11.1.1 FUTURE PROJECTS

The following three reasonably foreseeable projects were identified in EIS Volume 5, Part F, Section 12.6.2:

- Devon Canada Corporation's proposed Beaufort Sea Exploration Drilling Program
- Deh Cho Corporation's proposed Mackenzie River bridge near Fort Providence
- GNWT winter bridges along the Mackenzie winter road between Wrigley and Fort Good Hope

11.1.2 DEVON BEAUFORT SEA EXPLORATION DRILLING PROGRAM

Devon's proposed Beaufort Sea Exploration Drilling Program would occur within Devon's Exploration Lease 420 (Devon 2004). Figure 11-1 shows the location of the lease and the candidate drilling sites within the lease. One well will be drilled per year. An estimated maximum of four wells will be drilled between 2006 and 2009.

The entire project is offshore during the winter on landfast ice. Three options are being considered for a drilling platform. The leading option, the steel drilling caisson, would have a combined footprint of about 0.1 km^2 for the caisson and grounded ice pad.

No land-based components exist for this project. The only land use is for some equipment storage within existing areas already designated for such use. Therefore, no land use disturbance is associated with this project.

11.1.3 DEH CHO CORPORATION MACKENZIE RIVER BRIDGE

The Deh Cho Corporation Ltd. proposes to construct a permanent bridge across the Mackenzie River (DFO 2003). The bridge would be located at the site of the existing ferry and ice bridge at kilometre 23 of Highway 3 near Fort Providence. The 1,045-m long bridge would include nine spans and two abutments on approach berms.

The in-stream area occupied by the piers and backfill on approaches would be 7,400 m^2. The existing south causeway would be lengthened by 60 m. The land area occupied by the project overlaps the existing road and causeway servicing the ferry crossing. A small amount of additional land is required for widening the existing road approaches to 12 m. As land-based disturbance is largely along an existing right-of-way, additional permanent area occupied by the bridge would be minimal.

Several temporary routes and sites would be occupied during construction. These include (Jivko Engineering 2004):

- 700 m of road detour at the bridge approaches to the ferry
- a concrete plant occupying 5,600 m^2 in an existing cleared area
- a limestone quarry occupying 20,000 m^2
- a gravel pit adjacent to an existing pit occupying 25,500 m^2 accessed by a 2-km long road
- a concrete aggregate pit occupying 25,000 m^2
- a quarry adjacent to an existing pit occupying 10,000 m^2
- a granite rock quarry occupying 8,000 m^2

11.1.4 GNWT MACKENZIE WINTER ROAD BRIDGES

As part of its ongoing improvement of road infrastructure, the Government of the Northwest Territories (GNWT) is constructing permanent winter bridges at 21 watercourse crossings and two major river crossings along the existing Mackenzie winter road between Wrigley and Fort Good Hope. Figure 11-2 shows the locations of the bridges. The large river crossings are at the Great Bear River and the Blackwater River.

The geographic area disturbed by these projects is not known. Information on bridge design has been requested from the GNWT's Department of Transportation (D. Auger, pers. comm.) Once obtained, this information will be reviewed and a summary of associated land use disturbance prepared.

Figure 11.1 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Figure 11.2 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

11.2.1 INTRODUCTION

The following hypothetical natural gas development scenario and associated expansion of the Mackenzie Valley pipeline was prepared for illustration only, and is highly uncertain. It represents one potential scenario that might happen. Irrespective of the extent of future natural gas development in any of the regions used in this scenario, i.e., Mackenzie Delta, Colville Hills or Beaufort Sea, any new activity would require its own regulatory approvals and cumulative effects assessment.

The scenario is based on a report prepared by Gilbert Laustsen Jung (GLJ) Associates Ltd., Gas Resources and Supply Study for Imperial Oil Resources Ventures Limited on behalf of the Mackenzie Gas Project (GLJ 2004). The report was filed with the NEB to support the planned design pipeline capacity of 34.0 Mm^3/d (1.2 bcf/d). In addition, a sensitivity forecast was prepared by GLJ for a fully expanded pipeline capacity of 51.0 Mm^3/d (1.8 bcf/d). To date 23.5 Mm^3/d (0.83 bcf/d) of the planned design capacity of the pipeline is supported by signed precedent agreements.

Conclusions on the significance of effects are not made because of the uncertainties associated with the hypothetical scenario. Over the timeframe of this scenario many things would change, including:

- the development of improved exploration and production technology that would result in smaller footprints on the environment
- further advancements in reclamation of disturbed areas and site decommissioning
- more experience with, and improved, environmental and social management systems
- the regulatory regime
- the capacity of northerners to live, work and benefit from such activities as depicted in this scenario

In the biophysical assessment, quantified data in the form of areas of disturbance caused by the scenario and the associated changes that might occur from 2009 onwards, upon which the EIS results are based, is used to provide a qualitative summary of effect. Changes might occur at the landscape or wildlife population

level in the Colville Hills area. Appropriate management programs would need to be in place to ensure impacts are avoided or reduced.

Socio-economic effects would reflect those identified in the EIS. In some cases these effects could represent substantial change, as part of a larger ongoing evolution of northern society, as it makes better use of the benefits, and overcomes the challenges, of such change. This highlights the need for ongoing planning and management on a co-operative basis, by industry, regulators, communities and governments.

11.2.1.1 EIS Terms of Reference for Cumulative Effects

The Mackenzie Gas Project EIS Terms of Reference (TOR) (August 2004) provided the following guidance to the project proponents with respect to the scope of the cumulative impacts assessment (see TOR, Section 17):

With respect to defining future projects and activities a degree of certainty that the project or activity will proceed is necessary for it to be included in this analysis.

For clarity, the identification of future projects or activities should include those that are reasonably foreseen to be carried out.

Projects that are conceptual in nature or otherwise limited with respect to information on specifications, timing or location may not be sufficiently developed to contribute to the assessment of cumulative impacts in a meaningful manner. A rationale for the inclusion of projects and activities, or the exclusion of certain others, should be provided.

Based on this direction, the proponents prepared a cumulative effects assessment as part of the EIS (see EIS Volume 5, Part F, Section 12 for the biophysical component, and EIS Volume 6, Part B, Section 9, for the socio-economic component).

11.2.1.2 EIS Cumulative Effects Assessment Summary

The EIS biophysical and socio-economic cumulative effects assessment included reasonably foreseeable land uses and development projects as identified in the Project Inclusion List (see EIS Volume 5, Part F, Appendix A, Table A-1).

The proponents also took the initiative to address hypothetical land uses in the EIS biophysical and socio-economic effects assessment. This included the potential for future gas exploration and development, and accompanying expansion of the Mackenzie Valley pipeline by adding compressor stations as necessary to bring the pipeline up to a capacity of 51 Mm^3/d (1.8 bcf/d).

Effects from the hypothetical land uses are not assessed quantitatively because of the considerable uncertainty associated with specific project or activity details and timing. This approach is consistent with existing federal guidelines on interpreting and assessing hypothetical projects (CEAA 2003).

Biophysical

The biophysical assessment of cumulative effects concluded that:

- the Mackenzie Gas Project would not contribute significant cumulative effects
- there would be no significant overall cumulative effects
- the project would result in one potential cumulative effect of management concern, direct grizzly bear mortality. This could be addressed with diligent monitoring and management by responsible parties.
- based on the project footprint, a negligible proportion of the regional study area would be disturbed and, therefore, also a negligible proportion of the Northwest Territories
- the project might encourage other development, particularly gas exploration and production in the Northwest Territories. However, information to adequately assess the potential cumulative effects contribution from such developments is not available.
- the pattern of any future hydrocarbon development on the land and any effects from such development, although currently unknown, would likely be similar to the effects predicted for current and reasonably foreseeable land uses. Those developments would be subject to their own regulatory review and environmental impact assessment, including cumulative effects.

