heights associated with concentrations in excess of the NT standards were increased to comply with NT standards. Paramount is committed to retrofit any existing stacks or build any future stacks to the heights listed above.

Table III-25 presents detailed emissions information for the oil wells included in the Planned Development Case assessment. Table III-26 presents the assumed stack heights for the pumpjacks associated with the oil wells discussed in Table III-25.

Table III-25 Equipment and Emission Assumptions for Oil Wells in the Planned Development Case

Equipment at Oil Wells			
Equipment	**Parameter**	**Value**	**Source of Data**
Pumpjack (gas engine)	• maximum power output	• 24.5 hp	• manufacturer's specifications
	• fuel source	• sweet fuel at D-78, L-39, O-27, L-17, N-16 and F-77 • H-03 group separator gas normalized to 2.5% H_2S for all other wells	• Paramount design information • H-03 group separator gas normalized to 2.5% H_2S (see Table III-20)
	• fuel consumption	• 7700 btu/hp-hr (139 m³/d)	• manufacturer's specifications
	• fuel H_2S content	• 2.50%	• Paramount design information
	• NO_X emissions	• 0.000615 t/d	• manufacturer's specifications
	• SO_2 emissions	• 0.0094 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.118 kt/yr	• U.S. EPA emission factors for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (U.S. EPA 1995; CAPP 2003)
	• stack height	• see Table III-26	• Paramount design information
	• stack diameter	• 0.051 m	• Paramount design information
	• exit velocity	• 25.11 m/s	• based on exit temperature, 6% excess air (from manufacturer's data) and 2 inch diameter stack
	• exhaust temperature	• 823.15 K	• Paramount design information
Chemical Dewaxing Tank	• air emissions	• not expected to be an emission source	• Paramount design information
Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• well gas	• Paramount design information
	• gas flow	• 71 m³/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information
Flare	• gas flow	• 71 m³/d	• gas flow from pneumatic pumps
	• gas source	• H-03 group separator gas normalized to 2.5% H_2S	• see Table III-20
	• flare stack height[(b)]	• A-28: 12.2 m • 9.1 m at all other wells	• Paramount design information
	• flare stack diameter	• 76.2 mm	• Paramount design information
	• NO_X emissions	• 0.00007 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.0047 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.058 kt/yr	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)

(a) Expressed as tonnes of equivalent CO2 (includes methane and nitrous oxide).

(b) A standard flare stack height of 9.1 m was assumed. The stack heights associated with concentrations in excess of the NT standards was increased to comply with NT standards. Paramount is committed to build any future stacks to the heights listed above.

Table III-26 Stack Heights for the Pumpjacks at Oil Wells in the Planned Development Case

Oil Well	Stack Heights used in SO_2 Modelling [m]	Stack Heights used in NO_X Modelling [m]
G-21	4.0	4.0
L-47	8.5	8.5
I-10	3.0	3.0
L-44	3.0	3.0
B-25	3.0	3.0
C-19	4.0	4.0
H-72	4.0	4.0
F-03	3.0	3.0
F-73	4.0	4.0
H-03	4.0	4.0
I-73	3.0	3.0
M-73	4.0	4.0
C-74	3.0	3.0
D-78	3.0	3.0
I-74	4.0	4.0
C-75	3.0	3.0
K-74	3.0	3.0
F-75	4.0	4.0
E-19	6.0	3.0
K-16	6.0	3.0
D-20	6.0	3.0
C-20	3.0	3.0
P-29	6.0	3.0
M-19	6.0	3.0
O-19	3.0	3.0
L-39	3.0	3.0
K-19	6.0	3.0
A-29	6.0	3.0
I-28	6.0	3.0
A-28	3.0	3.0
O-27	3.0	3.0
L-17	3.0	3.0
E-17	6.0	3.0
M-77	7.0	3.0
N-16	3.0	3.0
C-16	6.0	3.0
F-25	6.0	3.0
L-15	6.0	3.0
P-15	4.0	3.0

Table I-26 Stack Heights for the Pumpjacks at Oil Wells in the Planned Development Case

Oil Well	Stack Heights used in SO_2 Modelling [m]	Stack Heights used in NO_X Modelling [m]
L-05	3.0	3.0
F-76	6.0	3.0
F-77	3.0	3.0
M-78	6.0	3.0

[(a)] A standard pumpjack stack height of 3 m was assumed. Stack heights associated with concentrations in excess of the NT standards were increased to comply with NT standards. Paramount is committed to retrofit any existing stacks or build any future stacks to the heights listed above.

Table III-27 presents detailed emissions information for the test satellites and oil wells located at K-16 and E-19 that were included in the Planned Development Case assessment.

Table III-27 Equipment and Emission Assumptions for the Test Satellites and the Oil Wells at E-19 and K-16 in the Planned Development Case

Equipment at E-19 and K-16			
Equipment	**Parameter**	**Value**	**Source of Data**
Satellite Line Heater	• maximum power output	• 0.648 MMBtu/hr	• based on fuel consumption and an assumed fuel efficiency of 70%
	• fuel source	• fuel gas	• H-03 fuel gas composition normalized to 1.5% H_2S (see Table III-21)
	• fuel H_2S content	• 1.5%	• see Table III-21
	• fuel consumption	• 721.6 m³/d	• Paramount design information
	• NO_X emissions	• 0.00115 t/d	• U.S. EPA emission factors (U.S.EPA 1995)
	• SO_2 emissions	• 0.0293 t/d	• based on fuel consumption and composition
	• stack height	• 18 m	• Paramount design information
	• stack diameter	• 0.5 m	• Paramount design information
	• exit velocity	• 0.8 m/s	• based on 10% excess air
	• exhaust temperature	• 473 K	• assumed to be the same as line heaters at gas wells
	• GHG emissions (ECO_2)[(a)]	• 0.499 kt/yr	• fuel consumption and composition for CO_2 emissions, and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
Chemical Dewaxing Tank	• air emissions	• not expected to be an emission source	• Paramount design information
5100 Texsteam Series Pump	• power source	• electric	• Paramount design information
	• fuel source	• NA	• —
	• gas flow	• NA	• —
	• air emissions	• not expected to be an emission source	• Paramount design information

Table I-27 Equipment and Emission Assumptions for the Test Satellites and the Oil Wells at E-19 and K-16 in the Planned Development Case (continued)

Equipment at E-19 and K-16			
Equipment	**Parameter**	**Value**	**Source of Data**
Flare	• gas flow	• 140 m³/d of gas flow from pilot/purge • 71 m³/d of gas flow from pneumatic pumps	• Paramount design information
Flare (continued)	• gas source	• H-03 group separator gas normalized to 2.5% H_2S	• see Table III-20
	• flare stack height	• 9.1 m	• Paramount design information
	• flare stack diameter	• 76 mm	• Paramount design information
	• NO_X emissions	• 0.00021 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.014 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.174	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)
Chemical Dewaxing Tank	• air emissions	• not expected to be an emission source	• project description
Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• H-03 group separator gas normalized to 2.5% H_2S	• see Table III-20
	• gas flow	• 71 m³/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information
Pumpjack (gas engine)	• maximum power output	• 24.5 hp	• manufacturer's specification
	• fuel source	• H-03 group separator gas normalized to 2.5% H_2S	• see Table III-20
	• fuel consumption	• 7700 btu/hp-hr (139 m³/d)	• manufacturer's specification
	• fuel H_2S content	• 2.50%	• see Table III-20
	• NO_X emissions	• 0.000615 t/d	• manufacturer's specifications
	• SO_2 emissions	• 0.0094 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.118	• U.S. EPA emission factors for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (U.S. EPA 1995; CAPP 2003)
	• stack height	• see Table III-26	• —
	• stack diameter	• 0.051 m	• Paramount design information
	• exit velocity	• 25.11 m/s	• based on exit temperature, 6% excess air (from manufacturer's data) and 2 inch diameter stack
	• exhaust temperature	• 823.15 K	• Paramount design information

Table I-27 Equipment and Emission Assumptions for the Test Satellites and the Oil Wells at E-19 and K-16 in the Planned Development Case (continued)

Equipment at E-19 and K-16			
Equipment	**Parameter**	**Value**	**Source of Data**

(a) Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

Table III-28 presents detailed emissions information for the test satellite located at I-06 that was included in the Planned Development Case assessment.

Table III-28 Equipment and Emission Assumptions for the Test Satellite I-O6 in the Planned Development Case

Equipment at I-06			
Equipment	**Parameter**	**Value**	**Source of Data**
Satellite Line Heater	• maximum power output	• 0.648 MMBtu/hr	• based on fuel consumption and an assumed fuel efficiency of 70%
	• fuel source	• fuel gas	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-21)
	• fuel H_2S content	• 1.5%	• see Table III-21
	• fuel consumption	• 721.6 m³/d	• Paramount design information
	• NO_X emissions	• 0.00115 t/d	• U.S. EPA emission factors (U.S. EPA)
	• SO_2 emissions	• 0.0293 t/d	• based on fuel c onsumption and composition
	• stack height	• 18 m	• Paramount design information
	• stack diameter	• 0.5 m	• Paramount design information
	• exit velocity	• 0.8 m/s	• based on 10% excess air
	• exhaust temperature	• 473 K	• assumed to be the same as line heaters at gas wells
	• GHG emissions (ECO_2)[(a)]	• 0.499	• fuel consumption and composition for CO_2 emission and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA)
Chemical Dewaxing Tank	• air emissions	• not expected to be an emission source	• Paramount design information
5100 Texsteam Series Pump	• power source	• electric	• Paramount design information
	• fuel source	• NA	• —
	• gas flow	• NA	• —
	• air emissions	• not expected to be an emission source	• Paramount design information
Flare	• gas flow	• 140 m³/d of gas flow from pilot/purge	• Paramount design information
	• gas source	• H-03 group separator gas composition normalized to 2.5% H_2S	• see Table III-20
	• flare stack height	• 9.1 m	• Paramount design information
	• flare stack diameter	• 76 mm	• Paramount design information
	• NO_X emissions	• 0.000141 t/d	• U.S. EPA emission factors (U.S EPA 1995)
	• SO_2 emissions	• 0.0093 t/d	• based on fuel consumption and composition
	• GHG emissions (ECO_2)[(a)]	• 0.115	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)

(a) Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

Table III-29 presents detailed emissions information for the test satellites and gas wells located at H-04, B-08 and G-18 that were included in the Planned Development Case assessment.