Socio-Economic

The socio-economic assessment of cumulative effects concluded that:

- the Mackenzie Gas Project would not contribute significantly to cumulative effects
- there would be no significant overall cumulative effects
- the project would result in one potential cumulative effect of management concern. This is the competition for qualified northern goods, services and labour, which could be addressed with diligent monitoring and management by responsible parties.
- demand for qualified northern content in projects is expected to use all available northern capacity. This would limit the extent of potential increased benefit and social costs among northern residents. However, it could marginally increase temporary speculative in-migration and associated social costs in the regional and commercial centres of Inuvik and Norman Wells.
- the project might encourage other development, particularly gas exploration and production in the Northwest Territories. However, information to

adequately assess the potential cumulative effects contribution from such developments is not available.

- the effect of any future hydrocarbon development on the communities, although currently unknown, would likely be similar to the effects predicted for current and reasonably foreseeable land uses. Those developments would be subject to their own regulatory review and socio-economic assessment, including cumulative effects.

The EIS provided an assessment of the effects of the Mackenzie Gas Project combined with the effects of reasonably foreseeable future projects. The proponents believe that the cumulative effects assessment in the EIS meets the requirements of the Terms of Reference.

11.2.1.3 Joint Review Panel Information Request

In its letter of December 3, 2004 the Joint Review Panel (JRP) requested that the proponents:

Provide a description of a production, transportation, development and gathering system that would require the Mackenzie Valley Pipeline to operate at its maximum capacity (51 Mm^3/d) and to provide an assessment of the resulting impacts as outlined in TOR Section 17.0.

The EIS cumulative effects assessment considered future gas development and associated Mackenzie Valley pipeline expansion of 10 additional compressor stations and two NGL pipeline pump stations in the NWT. However, a specific scenario was not developed because of the speculative and conceptual nature of any such undertaking and its limited value in contributing to the assessment of cumulative effects in a meaningful manner.

The proponents are nevertheless providing the following hypothetical natural gas development scenario, to comply with the Joint Review Panel's request.

11.2.2 HYPOTHETICAL DEVELOPMENT SCENARIO

11.2.2.1 Hypothetical Scenario Basis and Uncertainty

The GLJ study considered the supply side of both discovered (contingent) and undiscovered (prospective) gas development potential in three principal areas:

- Mackenzie Delta
- Beaufort Sea
- Colville Hills

Other areas, including northern Yukon, Cameron Hills and the Liard area were not considered because of their distance from the Mackenzie Valley pipeline or the existence of more likely gas transportation alternatives.

This hypothetical scenario does not reflect a detailed economic analysis of future discovered or undiscovered gas resources. The likelihood of accelerated exploration and development in the described timeframe to meet a 51 Mm^3/day gas delivery, as outlined in the GLJ study (page 64, Figure 34, Tables 36 and 37), is remote.

The uncertainties associated with potential future development include:

- the potential for existing discoveries to be developed
- the probability associated with future discoveries
- the potential for future discoveries to be developed
- overall plans for future development of natural gas in the north
- regulatory approvals of future development

Because of these uncertainties, the proponents believe this hypothetical scenario does not contribute to the cumulative effects assessment in a meaningful way.

11.2.2.2 Hypothetical Scenario Assumptions

General Assumptions

The following general assumptions were made to develop this hypothetical natural gas development scenario:

- new gas fields developed by others would be connected to the project's gathering system and the Mackenzie Valley pipeline
- natural gas from new fields would have a chemical composition similar to the three anchor fields
- new fields would be developed near existing pipelines and in one of three regions of known or likely hydrocarbon potential: Mackenzie Delta, Beaufort Sea and Colville Hills
- future possible seismic and exploration activities could contribute to cumulative effects over the long term. In most cases the activities are short-term and temporary, and tend to occur in the winter, when the potential for environmental impacts is reduced.
- the planned NGL pipeline would not support commercial crude oil development or transportation
- only non-associated natural gas would be delivered to the Mackenzie Valley pipeline
- the timing and volume of gas production in the fields is based on the GLJ study
- the scenario timeline would be based on a period in 2016 when maximum pipeline capacity throughput would first come on stream, and another in

2030 when the final gas development would come on stream, to allow for a maximum capacity throughput (51 Mm^3/d) as per the GLJ study. For scenario assumptions for the years of production, see:

- Figure 11-3 for the hypothetical development scenario overview for 2016
- Figure 11-4 for the hypothetical development scenario overview for 2030
- Figure 11-5 for the Mackenzie Delta and Beaufort Sea scenario for 2016
- Figure 11-6 for the Mackenzie Delta and Beaufort Sea scenario for 2030
- Figure 11-7 for the Colville Hills scenario for 2016
- Figure 11-8 for the Colville Hills scenario for 2030

- the hypothetical scenario does not consider end use of the gas once it enters the NGTL system in northwestern Alberta. Under any development scenario, once the gas enters the NGTL system, it would be treated like gas received at any other receipt point, of which there are about 1,000. It could be purchased and delivered to any of about 200 delivery points on the NGTL system. These delivery points include delivery points within Alberta and export delivery points that interconnect with other pipelines serving other provinces and the United States.

Specific Assumptions

Further assumptions specific to certain scenario components are outlined in the following topics.

Mackenzie Valley Pipeline

For the Mackenzie Valley pipeline, it was assumed that an additional 10 compressor stations would be in place by 2016 (see Figure 11-9).

NGTL Dickins Lake and Vardie River Sections

For the NGTL Dickins Lake and Vardie River Sections, it was assumed that two heater stations would be built by 2016 at:

- an interconnect facility near the Alberta–NWT boundary

- Thunder Creek compressor station at the southern end of the Vardie River Section

Gathering System

For the gathering system, it was assumed that:

- the existing gathering pipeline would be looped by 2016 with an incremental right-of-way width of 20 m

- new gas fields would be connected to the existing gathering system in the Mackenzie Delta with buried lines in a 30 m right-of-way, to reduce footprint and length

- Inuvik area facility expansion would be within the existing facility footprint
- two new pump stations would be built on the NGL pipeline at Thunder River and Loon River

Mackenzie Delta Production

For Mackenzie Delta production, it was assumed that (see Table 11-1 and Figure 11-10):

- Niglintgak, Taglu and Parsons Lake would continue to be central gas conditioning facilities
- 19 new producing satellite fields would be producing by 2016
- producing satellite fields and their associated tie-in lines would come online and offline between 2016 and 2030
- 15 satellite fields would be producing by 2030
- satellite fields would have small footprints with modules moved via winter roads from one location to another as fields went on and off line
- access to satellite fields for operations and maintenance would be by helicopter and winter access roads
- after satellite fields and tie-in lines went offline, they would be decommissioned and the landscape reclaimed

Beaufort Sea Production

For Beaufort Sea production, it was assumed that (see Table 11-2 and Figure 11-11):

- one offshore platform or artificial island would be built at Issungnak by 2016 and an associated subsea gathering pipeline would come ashore onto North Point of Richards Island and connect to the gathering system
- two additional offshore platforms or artificial islands would be built by 2030 at Amauligak and Netserk in addition to Issungnak
- 13 subsea satellite fields would be connected to the platforms or artificial islands by subsea buried tie-in gathering lines
- after satellite fields and associated tie-in lines went offline, they would be decommissioned
- Pelly and Adgo fields are categorized as onshore fields by the NEB and would tie in to South Garry

Colville Hills Production

For the Colville Hills production, it was assumed that (see Table 11-3 and Figure 11-12):

- there would be three central fields and processing facilities at Bele/Tedji, Tweed and in the Eastern Ridge area
- nine fields would be producing by 2016
- small satellite field footprints with buried tie-in lines would come on line and offline between 2016 and 2030
- after satellite fields and tie-in lines went offline, they would be decommissioned and the landscape reclaimed. Some lines would continue to serve new fields nearby.
- 17 satellite fields would be producing by 2030
- gas production would tie in to the Mackenzie Valley pipeline at Loon Lake compressor station, with a 120-km interconnecting pipeline

Infrastructure

For infrastructure, the following assumptions were made:

- existing infrastructure sites would be used where possible
- existing project operations sites would be used where possible
- existing disturbed borrow sites would be used where possible
- the marine staging area and operations base would be at Tuktoyaktuk for offshore fields