Table III-29 Equipment and Emission Assumptions for the Test Satellites and the Gas Wells at H-04, B-08 and G-18 in the Planned Development Case

Equipment at the Test Satellites and Gas Wells Located at H-04, B-08 and G-18			
Equipment	**Parameter**	**Value**	**Source of Data**
Satellite Line Heater	• maximum power output	• 0.648 MMBtu/hr	• based on fuel consumption and an assumed fuel efficiency of 70%
	• fuel source	• fuel gas	• H-03 fuel gas normalized to 1.5% H_2S (see Table III-21)
	• fuel H_2S content	• 1.5%	• see Table III-21
	• fuel consumption	• 721.6 m³/d	• Paramount design information
	• NO_X emissions	• 0.00115 t/d	• U.S. EPA emission factors (U.S. EPA)
	• SO_2 emissions	• 0.0293 t/d	• based on fuel consumption and composition
	• stack height	• H-04: 9.0 m • B-08: 18.0 m • G-18: 18.0 m	• Paramount design information
	• stack diameter	• 0.5 m	• Paramount design information
	• exit velocity	• 0.8 m/s	• based on 10% excess air
	• exhaust temperature	• 473 K	• assumed to be the same as line heaters at gas wells
	• GHG emissions (ECO_2)[(a)]	• 0.499	• fuel consumption and composition for CO_2 emissions and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
Chemical Dewaxing Tank	• air emissions	• not expected to be an emission source	• Paramount design information
5100 Texsteam Series Pump	• power source	• electric	• Paramount design information
	• fuel source	• NA	• —
	• gas flow	• NA	• —
	• air emissions	• not expected to be an emission source	• Paramount design information
Flare	• gas flow	• 140 m³/d from pilot/purge (well gas) • 156 m³/d from pneumatic pumps and the 500 scf/d from instruments (well gas)	• Paramount design information (see Table III-19)
	• gas source	• well gas	• A-73 gas composition normalized to 2% H_2S (see Table III-19)
	• flare stack height	• 12.2 m	• Paramount design information
	• flare stack diameter	• 0.102 m	• Paramount design information
	• NO_X emissions	• 0.000289 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.0176 t/d	• based on fuel consumption and composition

Table I-29 Equipment and Emission Assumptions for the Test Satellites and the Gas Wells at H-04, B-08 and G-18 (continued)

Equipment at the Test Satellites and Gas Wells Located at H-04, B-08 and G-18			
Equipment	**Parameter**	**Value**	**Source of Data**
Flare (continued)	• GHG emissions (ECO_2)[(a)]	• 0.236 kt/yr	• fuel consumption and composition for CO_2 and CH_4 emissions and CAPP emission factor for N_2O emission (CAPP 2003)
Thermo-electric generator	• maximum power output	• 54 Watts	• Paramount design information
	• fuel source	• propane	• Paramount design information
	• fuel H_2S content	• negligible	• —
	• fuel consumption	• 2.9 kg/d	• Paramount design information
	• NO_X emissions	• 0.000013 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• negligible	• —
	• stack height	• 2.5 m	• Paramount design information
	• stack diameter	• 76 mm	• Paramount design information
	• exit velocity	• 0.4 m/s	• based on 30 % excess air and exhaust temperature
	• exhaust temperature	• 819 K	• Paramount design information
	• GHG emissions (ECO_2)[(a)]	• 0.003 kt/yr	• U.S. EPA emission factors (U.S. EPA 1995)
Gas Well Line Heater	• maximum power output	• 0.50 MMBtu/hr	• Paramount design information
	• fuel source	• well gas	• A-73 gas composition normalized to 2% H_2S (see Table III-19)
	• fuel H_2S content	• 2%	• —
	• fuel consumption	• 555 m³/d	• assumed fuel efficiency of 70%
	• NO_X emissions	• 0.0009 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• 0.03 t/d	• Paramount design information
	• stack height	• see Table III-24	• —
	• stack diameter	• 0.152 m	• Paramount design information
	• exit velocity	• 6.67 m/s	• based on 10% excess air
	• exhaust temperature	• 473 K	• Paramount design information
	• GHG emissions (ECO_2)[(a)]	• 0.382 kt/yr	• fuel consumption and composition for CO_2 emission and U.S. EPA emission factors for CH_4 and N_2O emissions (U.S. EPA 1995)
Building Heaters	• maximum power output	• 48,000 Btu/hr	• Paramount design information
	• fuel source	• propane	• Paramount design information
	• fuel H_2S content	• negligible	• —
	• fuel consumption	• 96,000 Btu/hr	• based on 50 % efficiency
	• NO_X emissions	• 0.000217 t/d	• U.S. EPA emission factors (U.S. EPA 1995)
	• SO_2 emissions	• negligible	• —
	• stack height	• 3.5 m	• Paramount design information
	• stack diameter	• 76 mm	• Paramount design information
	• exit velocity	• 3.72 m/s	• based on 25% excess air
	• exhaust temperature	• 473 K	• assumption made by Golder
	• GHG emissions (ECO_2)[(a)]	• 0.053 kt/yr	• U.S. EPA emission factors (U.S. EPA 1995)

Table I-29 Equipment and Emission Assumptions for the Test Satellites and the Gas Wells at H-04, B-08 and G-18 (continued)

Equipment at the Test Satellites and Gas Wells Located at H-04, B-08 and G-18			
Equipment	**Parameter**	**Value**	**Source of Data**
Methanol Tank	• air emissions	• vented to atmosphere • not expected to be a significant emission source	• Paramount design information
2-5100 Texsteam Series Pump	• power source	• pneumatic	• Paramount design information
	• fuel source	• well gas	• A-73 gas composition normalized to 2% H_2S (see Table III-19)
	• gas flow to each pump	• 71 m³/d	• Paramount design information
	• air emissions	• captured and flared	• Paramount design information
1000 gallon corrosion Inhibitor tank	• air emissions	• not expected to be an emission source	• Paramount design information
50 barrel corrosion Inhibitor tank	• air emissions	• not expected to be an emission source	• Paramount design information
Three phase separator	• air emissions	• not expected to be an emission source	• Paramount design information
2-1000 gallon propane tanks	• air emissions	• not expected to be an emission source	• Paramount design information
Flare knockout drum	• air emissions	• not expected to be an emission source	• Paramount design information

(a) Expressed as tonnes of equivalent CO_2 (includes methane and nitrous oxide).

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APPENDIX IV

WELL TESTING ASSESSMENT

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INTRODUCTION

Paramount is planning to drill, complete and test gas and oil wells throughout the life of the Cameron Hills Extension Project. This appendix provides the results of a cumulative air quality assessment of SO_2 concentrations resulting from well tests at the Cameron Hills development.

Paramount does not plan to test more than two gas wells and one oil well concurrently. Therefore, one future oil well (N-16) and two future gas wells (H-04 and A-04) were selected for inclusion in the well test flaring assessment. The future oil well N-16 was chosen as it is inside the valley system which may result in elevated ground-level SO_2 predictions. The gas wells H-04 and A-04 were selected because of their close proximity to each other and to the central battery, which could potentially result in elevated cumulative concentrations.

To assess the cumulative effects of the potential future well tests scenario, SO_2 concentrations were predicted by modelling the cumulative emissions from testing of the oil well N-16 and the gas wells H-04 and A-04 concurrently in combination with the Application Case sources detailed in Section 7.2.5 of the EIA.

COMPOSITION OF FLARED GASES

One of the most important factors affecting the emissions during the planned well tests is the composition of the flared gas. Table IV-1 provides the expected gas composition for both oil and gas wells. The oil well gas composition is based on the H-03 group separator gas analysis. The measured H_2S content of 2.04% was conservatively increased to 2.5% H_2S for this assessment, and the composition was normalized accordingly. The composition of gas used for testing gas wells is based on a sample taken of the A-73 well gas on July 3, 2003. The measured H_2S content of 1.5% was conservatively increased to 2% H_2S for this assessment and the composition was normalized accordingly. As shown in Table IV-1, there are no heavy hydrocarbons or hydrocarbon liquids. Therefore, the flaring of these gases should occur with a high degree of efficiency (Strosher 1996) and should not result in emissions of incomplete combustion products.