Table 11-1: Field Production Assumptions for the Mackenzie Delta

Year On Line	Year Off Line	Field[1]	Max. Production (MMscf/d)	Years on Production	Facility Footprint Size	Pipeline Destination	Compression Location	Site Dehydration	Facility Off Line	Pipeline Off Line	ROW width (m)	Line Length (km)	Line Size (NPS)
2009	2033	Niglintgak	130	25	Niglintgak	Taglu	Niglintgak	yes	2033	2044	30	15.7	16
2009	2036	Taglu	400	28	Taglu	IAF	Taglu	yes	2042	2046	40	81.4/52.5	26/30
2009	2035	Parsons Lake	300	27	Parsons Lake	Storm Hills	Parsons Lake	yes	2046	2046	30	26.5	18
2011	2021	Kumak	8.9	11	Parsons Lake South Pad	Niglintgak	Niglintgak	yes	2021	2021	30	11	6
2011	2021	Mallik	9.5	11	Parsons Lake South Pad	Taglu	Mallik	yes	2021	2046	40	17	6/30
2011	2020	Reindeer	6.1	10	Parsons Lake South Pad	YaYa South	YaYa South	yes	2020	2036	30	12	6
2011	2022	Titalik	18.9	12	1/2 Niglintgak	YaYa South	Titalik	yes	2028	2038	30	22	12
2011	2023	Tuktoyaktuk	62.4	13	Niglintgak	Parsons Lake	Tuktoyaktuk	yes	2043	2043	30	45	16
2011	2022	Ya Ya North	17.9	12	Parsons Lake South Pad	Taglu lateral	YaYa North	yes	2022	2022	30	4	6
2011	2022	YaYa South	15.8	12	1/2 Niglintgak	Taglu lateral	YaYa South	yes	2038	2038	30	4	16
2012		Niglintgak lateral loop									20	15.7	12
2012		Taglu lateral loop									20	81.4	20
2012		Parsons Lake loop									20	26.5	16
2012		Storm Hills loop									20	52.5	24
2012	2023	Adgo	35.9	12	subsea	Garry South	Garry South	no	2023	2043	30	16	20
2012	2024	Pelly	31.7	13	subsea	Netserk lat	Garry South	no	2024	2024	30	28	8
2012	2024	Garry South	30.6	13	1/2 Niglintgak	Niglintgak	Garry South	yes	2024	2043	30	14	20
2012	2023	Hansen	38.6	12	1/2 Niglintgak	Taglu	Hansen	yes	2023	2046	40	33	8/30
2013	2026	BM No.1	44.4	14	Parsons Lake South Pad	Parsons Lake	Parsons Lake	yes	2026	2026	30	7	8
2013	2027	BM No.2	44.4	15	Parsons Lake South Pad	Parsons Lake South Pad	Parsons Lake	yes	2027	2026	30	1	8
2013	2026	LFOn No.1	39.9	14	1/2 Niglintgak	Niglintgak	LFOn No.1	yes	2026	2026	30	15	10

Table 11-1: Field Production Assumptions for the Mackenzie Delta (cont'd)

Year On Line	Year Off Line	Field[1]	Max. Production (MMscf/d)	Years on Production	Facility Footprint Size	Pipeline Destination	Compression Location	Site Dehydration	Facility Off Line	Pipeline Off Line	ROW width (m)	Line Length (km)	Line Size (NPS)
2013	2026	LFOn No.2	39.9	14	Parsons Lake South Pad	LFOn No.1	LFOn No.1	yes	2026	2026	30	1	8
2013	2026	LFOn No.3	39.9	14	Parsons Lake South Pad	Titalik	Titalik	yes	2026	2028	30	13	10
2013	2028	LFOn No.4	39.9	16	Parsons Lake South Pad	LFOn No.3	Titalik	yes	2028	2028	30	6	8
2014	2030	BM No.3	44.4	17	1/2 Niglintgak	Tuktoyaktuk lateral	BM No.3	yes	2030	2030	30	6	8
2015	2030	LFOn No.5	39.9	16	1/2 Niglintgak	Taglu	LFOn No.5	yes	2030	2030	30	4	8
2017	2032	BM No.4	44.4	16	1/2 Niglintgak	Storm Hills PF	BM No.4	yes	2032	2032	30	8	8
2017	2032	LFOn No.6	39.9	16	1/2 Niglintgak	Taglu	LFOn No.6	yes	2046	2046	30	3	8
2019	2035	BM No.5	44.4	17	1/2 Niglintgak	Storm Hills PF	BM No.5	yes	2035	2035	30	8	8
2019	2034	LFOn No.7	39.9	16	Parsons Lake South Pad	YaYa South	YaYa South	yes	2034	2034	30	8	8
2021	2036	LFOn No.8	39.9	16	Parsons Lake South Pad	Reindeer	YaYa South	yes	2036	2036	30	3	8
2022	2038	BM No.6	44.4	17	Parsons Lake South Pad	Tuktoyaktuk lateral	BM No.3	yes	2038	2038	30	1	8
2023	2038	LFOn No.9	39.9	16	Parsons Lake South Pad	Titalik	YaYa South	yes	2038	2038	30	7	8
2025	2040	BM No.7	44.4	16	Parsons Lake South Pad	Tuktoyaktuk	Tuktoyaktuk	yes	2040	2040	30	6	8
2025	2040	LFOn No.10	39.9	16	1/2 Niglintgak	Issungnak lat	LFOn No.10	yes	2040	2040	30	1	8
2027	2043	BM No.8	44.4	17	Parsons Lake South Pad	Tuktoyaktuk	Tuktoyaktuk	yes	2043	2043	30	16	8
2027	2042	LFOn No.11	39.9	16	1/2 Niglintgak	Taglu	Taglu	yes	2042	2042	30	1	8
2029	2044	LFOn No.12	39.9	16	Parsons Lake South Pad	LFOn No.10	LFOn No.10	yes	2044	2044	30	9	8

Table 11-1: Field Production Assumptions for the Mackenzie Delta (cont'd)

Year On Line	Year Off Line	Field[1]	Max. Production (MMscf/d)	Years on Production	Facility Footprint Size	Pipeline Destination	Compression Location	Site Dehydration	Facility Off Line	Pipeline Off Line	ROW width (m)	Line Length (km)	Line Size (NPS)
2030	2046	BM No.9	44.4	17	Parsons Lake South Pad	Parsons Lake	Parsons Lake	yes	2046	2046	30	14	8
2031	2046	LFOn No.13	39.9	16	Parsons Lake South Pad	LFOn No.6	LFOn No.6	yes	2046	2046	30	6	8

Note:

1. LFO = Listric Fault [Zone], CH = Colville Hills, LFB = Listric Fault Basin, BM = Basin Margin [Play], PL = Parsons Lake

Table 11-2: Field Production Assumptions for the Beaufort Sea

Year On Line	Year Off Line	Field[1]	Max. Production (MMscf/d)	Years on Production	Facility Footprint Size	Pipeline Destination	Compression Location	Site Dehydration	Facility Off Line	Pipeline Off Line	ROW width (m)	Line Length (km)	Line Size (NPS)
2016	2041	Issungak	189.6	26	platform	LFOn No.10	Issungak	yes	2041	2044	40 (onshore)	52	30
2023	2041	Amauligak	206.5	19	platform	Issungnak	Amauligak	yes	2041	2044	NA	24	24
2025	2038	South Isserk	37.6	14	subsea	Issungnak	Issungnak	no	2038	2038	NA	13	8
2026	2037	Itiyok	17.9	12	subsea	Issungnak	Issungnak	no	2037	2037	NA	12	6
2026	2037	Kadluk	28.7	12	subsea	Netserk	Netserk	no	2037	2037	NA	16	8
2026	2038	Netserk	38.7	13	platform	Adgo	Netserk	yes	2038	2043	NA	21	8
2026	2038	S Nipterk	41.4	13	subsea	Netserk	Netserk	no	2038	2038	NA	22	8
2026	2038	Ukalerk	34.5	13	subsea	Amauligak	Amauligak	no	2038	2038	NA	40	12
2027	2039	Kiggavik	39.3	13	subsea	Kadluk	Netserk	no	2039	2039	NA	7	8
2027	2038	Minuk	32	12	subsea	LFB No.1	Netserk	no	2038	2038	NA	4	8
2027	2041	LFB No.1	90	15	subsea	Netserk	Netserk	no	2041	2041	NA	16	10
2027	2041	LFB No.2	90	15	subsea	Issungnak	Netserk	no	2041	2041	NA	7	10
2028	2042	LFB No.3	90	15	subsea	Issungnak lateral	Issungak	no	2042	2042	NA	3	10
2029	2043	LFB No.4	90	15	subsea	Netserk lateral	Netserk	no	2043	2043	NA	3	10
2030	2044	LFB No.5	90	15	subsea	Amauligak	Amauligak	no	2044	2044	NA	4	10
2031	2044	LFB No.6	90	14	subsea	Amauligak	Amauligak	no	2044	2044	NA	3	10