Table IV-1 Flared Gas Composition for Oil and Gas Wells Tests

Compound	Oil Wells Mole Percent [%][(a)]	Gas Wells Mole Percent [%][(b)]
H_2	0.01	0.01
He	0.07	0.08
N_2	1.48	1.60
CO_2	4.85	5.00
H_2S	2.50	2.00
C_1	85.87	88.73
C_2	2.01	1.32
C_3	1.40	0.69
iC_4	0.30	0.11
nC_4	0.68	0.25
iC_5	0.23	0.07
nC_5	0.23	0.07
C_6	0.20	0.06
$+C_7$	0.17	0.01

(a) Based on gas analysis of sample taken from the H-03 group separator July 3, 2003. The measured H_2S content of 2.04% was conservatively increased to 2.5% H_2S for this assessment and compositions was normalized accordingly.

(b) Based on gas analysis of sample taken of the A-73 well gas July 3, 2003. The measured H_2S content of 1.5% was conservatively increased to 2% H_2S for this assessment and compositions was normalized accordingly.

FLARE EMISSION CHARACTERISTICS

For the purposes of modelling emissions from a flare stack, a series of pseudo stack characteristics must be determined. The pseudo stack parameters allow for the simulation of the unconfined combustion of a flare to be simulated with the dispersion model used. The calculation of the required parameters assumes the following:

- the pseudo-height of the flare is equal to the height of the flame tip;
- the plume rise is determined on the basis of the buoyancy flux provided by the heat of combustion;
- the pseudo-diameter of the flare is determined by simultaneously solving the buoyancy flux equation for a stack and a flare;
- the velocity of the flared gas is calculated from the flare diameter and the volume of gas discharged; and
- the flare is assumed to have a pseudo-temperature of 1,000ºC.

The following formulation was used to derive the pseudo-height. This is based on the assumption that the flame will be tilted at an angle of 45º from the vertical (U.S. EPA 1992).

$$h_{pseudo} = h_{stack} + \underbrace{4.56 \times 10^{-3} \times H^{0.478}}_{\text{flame height}}$$

where:

h_{pseudo}	=	the pseudo-height of the stack [metres]
h_{stack}	=	the physical flare stack height [metres]
H	=	the total heat release of the flare [cal/s]

The buoyancy flux formulation for the flare has been based on the Briggs (1969) formulation, assuming that 55% of the heat released from the flare is radiated into the atmosphere (Leahey and Davies 1984). Recent guidance from Alberta Environment (AENV 2000a) recommends that the flaring calculations should be made assuming that only 25% of the heat released is radiated to the atmosphere. The formulation is as follows:

$$F_{b(flare)} = \frac{g \times Q_H}{p \times r \times c_p \times T_a}$$

$$and$$

$$Q_H = (1 - H_{rad}) \times H$$

where:

$F_{b\,(flare)}$	=	the buoyancy flux from the flare [m^4/s^3]
g	=	gravitational acceleration [m/s^2]
Q_H	=	the sensible heat release rate [cal/s]
H	=	the total heat release of the flare [cal/s]
H_{rad}	=	the fraction of heat lost to radiation [%]
r	=	the gas density [1,205 g/m^3]
c_p	=	the specific heat of the gas [0.24 cal/K]
T_a	=	the ambient temperature [293 K]

Using the above, it is then possible to determine the pseudo stack parameters required for achieving the same buoyancy flux from a non-flare source. Simultaneously solving the buoyancy flux formula for a point source (Briggs 1975) and the flare buoyancy flux noted above will accomplish this:

$$F_{b(stack)} = F_{b(flare)}$$
$$or$$
$$g \times v_s \times d_{pseudo}^2 \times \left(\frac{T_s - T_a}{4 \times T_s} \right) = \frac{g \times (1 - H_{rad}) \times H}{p \times r \times c_p \times T_a}$$

where:

$F_{b(stack)}$	=	the buoyancy flux of the pseudo stack [m^4/s^3]
g	=	gravitational acceleration [m/s^2]
v_s	=	the release velocity [m/s]
d_{pseudo}	=	the pseudo-diameter of the stack [m]
T_s	=	the release temperature [1,273 K]
T_a	=	the ambient temperature [293 K]
H	=	the total heat release of the flare [cal/s]
r	=	the gas density [1,205 g/m^3]
c_p	=	the specific heat of the gas [0.24 cal/K]
T_a	=	the ambient temperature [273 K]

By rearranging the above formula, it can be simplified in the following manner:

$$d_{pseudo}^2 = \frac{(1 - H_{rad}) \times H \times 4 \times T_s}{p \times r \times c_p \times T_a \times v_s \times (T_s - T_a)}$$
$$or$$
$$d_{pseudo} = 4.531 \times 10^{-3} \sqrt{\frac{(1 - H_{rad}) \times H}{v_s}}$$

where:

d_{pseudo}	=	the pseudo-diameter of the stack [m]
H_{rad}	=	the fraction of heat lost to radiation [%]
H	=	the total heat release of the flare [cal/s]
v_s	=	the release velocity [m/s]

Following the AENV (1999 and 2000b) guidance, a 25% radiant heat loss is to be assumed and the actual exit velocities included in the calculation. The above formula can be reduced to the following relationship:

$$d_{pseudo} = 3.829 \times 10^{-3} \sqrt{\frac{H}{v_s}}$$

For the purpose of dispersion modelling, each gas well was assumed to flare at the maximum gas flow rate of 113.3×10³ m³/d (4 MMscf/d) with a flare stack height of 12.2 m. The single oil well was assumed to flare at the maximum gas flow rate of 14.2×10³ m³/d (0.5 MMsfc/d) with a flare stack height of 12.2 m. The flare stacks to be used during well evaluations will be selected to meet the 1-hour NT standard for SO_2 of 450 µg/m³ and to comply with flare design requirements in the Alberta EUB Guide 60 (AEUB 1999). The pseudo characteristics of the flare stack and gas flow rates calculated using the AENV method are presented in Table IV-2.

Table IV-2 Dispersion Modeling Inputs for Gas and Oil Well Test Flaring

Parameter	Dispersion Model Inputs	
	Oil Wells	**Gas Wells**
typical flared gas volume [m³/d]	14,158	113,264
fraction of C_1 to C_4 [molar %]	90.26	91.10
fraction of $+C_5$ [molar %]	0.83	0.21
fraction of H_2S [molar %]	2.50	2.00
lower heating value [MJ/m³]	34.45	32.60
total heat release [MJ/s]	5.65	42.74
SO_2 emission rate [g/s][(a)]	10.86	69.51
H_2S emission rate [g/s][(a)]	0.12	0.75
physical height [m]	12.19	12.19
physical diameter [mm]	76.20	152.40
pseudo-height [m][(b)]	16.07	22.41
pseudo-diameter [m][(b)]	0.74	1.44
exit velocity [m/s]	35.93	71.87
pseudo-temperature [°C]	1,000	1,000

(a) 98% of the inlet sulphur to the flare (in the form of hydrogen sulphide or H_2S) was assumed to be converted to SO_2 (AENV 1999 and 2000). The balance of the inlet sulphur will be released in the form of H_2S.
(b) Pseudo parameters were determined in accordance with the AENV (1999 and 2000a) guidance.

PREDICTED CONCENTRATIONS

The results of the ISCST3 dispersion modelling of 1-hour ground level SO_2 concentrations are summarized in Table IV-3. The table includes the predicted concentrations over the five years of meteorological data modelled. The overall maximum 1-hour ground level SO_2 concentration is predicted to be within the NT standard of 450 µg/m³.

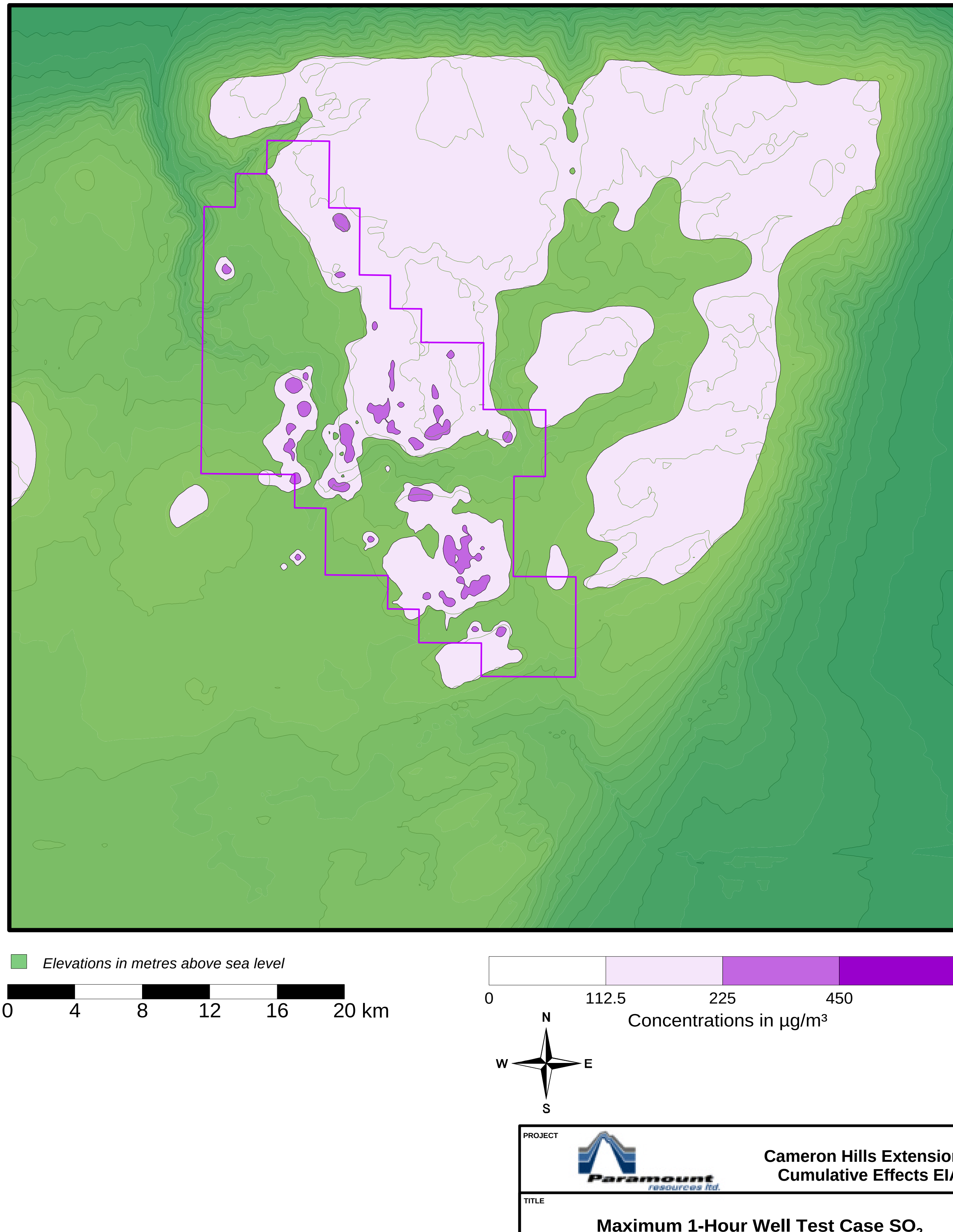
Table IV-3 Maximum Predicted SO_2 Concentrations during Well Tests

Parameter	1-Hour Averaging Period
Regional Predictions	
maximum SO_2 [µg/m³]	444
distance to the maximum SO_2[(a)] [km]	0.2
direction to the maximum SO_2[(a)]	ESE
Community Predictions	
Steen River, AB	20.1
Indian Cabins, AB	39.0
Kakiska, NT	13.0
Hay River, NT	7.6
Enterprise, NT	10.9
Trout Lake, NT	6.7
NT standard for SO_2 [µg/m³]	**450**

(a) Distance and directions presented in the table are relative to the central battery.

Graphical representations of the predicted maximum 1-hour SO_2 concentrations are given in Figure IV-1.

R:/Active/2003/03-1322/03-1322-104 Paramount/8000 Air & People/8000 Air/reporting/figures/SO2_e2_h.srf



PROJECT

Paramount resources ltd.

Cameron Hills Extension
Cumulative Effects EIA

TITLE

Maximum 1-Hour Well Test Case SO_2

Golder Associates

FIGURE IV-1

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APPENDIX V

WILDLIFE HSI MODEL DESCRIPTIONS

Wildlife habitat within the TSA, and the effects of the project on the habitat, was assessed through the use of habitat suitability index (HSI) modeling as described in Section 7.6.3.4.2. The HSI values for each vegetation type and VEC are presented in Table V-1.

Table V-1 Habitat Suitability Values of Terrestrial Study Area Vegetation Types for the Valued Ecosystem Components

TSA Vegetation Type	Woodland Caribou	Moose	Marten	Forest Songbird Community
Shallow Water	0	0	0	0
Water	0	0	0	0
Herbaceous	0	0.33	0	0
Herbaceous Wet	0.33	0.66	0	0
Herbaceous with Shrubs	0.33	1	0	0.66
Shrubland	0	1	0	0.33
Burn	0.33	0.66	0.33	0
White Spruce Mature Closed	0.33	0.66	1	1
Black Spruce Closed Uneven Sized	0.66	0.33	1	0.66
Black Spruce Mature Closed	0.66	0.33	1	0.66
Black Spruce Mature Open with sphagnum and lichen	1	0.33	0.33	0.33
Black Spruce Open Uneven Sized with Lichen	1	0.33	0.33	0.33
Pine Young Closed	0.33	0.33	0.33	0.33
Pine Mature Closed	0.33	0.33	0.66	0.33
Aspen Young Closed	0.33	1	0.33	0.33
Aspen Mature Closed	0.33	0.66	0.66	0.66
Developed or Bare Ground	0	0	0	0

Summaries of the HSI models are presented below:

Woodland Caribou

Woodland caribou habitat selection for peatlands may be influenced by a number of factors including food availability and avoidance of predation. The most important winter food source for woodland caribou are terrestrial lichens (Fuller and Keith 1981; Edmonds and Bloomfield 1984; Manitoba Model Forest 1995). In boreal region of Alberta, preferred forage species include *Cladina* species, such as *C. mitis, C. uncialus and C. rangiferina; Centraria islandica* and *Stereocaulon* spp (Manitoba Model Forest 1995). Cladina species were most commonly found in snow craters dug by woodland caribou in northeastern Alberta (Bradshaw et al. 1995). In years of high snow accumulation, terrestrial species are less accessible and there may be greater use of arboreal lichens (e.g., *Usnea* species, *Evernia mesomorpha*, *Alectoria* spp., *Bryoria trichoides*)

(Manitoba Model Forest 1995). Other food sources that are more frequently consumed in spring and summer are: sedges, cotton-grass, fungi, grasses, ericaceous shrubs (e.g., Labrador tea, blueberry, bearberry), twinflower, mosses, and woody browse (e.g., willows, birch and aspen). Predation is an important limiting factor for woodland caribou populations (Fuller and Keith 1981; Stuart-Smith et al. 1997; Dyer et al. 2001; Dzus 2001). Woodland caribou avoid predators by separating themselves spatially from other ungulate prey (Bergerud et al. 1984; Stuart-Smith et al. 1997; James 1999). As a result, upland areas considered suitable habitat for ungulates such as moose are not considered suitable habitat for woodland caribou as indicated in Table V-1.

Vegetation types within the TSA considered highly suitable (HSI value = 1.0) for woodland caribou include: “black spruce mature open with sphagnum and lichen” and “black spruce open uneven sized with lichen”. “Black spruce closed uneven sized and black spruce mature closed” are considered to be moderately suitable vegetation types, while those remaining are considered unsuitable or of low suitability.

Moose

The preferred habitat of moose consists of early successional areas created by flooding and fires, with rich deciduous shrub growth of willow, birch and alder. However, moose may use dense mature forest as bedding cover in winter and for feeding during severe winter periods (Veitch et al. 1995). In winter, moose concentrate in three main types of habitat: river valleys and floodplains, wetland complexes and upland slopes. As favourable habitat for moose is restricted to smaller areas during the winter, they tend to be concentrated and therefore more vulnerable to disturbance (Veitch et al. 1995). Within the TSA, the best moose habitat is associated with the Cameron River valley.

Vegetation types within the TSA considered highly suitable for moose include: “herbaceous with shrub, shrubland, and aspen young closed”. “Herbaceous wet, burn, white spruce mature closed, and aspen mature closed” are considered moderately suitable while the remaining habitat types are of low or nil suitability (Table V-1).

Marten

Marten range throughout the boreal forest and favour mature conifer forests, especially spruce and fir dominated stands, but if food and cover is sufficient they will utilize other forest types. In general marten avoid large clearings, although during summer months they may use natural clearings or small clear-cuts if sufficient cover exists. Sufficient food and cover may occur in sparse open forests, clearing and low intensity burn area, if there is plenty of undergrowth and fallen trees to provide dens, under-snow spaces for winter hunting, and suitable habitat for prey. (RWED 2003b). Vegetation types within the TSA considered to have high suitability for marten include: “white spruce mature closed, black spruce closed uneven sized, and black spruce mature closed”. “Pine mature closed and aspen mature closed” are considered moderately suitable while the remaining habitat types are of low or nil suitability (Table V-1).

Forest Songbird Community

The HSI for the forest songbird community focused on the availability of vertical vegetation structure for nesting habitats, as it was assumed that this may be the main limiting factor for songbirds in the Cameron Hills. Vegetation types within the TSA considered to have high suitability for songbird communities include the “white spruce mature closed” as white spruce stands tend to have more vertical structure at maturity than do mature aspen or pine stands. “Herbaceous with shrub, black spruce closed uneven sized, black spruce mature closed and aspen mature closed” are considered moderately suitable while the remaining habitat types are of low or nil suitability (Table V-1).