Note:

1. LFO = Listric Fault [Zone], CH = Colville Hills, LFB = Listric Fault Basin, BM = Basin Margin [Play], PL = Parsons Lake

Table 11-3: Field Production Assumptions for Colville Hills

Year On Line	Year Off Line	Field[1]	Max. Production (MMscf/d)	Years on Production	Facility Footprint Size	Pipeline Destination	Compression Location	Site Dehydration	Facility Off Line	Pipeline Off Line	ROW width (m)	Line Length (km)	Line Size (NPS)
2011	2020	Bele	62.9	10	Niglintgak	Loon River	Bele	yes	2041	2041	50	112	24/6
2011	2022	Tweed	62.9	12	Niglintgak	Bele	Tweed	yes	2038	2038	40	43	12
2013	2024	Tedji	11.7	12	1/2 Niglintgak	Tweed	Tedji	yes	2024	2024	30	111	6
2013	2026	CH No. 1	21.5	14	1/2 Niglintgak	Bele	CH No. 1	yes	2041	2041	30	28	12
2013	2026	CH No. 2	21.5	14	Parsons Lake South Pad	CH No. 1	CH No. 1	yes	2026	2026	30	11	6
2013	2027	CH No. 3	21.5	15	Parsons Lake South Pad	CH No. 1	CH No. 1	yes	2027	2027	30	12	6
2014	2028	CH No. 4	21.5	15	1/2 Niglintgak	CH No. 1	CH No. 4	yes	2041	2041	30	39	10
2015	2028	CH No. 5	21.5	14	Parsons Lake South Pad	CH No. 4	CH No. 4	yes	2028	2028	10	14	6
2016	2029	CH No. 6	21.5	14	Parsons Lake South Pad	CH No. 4	CH No. 4	yes	2029	2029	30	11	6
2016	2030	CH No. 7	21.5	15	1/2 Niglintgak	Tweed	CH No. 7	yes	2031	2038	30	50	10
2017	2030	CH No. 8	21.5	14	Parsons Lake South Pad	CH No. 7	CH No. 7	yes	2030	2030	30	10	6
2017	2031	CH No. 9	21.5	15	Parsons Lake South Pad	CH No. 7	CH No. 7	yes	2031	2031	30	10	6
2018	2031	CH No. 10	21.5	14	Parsons Lake South Pad	Bele	Bele	yes	2031	2031	30	14	6
2018	2032	CH No. 11	21.5	15	Parsons Lake South Pad	Bele	Bele	yes	2032	2032	30	14	6
2019	2033	CH No. 12	21.5	15	Parsons Lake South Pad	Tweed	Tweed	yes	2033	2033	10	7	6
2020	2033	CH No. 13	21.5	14	Parsons Lake South Pad	Tweed	Tweed	yes	2033	2033	30	8	6
2020	2034	CH No. 14	21.5	15	Parsons Lake South Pad	Tweed	Tweed	yes	2034	2034	30	12	6
2021	2034	CH No. 15	21.5	14	Parsons Lake South Pad	CH No. 1	CH No. 1	yes	2034	2034	30	17	6

Table 11-3: Field Production Assumptions for Colville Hills (cont'd)

Year On Line	Year Off Line	Field[1]	Max. Production (MMscf/d)	Years on Production	Facility Footprint Size	Pipeline Destination	Compression Location	Site Dehydration	Facility Off Line	Pipeline Off Line	ROW width (m)	Line Length (km)	Line Size (NPS)
2021	2035	CH No. 16	21.5	15	Parsons Lake South Pad	CH No. 17	CH No. 17	yes	2035	2035	30	9	6
2022	2035	CH No. 17	21.5	14	1/2 Niglintgak	Bele	CH No. 17	yes	2036	2036	30	26	10
2023	2036	CH No. 18	21.5	14	Parsons Lake South Pad	CH No. 17	CH No. 17	yes	2036	2036	30	10	6
2023	2037	CH No. 19	21.5	15	1/2 Niglintgak	CH No. 7	CH No. 19	yes	2038	2038	30	32	8
2024	2037	CH No. 20	21.5	14	Parsons Lake South Pad	CH No. 19	CH No. 19	yes	2037	2037	30	8	6
2024	2038	CH No. 21	21.5	15	Parsons Lake South Pad	CH No. 19	CH No. 19	yes	2038	2038	30	17	6
2025	2039	CH No. 22	21.5	15	Parsons Lake South Pad	Bele	Bele	yes	2039	2039	30	16	6
2026	2041	CH No. 23	21.5	16	Parsons Lake South Pad	CH No. 4	CH No. 4	yes	2041	2041	30	15	6

Note:

1. LFO = Listric Fault [Zone], CH = Colville Hills, LFB = Listric Fault Basin, BM = Basin Margin [Play], PL = Parsons Lake

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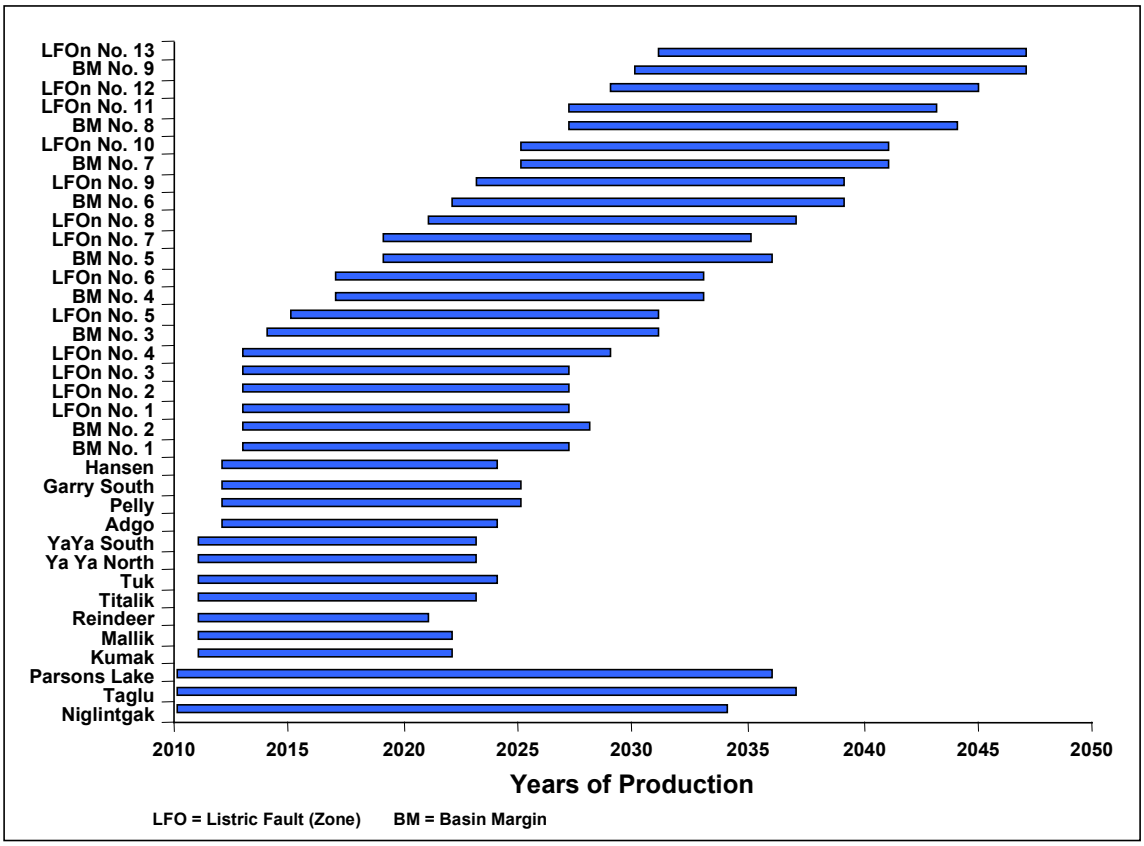