APPENDIX VI

WILDLIFE SIGNS AND SIGHTINGS – 2003/2003

CAMERON HILLS Gathering System, Pipeline, and Oil & Gas Project

Wildlife Signs and Sightings - 2002/2003

Date	Time	Observer's Name	Observer's Employer	WILDLIFE SIGHTINGS		No.	WILDLIFE SIGNS	Activity or Behavior	LOCATION	INTERACTION
				Animal Species	Migratory Bird Species				Km post, on road, ROW clearing, forest edge	Human-wildlife or vehicle-wildlife
Feb. 13/02	5:00 PM	n/a	n/a	Wolf		1		n/a	Km 44 on pipeline	n/a
Feb. 15/02	n/a	Fred Simba	n/a	Lynx and Marten			Tracks	n/a	Km 15 on pipeline ROW	n/a
Feb. 15/02	3:00 PM	n/a	n/a	Lynx		1		n/a	Km 45 on pipeline	n/a
Feb. 16/02	n/a	Fred Simba	n/a	Moose			Tracks	n/a	AB. - 2 kms west of NWT turnoff	n/a
Feb. 16/02	3:30 PM	n/a	n/a	Moose		1		n/a	6-33 Paramount ice road	n/a
Feb. 16/02	n/a	n/a	n/a	Squirrel		n/a		n/a	EOS camp	n/a
Feb. 17/02	n/a	Fred Simba	n/a	Lynx		1		n/a	AB. - 6 kms west of NWT turnoff	n/a
Feb. 17/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	On NWT border and Km 14.5	n/a
Feb. 17/02	n/a	Fred Simba	n/a	Marten			Tracks	n/a	Km 15 and 18 on NWT road	n/a
Feb. 17/02	4:00 PM	n/a	n/a	Moose		2		n/a	3 miles north of camp	n/a
Feb. 18/02	n/a	Fred Simba	n/a	Cow and Calf Moose		1		n/a	AB. - 7 kms west of NWT turnoff	n/a
Feb. 18/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	Km 5 north of border on hill	n/a
Feb. 18/02	n/a	Fred Simba	n/a	Wolverine			Tracks	n/a	15 km north of border	n/a
Feb. 18/02	n/a	Fred Simba	n/a	Marten			Tracks	n/a	Just north of Wolverine tracks	n/a
Feb. 18/02	n/a	Fred Simba	n/a	Squirrel			Tracks	n/a	By N-38	n/a
Feb. 18/02	n/a	Fred Simba	n/a	Spruce Hen			Tracks	n/a	By N-38	n/a
Feb. 18/02	n/a	Darren Unrau	n/a	Rabbit		n/a		n/a	n/a	n/a
Feb. 18/02	n/a	Darren Unrau	n/a	Martin		n/a		n/a	n/a	n/a
Feb. 19/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	Km 5 north of border on hill	n/a
Feb. 19/02	n/a	Fred Simba	n/a	Marten			Tracks	n/a	Km 7	n/a
Feb. 20/02	n/a	Fred Simba	n/a	Lynx		1		n/a	N-28 wellsite	n/a
Feb. 20/02	n/a	Fred Simba	n/a	Lynx and Rabbit			Tracks	n/a	North of new bridge	n/a
Feb. 20/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	On hills by Km 17	n/a
Feb. 20/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	Km 5 north of border	n/a
Feb. 21/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	8 Km west of NWT border	n/a
Feb. 21/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	Along pipeline route	n/a
Feb. 21/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	Along pipeline route	n/a
Feb. 21/02	n/a	Fred Simba	n/a	Squirrel		1		n/a	Along pipeline route	n/a
Feb. 21/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	North of border and west 10 km	n/a
Feb. 21/02	n/a	Fred Simba	n/a	Marten		1	Tracks	n/a	North of border and west 10 km	n/a
Feb. 21/02	n/a	Fred Simba	n/a	Wolverine			Tracks	n/a	In the creek	n/a
Feb. 21/02	n/a	Fred Simba	n/a	Moose			Tracks	n/a	By the river	n/a
Feb. 22/02	n/a	Fred Simba	n/a	Lynx		4	Tracks	n/a	N 17 km & west 6 km from border	n/a
Feb. 22/02	n/a	Fred Simba	n/a	Moose			Tracks	n/a	By the river	n/a
Feb. 22/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	On road coming back to border	n/a
Feb. 22/02	n/a	Fred Simba	n/a	Spruce Hen		1		n/a	On road coming back to border	n/a
Feb. 22/02	n/a	Fred Simba	n/a	Lynx		3		n/a	On road coming back to border	n/a
Feb. 22/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	On road coming back to border	n/a
Feb. 22/02	n/a	Fred Simba	n/a	Lynx		1	Tracks	n/a	West from the border on pipeline	n/a
Feb. 22/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	West from the border on pipeline	n/a
Feb. 22/02	n/a	Duane Auger	n/a	Rabbit		n/a		n/a	Under tire	n/a
Feb. 23/02	n/a	Fred Simba	n/a	Lynx		1	Tracks	n/a	N 12 km & west 10 km from border	n/a
Feb. 23/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	N 12 km & west 10 km from border	n/a
Feb. 23/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	North again 8 km	n/a
Feb. 23/02	n/a	Fred Simba	n/a	Spruce Hen		3		n/a	North again 8 km	n/a
Feb. 23/02	n/a	Fred Simba	n/a	Porcupine		1		n/a	On the hill	n/a
Feb. 23/02	n/a	Fred Simba	n/a	Caribou			Tracks	n/a	n/a	n/a
Feb. 24/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	SW from the border towards pipeline	n/a
Feb. 24/02	n/a	Fred Simba	n/a	Ptarmigan		4		na/	SW from the border towards pipeline	n/a
Feb. 24/02	n/a	Fred Simba	n/a	Lynx		1	Tracks	n/a	Below the hill	n/a
Feb. 24/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	17 km north of the border	n/a
Feb. 24/02	n/a	Fred Simba	n/a	Timber Wolf		1	Tracks	n/a	On the pipeline route SW of border	n/a
Feb. 24/02	n/a	Tom Flannery	n/a	Wolf		n/a		n/a	EOS camp	n/a
Feb. 24/02	n/a	Kent Halverson	n/a	Lynx		n/a		n/a	3 km north of 5-24-126-22 W5M	n/a
Feb. 24/02	n/a	n/a	n/a	Lynx		2		n/a	5-24-126-22 W5M	n/a

CAMERON HILLS Gathering System, Pipeline, and Oil & Gas Project

Wildlife Signs and Sightings - 2002/2003

Date	Time	Observer's Name	Observer's Employer	WILDLIFE SIGHTINGS		No.	WILDLIFE SIGNS	Activity or Behavior	LOCATION	INTERACTION
				Animal Species	Migratory Bird Species				Km post, on road, ROW clearing, forest edge	Human-wildlife or vehicle-wildlife
Feb. 25/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	North of the border	n/a
Feb. 25/02	n/a	Fred Simba	n/a	Fox		1	Tracks	n/a	North of the border	n/a
Feb. 25/02	n/a	Fred Simba	n/a	Lynx		1	Tracks	n/a	North of the border	n/a
Feb. 25/02	n/a	Fred Simba	n/a	Lynx		2		n/a	On the road	n/a
Feb. 25/02	n/a	Fred Simba	n/a	Porcupine		1		n/a	Along the new cutline	n/a
Feb. 25/02	n/a	Fred Simba	n/a	Lynx		1	Tracks	n/a	At the NWT border	n/a
Feb. 25/02	n/a	Fred Simba	n/a	Marten		1	Tracks	n/a	18 km NW on pipeline	n/a
Feb. 25/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	18 km NW on pipeline	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Lynx		4	Tracks	n/a	Northwest	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	Northwest	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	Northwest	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Fox		1	Tracks	n/a	Northwest	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Ptarmigan		8		n/a	Northwest	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Spruce Hen		6		n/a	Northwest	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Lynx		1	Tracks	n/a	By the river	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Porcupine		1		n/a	By the steep hill on pipeline route	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Squirrel		2		n/a	By the camp	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	By the camp	n/a
Feb. 26/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	On top of the hill by the new bridge	n/a
Feb. 26/02	n/a	Tom Flannery	n/a	Lynx		n/a		n/a	Paramount camp	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Wolf		1	Tracks	n/a	SW 25 km from NWT border	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Marten		6	Tracks	n/a	SW 25 km from NWT border	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Caribou			Tracks	n/a	SW 25 km from NWT border	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	SW 25 km from NWT border	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Ptarmigan		6		n/a	SW 25 km from NWT border	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Mink		1	Tracks	n/a	SW 25 km from NWT border	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	Northwest	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Beaver		1	Lodge	n/a	Northwest	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Spruce Hen		4		n/a	Northwest by the water hole	n/a
Feb. 27/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	Northwest by the water hole	n/a
Feb. 27/02	2:00 PM	n/a	n/a	Lynx		1		n/a	West of camp	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	NW from NWT border on pipeline	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Porcupine			Tracks	n/a	NW from NWT border on pipeline	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Spruce Hen		2		n/a	NW from NWT border on pipeline	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Lynx		1		n/a	West from pipeline on the road	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Marten			Tracks	n/a	West from pipeline on the road	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Squirrel		1		n/a	West from pipeline on the road	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	West from pipeline on the road	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	West on new cutlines	n/a
Feb. 28/02	n/a	Fred Simba	n/a	Lynx		1		n/a	Close to creek	n/a
Mar. 1/02	n/a	Fred Simba	n/a	Marten			Tracks	n/a	Southwest on pipeline	n/a
Mar. 1/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	Southwest on pipeline	n/a
Mar. 1/02	n/a	Fred Simba	n/a	Fox			Tracks	n/a	Southwest on pipeline	n/a
Mar. 1/02	n/a	Fred Simba	n/a	Ptarmigan		6		n/a	Southwest on pipeline	n/a
Mar. 1/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	Northwest from the camp	n/a
Mar. 1/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	Northwest from the camp	n/a
Mar. 1/02	n/a	Fred Simba	n/a	Squirrel		2		n/a	Northwest from the camp	n/a
Mar. 1/02	n/a	Fred Simba	n/a	Lynx		2		n/a	Coming back to camp	n/a
Mar. 2/02	n/a	Fred Simba	n/a	Lynx		4	Tracks	n/a	On the new cutline	n/a
Mar. 2/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	On the new cutline	n/a
Mar. 2/02	n/a	Fred Simba	n/a	Spruce Hen		4		n/a	On the new cutline	n/a
Mar. 2/02	n/a	Fred Simba	n/a	Prairie Chicken		3		n/a	On the new cutline	n/a
Mar. 2/02	n/a	Fred Simba	n/a	Beaver			Lodge	n/a	Northwest from cutline	n/a
Mar. 2/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	Pipeline route	n/a
Mar. 2/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	Pipeline route	n/a

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				Animal Species	Migratory Bird Species				Km post, on road, ROW clearing, forest edge	Human-wildlife or vehicle-wildlife
Mar. 2/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	Pipeline route	n/a
Mar. 2/02	n/a	Albert Auger	n/a	Ptarmigan		n/a		n/a	Km 19	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	SW from NWT border on pipeline	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Marten			Tracks	n/a	SW from NWT border on pipeline	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Ptarmigan		n/a		n/a	SW from NWT border on pipeline	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	Pipeline route	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Wolverine			Tracks	n/a	Pipeline route	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	Pipeline route	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	Northwest	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Moose		1	Tracks	n/a	By the creek	n/a
Mar. 3/02	n/a	Fred Simba	n/a	Lynx		1		n/a	On the road	n/a
Mar. 4/02	n/a	Fred Simba	n/a	Prairie Chicken		3		n/a	Straight north	n/a
Mar. 4/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	Straight north	n/a
Mar. 4/02	n/a	Fred Simba	n/a	Squirrel		1		n/a	Straight north	n/a
Mar. 4/02	n/a	Fred Simba	n/a	Grouse		1		n/a	Straight north	n/a
Mar. 4/02	n/a	Fred Simba	n/a	Porcupine		1		n/a	Straight north	n/a
Mar. 4/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	SW on pipeline route	n/a
Mar. 4/02	n/a	Fred Simba	n/a	Ptarmigan		4		n/a	SW on pipeline route	n/a
Mar. 4/02	n/a	Fred Simba	n/a	Lynx		1		n/a	By EOS camp on the road	n/a
Mar. 5/02	n/a	Fred Simba	n/a	Lynx		1		n/a	NW on top of the hill	n/a
Mar. 5/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	NW on the road	n/a
Mar. 5/02	n/a	Fred Simba	n/a	Spruce Hen		3		n/a	NW on the road	n/a
Mar. 5/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	NW on the road	n/a
Mar. 5/02	n/a	Fred Simba	n/a	Squirrel		1		n/a	NW on the road	n/a
Mar. 5/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	NW on the road	n/a
Mar. 5/02	n/a	Fred Simba	n/a	Lynx		1		n/a	Coming back to camp	n/a
Mar. 6/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	By the pipeline route	n/a
Mar. 6/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	n/a	n/a
Mar. 6/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	n/a	n/a
Mar. 6/02	n/a	n/a	n/a	Wolf		n/a		n/a	Camp tower	n/a
Mar. 6/02	n/a	n/a	n/a	Martin		n/a		n/a	A-05	n/a
Mar. 6/02	n/a	n/a	n/a	Wolf		n/a		n/a	Garbage bin	n/a
Mar. 7/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	Northwest towards pipeline route	n/a
Mar. 7/02	n/a	Fred Simba	n/a	Marten		3	Tracks	n/a	Northwest towards pipeline route	n/a
Mar. 7/02	n/a	Fred Simba	n/a	Spruce Hen		2		n/a	Northwest towards pipeline route	n/a
Mar. 7/02	n/a	Fred Simba	n/a	Porcupine			Tracks	n/a	On top of the hill on seismic line	n/a
Mar. 7/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	n/a	n/a
Mar. 7/02	n/a	Jim Hamilton	n/a	Wolf		n/a		n/a	Pillar office site	n/a
Mar. 7/02	n/a	n/a	n/a	Wolf		n/a		n/a	Camp tower	n/a
Mar. 7/02	n/a	n/a	n/a	Wolf		n/a		n/a	Garbage bin	n/a
Mar. 8/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	North on new seismic road	n/a
Mar. 8/02	n/a	Fred Simba	n/a	Marten		1	Tracks	n/a	North on new seismic road	n/a
Mar. 8/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	North on new seismic road	n/a
Mar. 8/02	n/a	Fred Simba	n/a	Squirrel		1		n/a	North on new seismic road	n/a
Mar. 8/02	n/a	Fred Simba	n/a	Wolverine			Tracks	n/a	North on new seismic road	n/a
Mar. 8/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	Beside airstrip	n/a
Mar. 8/02	n/a	Fred Simba	n/a	Ptarmigan		2		n/a	Beside airstrip	n/a
Mar. 8/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	Beside EOS camp	n/a
Mar. 9/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	North on the pipeline	n/a
Mar. 9/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	North on the pipeline	n/a
Mar. 9/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	North on the pipeline	n/a
Mar. 9/02	n/a	Fred Simba	n/a	Marten		3	Tracks	n/a	North on the pipeline	n/a
Mar. 9/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	Beside EOS camp	n/a
Mar. 9/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	Toward EOS camp	n/a
Mar. 9/02	n/a	n/a	n/a	Lynx		n/a		n/a	A-73 wellsite	n/a

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				Animal Species	Migratory Bird Species				Km post, on road, ROW clearing, forest edge	Human-wildlife or vehicle-wildlife
Mar. 10/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	N on pipeline beside hill S of camp	n/a
Mar. 10/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	N on pipeline beside hill S of camp	n/a
Mar. 10/02	n/a	Fred Simba	n/a	Spruce Hen		2		n/a	N on pipeline beside hill S of camp	n/a
Mar. 10/02	n/a	Fred Simba	n/a	Ptarmigan		1		n/a	N on pipeline beside hill S of camp	n/a
Mar. 10/02	n/a	Fred Simba	n/a	Moose			Tracks	n/a	End of pipeline at North	n/a
Mar. 10/02	n/a	Fred Simba	n/a	Fox		2	Tracks	n/a	Airstrip N of Cameron River bridge	n/a
Mar. 10/02	n/a	n/a	n/a	Lynx		n/a		n/a	C-50 access	n/a
Mar. 11/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	North on pipeline	n/a
Mar. 11/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	North on pipeline	n/a
Mar. 11/02	n/a	Fred Simba	n/a	Moose		1	Tracks	n/a	On road coming back to PRL camp	n/a
Mar. 11/02	n/a	Fred Simba	n/a	Fox			Tracks	n/a	Seismic cut line	n/a
Mar. 11/02	n/a	Fred Simba	n/a	Fox			Tracks	n/a	Along pipeline route	n/a
Mar. 11/02	n/a	Fred Simba	n/a	Wolf		1		n/a	On road beside EOS camp	n/a
Mar. 11/02	n/a	n/a	n/a	Grouse		12		n/a	5 km south of plant	n/a
Mar. 12/02	n/a	Fred Simba	n/a	Caribou		6	Tracks	n/a	NW from NWT border	n/a
Mar. 12/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	NW from NWT border	n/a
Mar. 12/02	n/a	Fred Simba	n/a	Marten		3	Tracks	n/a	NW from NWT border	n/a
Mar. 12/02	n/a	Fred Simba	n/a	Wolf		2	Tracks	n/a	Beside EOS camp	n/a
Mar. 12/02	n/a	Fred Simba	n/a	Ptarmigan		4		n/a	On the road	n/a
Mar. 12/02	n/a	Fred Simba	n/a	Squirrel		1		n/a	Airstrip N of Cameron River bridge	n/a
Mar. 12/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	Airstrip N of Cameron River bridge	n/a
Mar. 12/02	n/a	Fred Simba	n/a	Fox		1	Tracks	n/a	Airstrip N of Cameron River bridge	n/a
Mar.12/02	n/a	n/a	n/a	Wolf		n/a		n/a	Plant site (tower)	n/a
Mar. 12/02	n/a	n/a	n/a	Wolf		n/a		n/a	500 m north of plant	n/a
Mar. 13/02	n/a	Fred Simba	n/a	Caribou		2	Tracks	n/a	Northwest towards pipeline route	n/a
Mar. 13/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	Northwest towards pipeline route	n/a
Mar. 13/02	n/a	Fred Simba	n/a	Mink		1	Tracks	n/a	By the creek	n/a
Mar. 13/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	By the creek	n/a
Mar. 13/02	n/a	Fred Simba	n/a	Lynx		1		n/a	On road beside EOS camp	n/a
Mar. 13/02	n/a	Fred Simba	n/a	Spruce Hen		3		n/a	By NWT border	n/a
Mar. 13/02	n/a	Fred Simba	n/a	Prairie Chicken		4		n/a	By the hill going back to PRL camp	n/a
Mar. 13/02	n/a	n/a	n/a	Grouse		2		n/a	A-73 wellsite	n/a
Mar. 14/02	n/a	Fred Simba	n/a	Lynx		1		n/a	Along the road	n/a
Mar. 14/02	n/a	Fred Simba	n/a	Spruce Hen		2		n/a	Along the road	n/a
Mar. 14/02	n/a	Fred Simba	n/a	Marten		1	Tracks	n/a	Along the road	n/a
Mar. 14/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	Along the road	n/a
Mar. 14/02	n/a	Fred Simba	n/a	Wolf		1		n/a	Beside EOS camp	n/a
Mar. 15/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	By EOS camp	n/a
Mar. 15/02	n/a	Fred Simba	n/a	Lynx		1		n/a	By EOS camp on the road	n/a
Mar. 15/02	n/a	Fred Simba	n/a	Ptarmigan		4		n/a	West of EOS camp road	n/a
Mar. 15/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	West of EOS camp road	n/a
Mar. 15/02	n/a	Fred Simba	n/a	Caribou		5	Tracks	n/a	West of EOS camp road	n/a
Mar. 16/02	n/a	Fred Simba	n/a	Spruce Hen		3		n/a	West on pipeline route	n/a
Mar. 16/02	n/a	Fred Simba	n/a	Ptarmigan		2		n/a	West on pipeline route	n/a
Mar. 16/02	n/a	Fred Simba	n/a	Caribou		2	Tracks	n/a	West on pipeline route	n/a
Mar. 16/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	West 3 km from EOS camp	n/a
Mar. 16/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	Beside EOS camp	n/a
Mar. 16/02	n/a	Fred Simba	n/a	Moose		2	Tracks	n/a	Pipeline route	n/a
Mar. 16/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	Pipeline route	n/a
Mar. 16/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	On hill by Cameron River bridge	n/a
Mar. 17/02	n/a	Fred Simba	n/a	Wolf		1	Tracks	n/a	North by the air strip	n/a
Mar. 17/02	n/a	Fred Simba	n/a	Prairie Chicken		2		n/a	Beside seismic road	n/a
Mar. 17/02	n/a	Fred Simba	n/a	Porcupine		1	Tracks	n/a	Beside seismic road	n/a
Mar. 17/02	n/a	Fred Simba	n/a	Mink		1	Tracks	n/a	Beside the creek	n/a
Mar. 17/02	n/a	Fred Simba	n/a	Lynx			Tracks	n/a	Beside Cameron River bridge	n/a