Figure 11-10: Scenario Assumptions for Years of Production per Field for the Mackenzie Delta

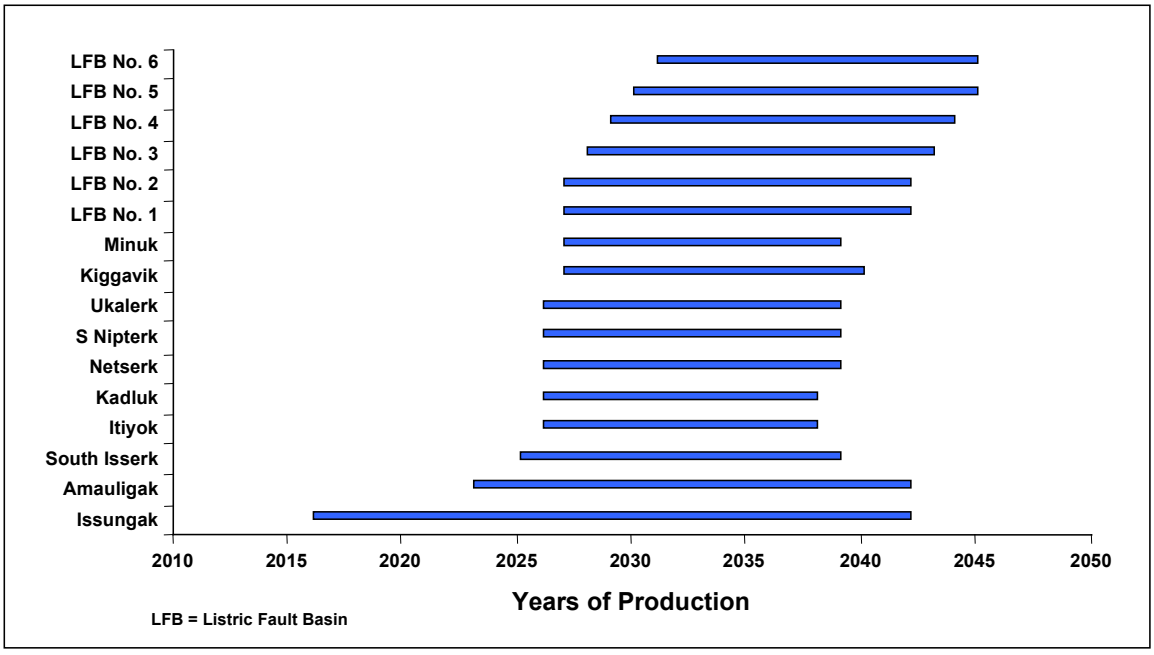

Figure 11-11: Scenario Assumptions for Years of Production per Field for Beaufort Sea

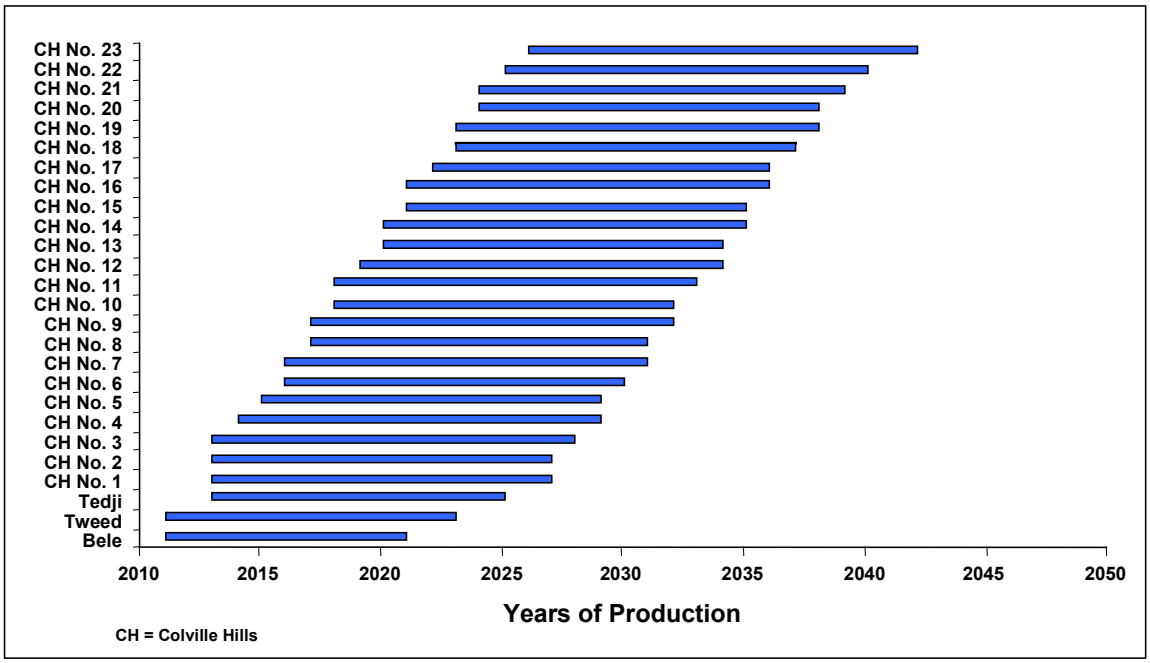

Figure 11-12: Scenario Assumptions for Years of Production per Field for Colville Hills

11.2.3 BIOPHYSICAL EFFECTS

11.2.3.1 Approach

The following approach was the basis for the biophysical effects assessment:

- assessing the same VCs or KIs as those identified in EIS Volume 5
- conducting a qualitative assessment, except for calculating disturbed areas
- using the information and results of the project-specific and cumulative effects assessments in EIS Volume 5 as the basis of this assessment. For example, effects from pads and pipelines, as assessed in the EIS for the Mackenzie Delta, would be similar to effects from similar project components in this scenario.
- using a broad landscape or regional approach to characterize biophysical conditions
- supplementing the EIS baseline data with some additional information on biophysical conditions in the Beaufort Sea and Colville Hills areas
- focusing on likely incremental changes from the start of project operations in 2009 to the first year of start–up of a fully expanded Mackenzie Valley pipeline (2016) and incremental changes from 2016 to 2030

- making no conclusions of significance, instead discussing trends and suggesting situations where cumulative effects could occur

- recognizing the spatial and temporal differences between the project and this hypothetical scenario

11.2.3.2 Disturbance

Areas of disturbance were based on the scenario assumptions for facility footprints, gathering lines and pipeline rights-of-way width and length (see Tables 11-1 to 11-3, shown previously).

The total area of disturbance was calculated for each year, and a year was identified when the disturbance area was maximum. Table 11-4 summarizes the disturbance areas for the scenario. The disturbance areas are illustrated in:

- Figure 11-13 for the Mackenzie Delta
- Figure 11-14 for the Beaufort Sea
- Figure 11-15 for Colville Hills

Development in the Mackenzie Delta would increase to a peak disturbance area in 2021, followed by a gradual decline. Development in the Beaufort Sea would increase slowly to a peak disturbance area in 2032 followed by a gradual decline. Colville Hills would increase gradually to a peak disturbance area in 2026 followed by a gradual decline. Taken together, the year of maximum area disturbance in this hypothetical scenario is 2030.