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Mar. 17/02	n/a	Fred Simba	n/a	Wolverine			Tracks	n/a	West side of pipeline	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Lynx		2	Tracks	n/a	By the air strip beside the camp	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Wolf		1	Tracks	n/a	By the air strip beside the camp	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Fox			Tracks	n/a	Coming back to camp	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Spruce Hen		4		n/a	Coming back to camp	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Prairie Chicken		3		n/a	Coming back to camp	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	Along seismic road	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Grouse		1		n/a	Along seismic road	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	Along seismic road	n/a
Mar. 18/02	n/a	Fred Simba	n/a	Porcupine			Tracks	n/a	On hill by Cameron River bridge	n/a
Mar. 18/02	n/a	n/a	n/a	Lynx		n/a		n/a	B-08	n/a
Mar. 19/02	n/a	Fred Simba	n/a	Spruce Hen		5		n/a	North on the pipeline	n/a
Mar. 19/02	n/a	Fred Simba	n/a	Moose		1	Tracks	n/a	North on the pipeline	n/a
Mar. 19/02	n/a	Fred Simba	n/a	Marten		2	Tracks	n/a	North on the pipeline	n/a
Mar. 19/02	n/a	Fred Simba	n/a	Lynx		1		n/a	On the road	n/a
Mar. 19/02	n/a	Fred Simba	n/a	Porcupine		1	Tracks	n/a	On hill coming back to camp	n/a
Mar. 19/02	n/a	Fred Simba	n/a	Prairie Chicken		4		n/a	4 km to Cameron Hills Bridge	n/a
Mar. 20/02	n/a	Fred Simba	n/a	Wolf			Tracks	n/a	Close to EOS camp	n/a
Mar. 20/02	n/a	Fred Simba	n/a	Lynx		1		n/a	On the road	n/a
Mar. 20/02	n/a	Fred Simba	n/a	Spruce Hen		6		n/a	N towards the end of the pipeline	n/a
Mar. 20/02	n/a	Fred Simba	n/a	Squirrel		2		n/a	N towards the end of the pipeline	n/a
Mar. 20/02	n/a	Fred Simba	n/a	Rabbit			Tracks	n/a	N towards the end of the pipeline	n/a
Mar. 19/02	n/a	n/a	n/a	Wolf		n/a		n/a	North of plant	n/a
Mar. 20/02	n/a	n/a	n/a	Lynx		n/a		n/a	B-08	n/a
13-Apr-02	AM	John Ross	Paramount	Wolf		1		Standing	ROW	
13-Apr-02	AM	John Ross	Paramount		Eagle	1		Flying over	ROW	
13-Apr-02	PM	Darryl Field	Paramount	Moose		1	Tracks		Lease and ROW	Vehicle-Wildlife
17-May-02	AM	S. Chortrand	Paramount	Caribou		1		Walking	3 km from N-28	Vehicle-Wildlife
18-May-02	AM	Darryl Field	Paramount		Spruce Grouse	3 or 4		Walking	ROW from H-05 to N-28	Vehicle-Wildlife
22-May-02	AM	Darryl Field	Paramount	Moose		2		Walking	ROW just prior to I-50	Vehicle-Wildlife
22-May-02	AM	Darryl Field	Paramount	Black Bear		2		Walking	On seismic line near ROW	Vehicle-Wildlife
24-Jun-02	Noon	Darryl Field	Paramount	Black Bear		2		Walking	East of trailer at H-03	Human-Wildlife
24-Jun-02	12:00 PM	Darryl Field	Paramount	(Brown) Black Bear		1		Standing	East of trailer at H-03	Human-Wildlife
25-Jun-02	PM	Darryl Field	Paramount		Sandhill Crane	3		Walking	ROW near H-03	Human-Wildlife
25-Jun-02	PM	Darryl Field	Paramount		Mallard	8		Walking	ROW 1km from H-03	Human-Wildlife
25-Aug-02	PM	Darryl Field Wayne Sabovrin	Paramount	Black Bear		2		Sow & Cub Eating Grass	Walked onto C-50 Lease while People worked on this site	Human-Wildlife
6-Sep-02	PM	D Field & Darcy Witlock	Paramount	Black Bear		2		Feeding on Clover	C-50 Site	Human-Wildlife
6-Sep-02		D Field & Darcy Witlock	Paramount		Canadian Geese	16		Flew overhead Landed in a pond	C-50 Lease	Human-Wildlife
11-Sep-02		Wayne Sabourin Darryl Field	Paramount	Porcupine		1		Walked around and into the bush	C-50 Lease	Vehicle-Wildlife
14-Sep-02	AM	Wayne Sabourin Darryl Field	Paramount	Porcupine		1		Walked around Building and wandered away	H-03	Human-Wildlife
14-Sep-02	PM	Wayne Sabourin Darryl Field	Paramount	Black Bear		1		Eating Grass	C-50 Lease Site	Human-Wildlife
15-Sep-02	PM	Wayne Sabourin Darryl Field	Paramount	Black Bear		2		Running into the bush	East of N-28 Airport Area	Vehicle-Wildlife
Oct-02/Nov-02	PM	Brian Palmer & Steve C.	Paramount	Porcupine		1		Walking	Right of way on forest edge between N-28 and airstrip	Skidoo (Vehicle) - Wildlife
6-Jan-03	13;30	Dennis Blais	EOS Pipeline	Lynx		1		Running	Pipeline ROW - Km 10	Vehicle-wildlife
6-Jan-03	14:00	Dennis Blais	EOS Pipeline	Weasal		1		Standing	Pipeline ROW - Km 15	Snowmobile-Wildlife
7-Jan-03		Gordon Lins	EOS Pipeline	Caribou		15-16			Km 30 Indian Cabinsj	Vehicle-wildlife
7-Jan-03		Peter Mahowich	Pillar	Caribou		6			10 Km South of H-03	Vehicle-wildlife
9-Jan-03	11:30 AM	Heath Bohay			Spruce Grouse	8		Standing	Bistcho Lake Road (23Km)	Vehicle-wildlife