Table 11-4: Summary of Areas of Disturbance

Component	Area of Disturbance (ha)					
	At Start of Operations (Year 2009)	Hypothetical Scenario (Year 2016)	Change (2009 to 2016)	At Year of Maximum Area of Disturbance	Hypothetical Scenario (Year 2030)	Change (2016 to 2030)
Beaufort						
Fields	0	4	4	60	60	56
Pipelines	0	208	208	592	592	384
Beaufort Subtotal	0	212	212	652 (year 2030)	652	440
Mackenzie Delta						
Fields	60	196	136	230	182	-14
Pipelines	394	1,573	1,179	1,663	1,570	-3
Mackenzie Delta Subtotal	454	1,770	1,316	1,893 (year 2021)	1,752	-18
Colville Hills						
Fields	0	96	96	162	146	50
Pipelines	0	150	150	811	811	661
Colville Hills Subtotal	0	246	246	973 (year 2026)	957	711
Compressor Stations	40	146	106	146	146	0
Total	494	2,374	1,880	3,664 (year 2030)	3,507	1,133

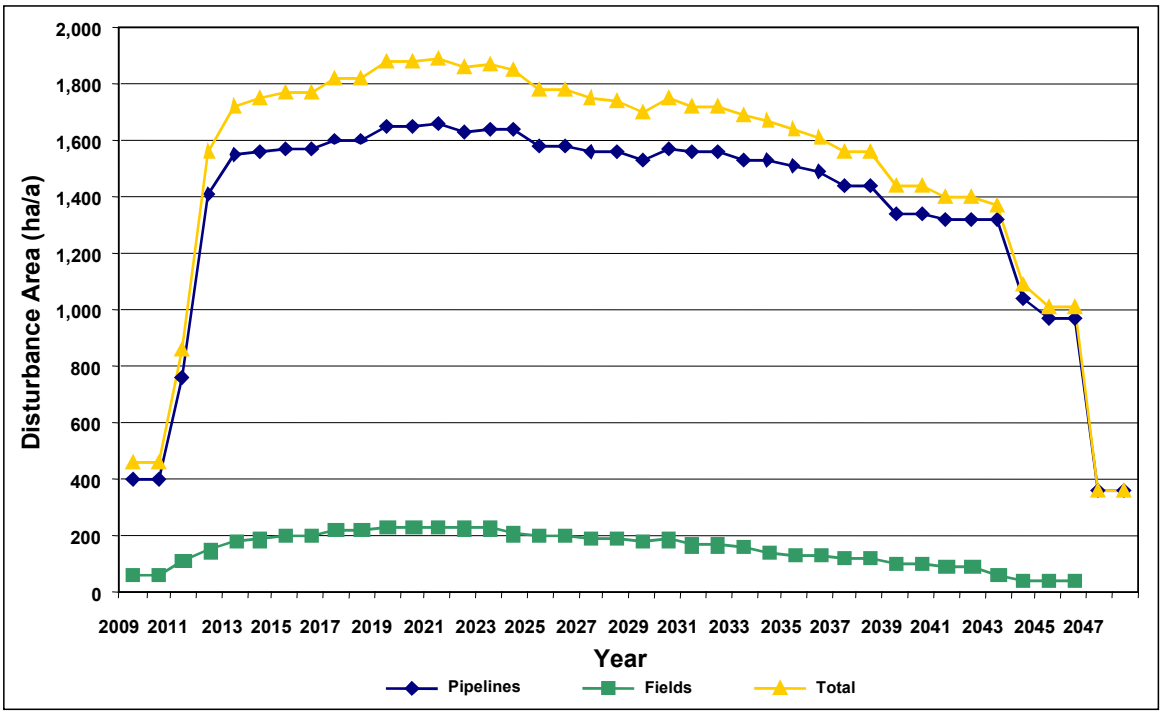

Figure 11-13: Scenario Assumptions for Total Disturbed Area for the Mackenzie Delta

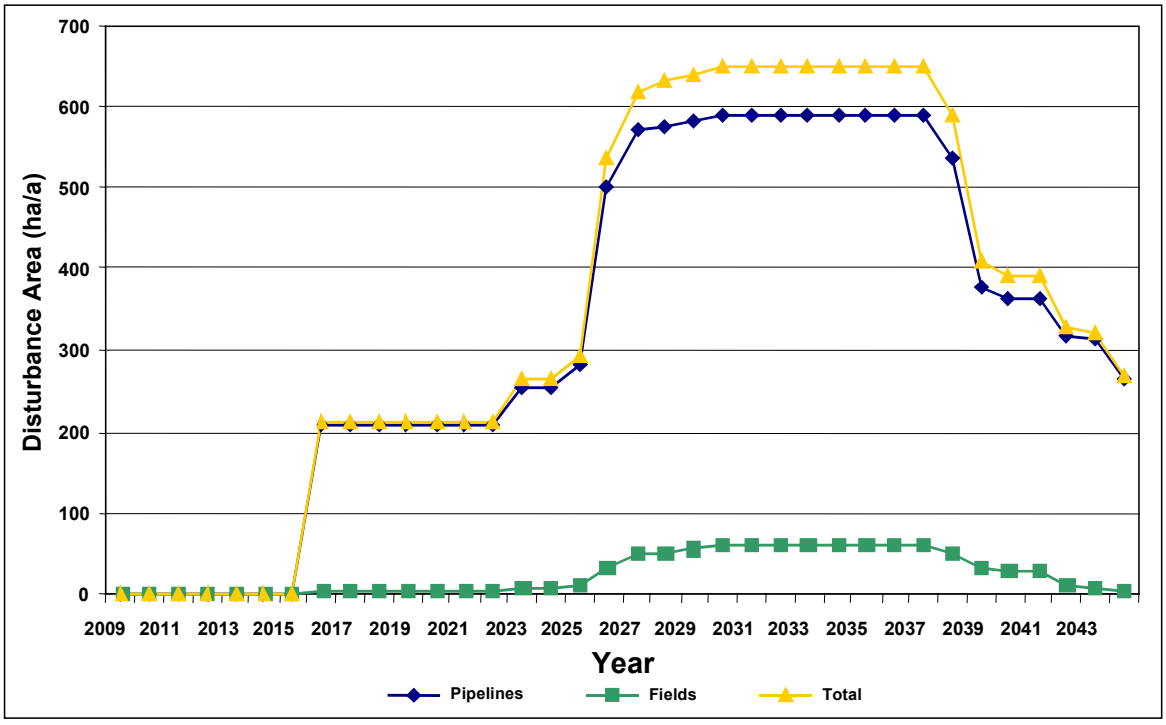

Figure 11-14: Scenario Assumptions for Total Disturbed Area for the Beaufort Sea

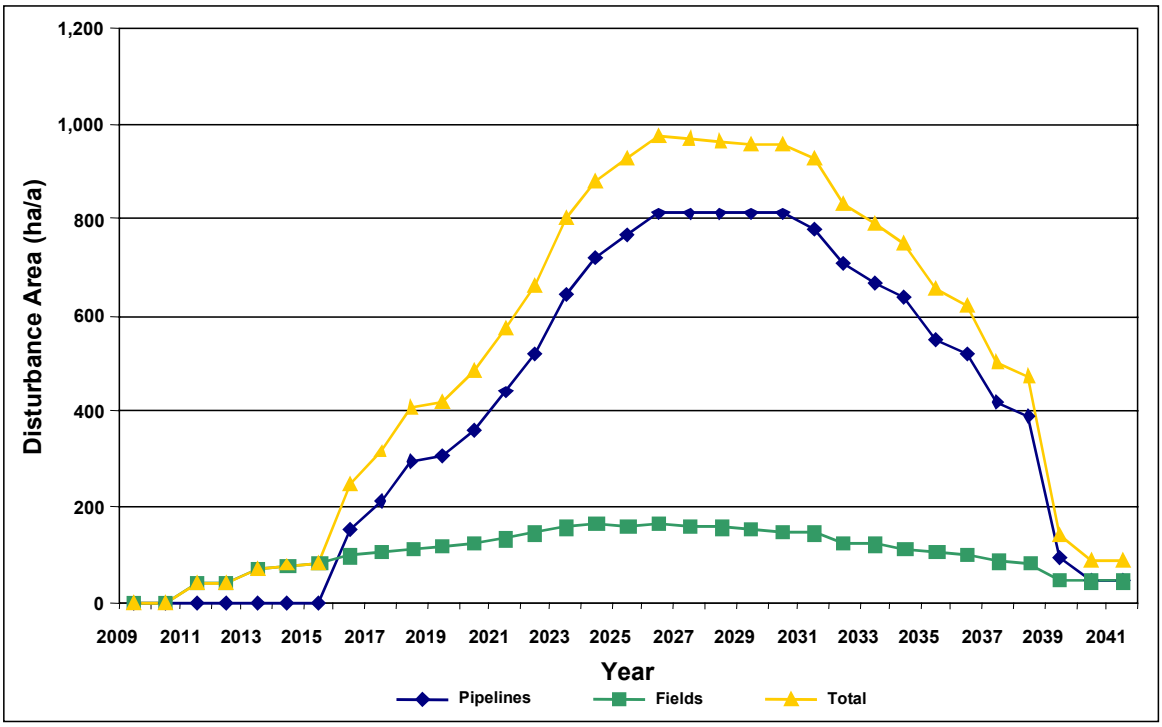

Figure 11-15: Scenario Assumptions for Total Disturbed Area for Colville Hills

11.2.3.3 Cumulative Effects Assessment

Ecological Zones

Each of the three producing regions occurs within separate ecological zones:

- Mackenzie Delta – Tundra Ecological Zone
- Beaufort Sea – Marine Ecological Zone
- Colville Hills – North Taiga Plains Ecological Zone. Although this ecological zone was identified in EIS Volume 5, because the project study area occurs within that zone, the Colville Hills region, outside the terrestrial RSA, was not mapped or assessed in detail in the EIS.

The gas pipeline occurs within the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones.

Because of the distinct separation of ecological zones, most biophysical effects from the scenario's projects within a given zone do not interact cumulatively with effects from other zones. Therefore, potential biophysical effects are mostly isolated within each zone. Exceptions are where a VC or KI affected by the project might move between zones. Examples of this include some far-ranging wildlife species, such as caribou and moose, or airborne or waterborne constituents.

Regional Effects

The following observations place the hypothetical development scenario in a regional context.

Land Area

The scenario would directly disturb only a relatively small geographic portion of the landscape. Pipelines, either buried, in the ground, or subsea, would constitute the largest portion of the disturbed area. After reclamation of disturbed areas, the effects of each pipeline would be minor for the duration of the scenario.

The direct disturbance caused by the new production field facilities would be a small portion of the total scenario area. Effects from each of these fields during construction and their operational life, on average 14 to 15 years, would be similar to the effects already identified and assessed in EIS Volume 5. Following reclamation of disturbed areas and the application of mitigation management practices, effects would be minimal. The effects of each field would be minor for the duration of the scenario.

The spatial footprint of the new onshore fields would be smaller than the anchor fields. The smallest field would be about 4 ha, about the size of the proposed Parson Lake south pad. The largest would be about 10 ha, about half the size of the proposed Niglintgak footprint. The size of above-water facilities in the Beaufort Sea is unknown. The scenario assumes there would be at most three platforms or artificial islands, and the remaining fields would be subsea.

Effects Pathways

Because the fields are relatively small, the cumulative effects of all the fields depends mainly on the distance between fields and the length of the pipelines. In the Mackenzie Delta, the distance between fields ranges from a few kilometres to 30 km. The further apart the fields are, the less likelihood of interactions between them that would result in cumulative effects.

For the onshore regions Mackenzie Delta and Colville Hills, cumulative effects might occur in the following situations:

- emission plumes overlapping under certain wind conditions
- waterborne constituents, such as sediment, being deposited when the same stream passes close to more than one field. This would be most likely during construction.
- surface water drainage being altered within a watershed that has multiple projects
- more than one field removing water from the same water source
- effects to fish occurring because of the effects on water

- local changes or loss of vegetation that are noticeable at a landscape scale
- loss of wildlife habitat or alienation from preferred habitat because of sensory disturbances
- increased use of vehicles along improved access roads, in summer and winter, leading to potential alteration of tundra

For the offshore Beaufort Sea region, cumulative effects might occur in the following situations:

- increased sediment load in the water column during construction
- noise and activity associated with offshore development
- noise and activity associated with marine transportation between land bases and offshore rigs
- effects on benthic organisms because of multiple subsea pipeline construction
- hydrology being altered at pipeline landfalls, with possible hydrology changes as a result of nearshore or land-based activities in the delta

For the additional compressor stations along the transmission pipeline, measurable cumulative effects might occur in the following situations:

- soils and vegetation changing because of air emissions from compressors and possible nearby land uses
- wildlife being affected by noise and lighting
- increased use of vehicles along improved access roads

Mackenzie Delta

Footprint

Mackenzie Delta development would peak at 26 fields between years 2019 and 2021, with a maximum disturbed area of 1,893 ha in 2021. An increase from 454 ha in the base year 2009 to 1,770 ha in year 2016, would be followed by a period of no appreciable change, ending with a slight decrease of 18 ha to 1,752 ha in 2030.

The total length of buried pipelines would be 1,027 km in 2016 and 1,284 km in 2030.

In the Kendall Island Bird Sanctuary, there would be two new fields, the South Garry and Kumak. The total area of the new fields and their associated new pipelines in the Kendall Island Bird Sanctuary would be 132 ha. The total

disturbed area in 2009 would be 0.15% of the Kendall Island Bird Sanctuary area, 0.36% in 2016 and 0.27% in 2030. The contribution of the scenario projects to this would be 0.21% in 2016 and 0.12% in 2030.

Effects

A detailed assessment has already been made of potential project-specific effects of the three anchor fields in the Mackenzie Delta. The cumulative effects of these fields with other existing and reasonably foreseeable land uses has also already been assessed. No effects were found that would require modifying the project design or applying additional effects management measures.

Adding 23 new production fields would be a substantial increase, with the potential for cumulative effects. However, the land base altered during operations would be small on a landscape scale, and most fields would be separated by distances that would reduce the likelihood of cumulative effects. Of the previously identified effects pathways, cumulative effects would be most likely from:

- human transportation between sites, typically by land or air
- movements of wildlife species that might interact with more than one field within a period when its physiological response remained altered by each subsequent interaction

Airborne and waterborne pathways might result in cumulative effects. However, the effects along these pathways would be small, or would not occur, because of:

- successful application of management measures on site
- the distances between fields
- the likely limited potential for flowing water interacting between fields given the limited hydrological movement

Because wildlife move, they pose the greatest challenge in understanding how cumulative effects might create responses that would cause displacement, mortality or increased stress. Despite extensive studies, effects are not always clear. However, it is certain that wildlife would be affected to some degree.

As discussed in the EIS, direct grizzly bear mortality was identified as a cumulative effects concern that would require monitoring and management by responsible parties.

Winter-based construction would contribute to reducing effects because of frozen conditions and the limited presence of wildlife.

Designated management areas, or areas of wildlife concentration, such as the Kendall Island Bird Sanctuary for waterfowl and beluga management zones for beluga, are geographic areas where cumulative effects might be a concern no

matter how seasonal the species occurrence might be. Ongoing monitoring of effects in these areas and protection measures, such as restrictions on transportation timing, need to be in place before development.

Beaufort Sea

Footprint

Beaufort Sea development would peak at 15 fields between 2030 and 2037, with a maximum disturbed area of 652 ha in 2030. There would be an increase in development from 0 ha in base year 2009 to 212 ha in 2016, followed by an increase of 440 to 652 ha in 2030. The disturbance from fields alone would increase from 0 ha in base year to 4 to 60 ha during the scenario years. Only three fields, Issungak, Amauligak and Netserk are assumed as platforms, the remainder would be subsea. In the peak year 2030, disturbance from fields would be only 9%, or 56 ha. All development would be decommissioned by 2044.

Effects

The Mackenzie Gas Project has some components located in or near saltwater or brackish marine environments. As indicated in the project cumulative effects assessment (see EIS Volume 5, Part F, Section 12), there is a small potential for effects on some marine mammals. However, as there is some possibility for interaction, effects from the Beaufort development might act cumulatively with Mackenzie Gas Project effects.

The marine mammal VCs, polar bear, beluga and bowhead whale and ringed seal range throughout the Beaufort region. Bowhead whales and ringed seals appear during seasonal migration in open water season and the polar bear during the season of landfast ice (Devon 2004). Beluga and bowhead whale might be affected by above-water platforms and any noise from their operation and associated shipping activities. Benthos, or benthic organisms, might be affected locally by pipelines. However, such effects would not act cumulatively with the project.