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16-Jan-03		Ed Flannery	EA Flannery	Wolf (Black - Big)		1			3.5 KM north of Zama - Bistcho Road	Vehicle-wildlife
16-Jan-03	11:15AM	Heath Bohay		Lynx		1		Standing	on Road 3.5 KM's north of Zama	Vehicle-wildlife
17-Jan-03		Doug Steinke		Lynx		1		Standing	Right of Way, Access 3	Vehicle-wildlife
18-Jan-03	2:15PM	Ed and Alice Flannery	EA Flannery	Wolf (Black)		1		Standing	On Road (Bistcho) 3 miles south of camp corner	Vehicle-wildlife
20-Jan-03	1:00PM	Ed Flannery	EA Flannery	Lynx		1			12-34-117-04W6	Vehicle-wildlife
20-Jan-03	12:40 PM	Darren Unrau	Paramount Resources	Martin		1		Walking across Road	South of C-50 - W Side of Cam. River	Vehicle-wildlife
21-Jan-03	1:30 PM	Darren Unrau	Paramount Resources	Lynx		1		Walking across Road	Northwest of N-28	Vehicle-wildlife
21-Jan-03		Darryl Nast	EOS Pipeline	Lynx		1			North Steen River Line Crossing	
21-Jan-03		Raymond Buggins	Raymond Buggins	Lynx/Moose		1 Each		No Info	No Info	Vehicle-wildlife
22-Jan-03		Darryl Nast	EOS Pipeline	Lynx		1			Cross ROW North 3A	
23-Jan-03		Darren Unrau	Paramount Resources	Lynx		1		-	Km 20 Indian Cabins	Vehicle-wildlife
23-Jan-03	12:15PM	Darren Unrau	Paramount Resources	Lynx		1		Sitting on Road	North of N-28	Vehicle-wildlife
24-Jan-03	4:30 PM	Eddy Blais	EOS Pipeline	Lynx		1		Standing	ROW Road Crossing #5	Vehicle-wildlife
24-Jan-03	AM	Heath Bohay	EOS Pipeline	Coyote		2		Running/Standing	8 KM North of Zama	Vehicle-wildlife
26-Jan-03		Raymond Buggins	Raymond Buggins	Moose		3		No Info	No Info	Vehicle-wildlife
26-Jan-03	4:25 PM	Heath Bohay	EOS Pipeline	Coyote		1		Walking across Road	1Km North of Caribou gates by zama	Vehicle-wildlife
26-Jan-03	12:52 PM	Heath Bohay	EOS Pipeline	Silver Fox		1		Running	West Bistcho Pipeline Project #573	Vehicle-wildlife
29-Jan-03		Bill Bradley	Paramount Resources	Bison		2			10 KM east of Zama	
30-Jan-03		B. Anderson		Bison		2			15-22-118W5	
2-Feb-03		Trevor Carnegie	EOS Pipeline	Buffalo		1		Standing	1/2 Mile north of Zama City	Vehicle-Wildlife
5-Feb-03		Bill Bradley	Paramount Resources							
6-Feb-03		Gary/Trish Sawchuk	EOS Pipeline	Fisher		1			6-28-106-8W6	Vehicle-Wildlife
9-Feb-03		Bill Bradley	Paramount Resources	Caribou		1			KM 6 Indian Cabins Winter Road	
13-Feb-03		Raymond Buggins	Raymond Buggins	Caribou		1		Standing	No Info	Vehicle-Wildlife
13-Feb-03		Darren Unrau	Paramount Resources	Caribou		4		Standing	12" Row 2 km north of NWT border	
13-Feb-03		Brian/Donna Anderson	Paramount Resources	Moose		2				
15-Feb-03		Darren Unrau	Paramount Resources	Bison		2		Grazing	Along highway ditch	Vehicle-Wildlife
17-Feb-03		Bill Bradley	Paramount Resources	Moose		2		Grazing		
23-Feb-03		Raymond Buggins	Raymond Buggins	Caribou		6		No Info	No Info	Vehicle-Wildlife
2-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		15-20		Standing	No Info	Vehicle-Wildlife
4-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		3		Standing	No Info	Vehicle-wildlife
5-Mar-03		Neil Kelly	Allnorth	Lynx/Rabbits			Tracks			
6-Mar-03		Neil Kelly	Allnorth	Martin/Rabbit/Lynx			Tracks			
6-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		2		Standing	NO Info	Vehicle-Wildlife
6-Mar-03		Raymond Buggins	Raymond Buggins	Lynx		1		Standing	NO Info	Vehicle-Wildlife
7-Mar-03		Neil Kelly	Allnorth	Lynx/Rabbits			Tracks			
8-Mar-03		Neil Kelly	Allnorth	Caribou			Tracks			
8-Mar-03	3:30 PM	Bruce Edgar	EOS Pipeline	Lynx		1		Lying on Edge of Road	K-74	Vehicle-Wildlife
8-Mar-03		Brian Anderson/Ed Flannery	Paramount Resources	Lynx		1		Sitting on side of road	North of H-03 at air strip	Vehicle-Wildlife
8-Mar-03	3:30pm	Doug Steinke	EOS Pipeline	Caribou (3 Cows)		3		Running	Winter Road	
8-Mar-03	3:30pm	Edgar Bruce	EOS Pipeline	Lynx		1		Lying/Running	Winter Road - Ran into bush	Vehicle-Wildlife
8-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		7		No Info	No Info	Vehicle-Wildlife
9-Mar-03		Neil Kelly	Allnorth	Lynx/Caribou			Tracks	No Info	C-74 Flowline/Wellsite	No Info
9-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		3		No Info	No Info	Vehicle-Wildlife
10-Mar-03		Neil Kelly	Allnorth	Martin/Rabbit/Caribou			Tracks			
11-Mar-03		Neil Kelly	Allnorth	Porcupine/Lynx/Martin			Tracks			
11-Mar-03		Neil Kelly	Allnorth	Prairie Chicken		06-Jan		No Info	Muskeg at C-74	Vehicle-Wildlife
11-Mar-03		Raymond Buggins	Raymond Buggins	Lynx		1		No Info	No Info	Vehicle-Wildlife
11-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		3		No Info	No Info	Vehicle-Wildlife
12-Mar-03		Neil Kelly	Allnorth	Lynx/Squirrell/Rabbit			Tracks	No Info	D-49 Wellsite and Flowline	No Info
13-Mar-03		Raymond Buggins	Raymond Buggins	Lynx		1		No Info	No Info	Vehicle-Wildlife
13-Mar-03		Neil Kelly	Allnorth	Rabbit/Lynx	Prairie Chicken		Tracks	No Info	D-49 Wellsite and Flowline	No Info
14-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		7		No Info	No Info	Vehicle-Wildlife
14-Mar-03		Neil Kelly	Allnorth	Lynx/Rabbits			Tracks	No Info	D-49 Wellsite and Flowline	Vehicle-Wildlife
14-Mar-03		Neil Kelly	Allnorth		Whiskeyjack	1		No Info	D-49 Wellsite and Flowline	Vehicle-Wildlife

CAMERON HILLS Gathering System, Pipeline, and Oil & Gas Project
Wildlife Signs and Sightings - 2002/2003

Date	Time	Observer's Name	Observer's Employer	WILDLIFE SIGHTINGS		No.	WILDLIFE SIGNS	Activity or Behavior	LOCATION	INTERACTION
				Animal Species	Migratory Bird Species				Km post, on road, ROW clearing, forest edge	Human-wildlife or vehicle-wildlife
14-Mar-03		Neil Kelly	Allnorth	Porcupine		1		Sitting	On Road - D-49	Vehicle-Wildlife
15-Mar-03		Neil Kelly	Allnorth	Porcupine			Tracks	No Info	D-49 Wellsite and Flowline	No Info
17-Mar-03		Neil Kelly	Allnorth		Whiskeyjacks	4		Flying	D-49 Wellsite and Flowline	Human-Wildlife
17-Mar-03		Neil Kelly	Allnorth	Martin/Lynx/Rabbit			Tracks	No Info	D-49 Wellsite and Flowline	
17-Mar-03		Raymond Buggins	Raymond Buggins	Lynx		2		No Info	No Info	Vehicle-Wildlife
18-Mar-03		Neil Kelly	Allnorth		Prairie Chicken	6		Sitting	Middle of the D-49 Road	Vehicle-Wildlife
18-Mar-03		Neil Kelly	Allnorth	Marten			Tracks	No Info	D-49 Wellsite and Flowline	No Info
18-Mar-03		Neil Kelly	Allnorth		Whiskeyjacks	3		Flying	D-49 Wellsite and Flowline	Human-Wildlife
18-Mar-03		Neil Kelly	Allnorth	Lynx			Tracks	No Info	D-49 Wellsite and Flowline	No Info
18-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		6		No Info	No Info	Vehicle-Wildlife
18-Mar-03		Raymond Buggins	Raymond Buggins	Lynx		1		No Info	No Info	Vehicle-Wildlife
20-Mar-03		Neil Kelly	Allnorth	Lynx/Rabbits			Residue of Lynx/Rabbit encounter	No Info	D-49 Wellsite and Flowline	No Info
21-Mar-03		Neil Kelly	Allnorth	Lynx			Tracks	No Info	D-49 Wellsite and Flowline	No Info
21-Mar-03		Neil Kelly	Allnorth	Rabbit		1		Running	Ran Across Road - D-49	Vehicle-wildlife
21-Mar-03		Raymond Buggins	Raymond Buggins	Caribou		3		No Info	No Info	Vehicle-Wildlife
22-Mar-03		Neil Kelly	Allnorth	Lynx/Martin/Rabbit			Tracks	No Info	D-49 Wellsite and Flowline	No Info
23-Mar-03		Neil Kelly	Allnorth	Wolverine/Lynx/Rabbit			Tracks		C-74 Flowline/Wellsite	
23-Mar-03		Neil Kelly	Allnorth	Lynx		07-Jan		Standing	C-74 Flowline/Wellsite	Vehicle-Wildlife
24-Mar-03		Neil Kelly	Allnorth	Lynx/Marten/Porcupine/Rabbit			Tracks	No Info	F-73 Flowline	No Info
25-Mar-03		Neil Kelly	Allnorth	Mink/Marten			Tracks	No Info	M-73 Flowline	
27-Mar-03		Neil Kelly	Allnorth	Lynx/Martin/Rabbit			Tracks	No Info	M-73 Flowline	No Info
28-Mar-03		Neil Kelly	Allnorth		Whiskeyjacks	5		Flying	C-74 Flowline/Wellsite	Vehicle-Wildlife
28-Mar-03		Neil Kelly	Allnorth		Sprucehens	Several		Walking	C-74 Flowline/Wellsite	Vehicle-Wildlife
28-Mar-03		Neil Kelly	Allnorth	Lynx/Rabbits			Tracks		C-74 Flowline/Wellsite	Vehicle-Wildlife
28-Mar-03		Neil Kelly	Allnorth	Mink/Lynx/Rabbit			Tracks		C-74 Flowline/Wellsite	No Info
29-Mar-03		Neil Kelly	Allnorth	Porcupine/Lynx			Tracks	No Info	C-74 Flowline/Wellsite	No Info
30-Mar-03		Neil Kelly	Allnorth	Rabbit/Lynx			Tracks	No Info	F-73 Flowline	No Info
31-Mar-03		Neil Kelly	Allnorth	Lynx/Marten/Rabbit			Tracks	No Info	F-73 Flowline	
1-Apr-03		Neil Kelly	Allnorth	Lynx/Rabbit/Marten/Mink			Tracks	No Info	H-58 Wellsite	No Info