Although the Pelly field is located in Beluga Management Zone 1A, the pending legislation on Beaufort marine protected areas is expected to exclude existing significant discovery licences from restrictions to industrial activities.

Cumulative effects between the project and possible Beaufort Sea projects would be rare or would not occur.

Colville Hills

Footprint

Colville Hills development would peak at 25 fields in 2026, the year of maximum disturbance of 973 ha. This is half the maximum disturbance in the Mackenzie Delta. Disturbance would increase from 0 ha in year 2009 to 246 ha in 2016, followed by an increase of 711 to 957 ha in 2030. All development would be decommissioned by 2046. The disturbance from fields alone would be

about 17% of disturbance, with an increase from 0 ha in 2009 to 96 ha in 2016 and 146 ha in 2030. The peak field size of 162 ha in 2026 would be equivalent to about eight times the size of the Niglintgak field.

The area required for new aggregate sites was not forecast.

Effects

Development in Colville Hills would be more than 100 km from the closest component of the Mackenzie Gas Project, the Loon River compressor station, where the gathering line from Colville Hills joins the Mackenzie Valley pipeline. Therefore, effects from the Colville Hills development would likely not overlap with Mackenzie Gas Project effects, except for pathways involving some far-ranging wildlife species, such as moose, woodland caribou and barren-ground caribou.

If the current winter road were upgraded to an all-weather road as part of the GNWT's ongoing infrastructure improvement, increased road traffic at all times of year might cause increased effects on wildlife through direct and indirect mortality.

The Colville Hills region, unlike the Mackenzie Delta region, has forest cover. Therefore, winter seismic, exploration, construction and operations would leave a footprint for rights-of-way and clearings. The coexistence of wildlife and industrial activities in other similar areas of Canada indicate the possibility of sustainable development but challenges in ensuring its continuation in the face of increasing land use. An example is the management of woodland caribou habitat in Alberta and southern NWT, in which thresholds are being identified based on linear corridor densities.

Mackenzie Valley Pipeline

Footprint

The approximate average size of the compressor stations would be 10 ha. The base case area of 40 ha would increase to 146 ha for the duration of the scenario. Adding pump stations for the NGL line to two of these stations would not increase this footprint. It is unlikely that new access roads would be required.

Effects

The principal change in effects from the compressor stations would be an increase in cleared area and concentrations of some air quality constituents. Depending on topographic conditions, the effects of air emissions would typically be quite localized. On a landscape scale, the additional clearing would cause some reduction in wildlife habitat directly and indirectly through sensory disturbance. However, given the isolated location of most of these stations, it is likely that there would be few other measurable land uses affected by the project.

NGTL Dickins Lake and Vardie River Sections

Footprint

The two heater stations built at the interconnect facility near the Alberta–Northwest Territories boundary and at Thunder Creek compressor station at the southern end of the Vardie River Section would be contained within the existing footprint.

Effects

There would be no effects on land use beyond those resulting from the pipeline footprint.

Summary of Effects

Table 11-5 summarizes the degree of change, if any, from the base case year 2009 to the scenario years of 2016 to 2030. The table is based on the same disciplines and KIs or VCs from the project biophysical cumulative effects assessment (see EIS Volume 5, Part E, Section 12, Table 12-26).

The ranking of effects is qualitative, and is used to indicate only a relative scale of possible change. Regional level changes, denoted by •••, do not imply that the change is of concern. This ranking indicates that some degree of change on a regional scale might occur.

11.2.4 SOCIO-ECONOMIC EFFECTS

11.2.4.1 Approach

The following approach and assumptions were made as the basis for the socio-economic effects assessed for the hypothetical scenario:

- socio-economic cumulative effects would be driven by total demand for goods and services, in particular by labour force demands created by the level of capital investment
- total investment requirements were estimated and were separated according to the region in which the related facilities and activities would be located
- the Beaufort–Delta Region (BDR) was considered as a combined affected area because:
  - the ISR and GSA share a common business and administrative centre, Inuvik, which is also the largest labour market in the area
  - potential effects could not be differentiated between the ISR and GSA
- the spatial and temporal differences between the Mackenzie Gas Project and the hypothetical scenario were recognized

Table 11-5: Summary of Biophysical Cumulative Effects

Discipline	Key Indicator or Valued Component	Effect Summary Change from Base Case Year 2009 to Scenario Years 2016–2030		
		Beaufort	Mackenzie Delta	Colville Hills
Air	NO_2, SO_2, CO, $PM_{2.5}$, benzene, BTEX, PAI	●	●●	●●
Noise	Sound level	●	●●	●●
Groundwater	Groundwater quantity and flow patterns, groundwater quality	●	●	●
Hydrology	Runoff amount and drainage patterns, water levels and flow velocities, sediment concentration, channel morphology	N/A	●	●
Water quality	Wastewater releases, suspended sediments	●	●	●
Fish and fish habitat	Habitat, health, abundance and distribution	●	●	●
Soils, landforms and permafrost	Ground stability, uncommon landforms, soil quality	●	●●	●●
Vegetation	Abundance and distribution of vegetation species and associations, and health of vegetation species	N/A	●●	●●●
Wildlife	Habitat availability, movements. Mortality.	●	●●	●●●

Note:
N/A = not applicable
● = no or negligible, i.e., barely measurable, change
●● = some measurable change at a local scale
●●● = a change measurable at a landscape or wildlife population scale

11.2.4.2 The Economy

The hypothetical development scenario would involve investing in:

- additional gas fields
- activities associated with development, production, compression and gathering systems

As a result, projected total capital estimates would be about $20 billion, or nearly three times greater than the capital expenditures for the project.

The geographic distribution of capital expenditures in the Northwest Territories would be concentrated in the Beaufort–Delta Region and Sahtu Settlement Area (SSA). Inuvik and Norman Wells would experience economic benefits, because they are the main commercial centres and transportation hubs for the Beaufort–Delta and Sahtu regions.

Outside the Northwest Territories, the distribution of capital expenditures would be similar to that predicted for the project, with about half of the capital expenditures and gross domestic product (GDP) flowing into Alberta.

During scenario operations, which would span about 40 years, total operating costs for the scenario could be about $10 billion (GLJ study 2004), compared to less than $4 billion for project operations. Distribution of GDP during scenario operations would be almost entirely within the Northwest Territories, with little flowing to other regions in Canada because all of the production and most of the employment would be in the Northwest Territories.

Construction-related employment (direct, indirect and induced) associated with the hypothetical scenario could total more than 275,000 jobs over 25 years, beginning in 2009. This would be 160,000 more than the construction-related jobs created by the project. Northwest Territories residents could fill about 20,000 of these jobs.

It is assumed that incremental direct construction jobs not filled by Northwest Territories residents would be filled by southerners that:

- work in the Northwest Territories on a rotational basis
- reside in camps while on the job
- maintain permanent residences in the south

Total incremental labour income would likely exceed $7 billion, and more than $1.3 billion would be retained in the Northwest Territories.

Operations-related employment (direct, indirect and induced) associated with the hypothetical scenario could total close to 75,000 jobs over 35 years, beginning in 2011. This would be 40,000 more than the operations-related jobs created by the project. Northwest Territories residents could fill more than 15,000 of these jobs.

It is assumed that many of the incremental direct operations jobs not filled by Northwest Territories residents would be taken up by southern rotational workers.

Total incremental labour income would likely exceed $2 billion, and more than $1 billion would be retained in the Northwest Territories.

It is assumed that beneficial effects from potential employment and income would be high in the study area for the duration of the scenario. The cumulative effects on government revenues would also likely be substantial. It is estimated that they would be about 50% to 60% higher than those presented for the project in the EIS.

Cumulative beneficial effects on the economy would likely be large and sustained for the life of the scenario in the Northwest Territories as a whole, and in the BDR and SSA regions. Beneficial effects would also increase in the Deh Cho Region (DCR) but would be lower and last for a shorter period than in the other regions.

11.2.4.3 Demography

Applying a precautionary approach to the socio-economic assessment of the cumulative effects scenario resulted in selecting the peak years of potential capital investment as the focus for the assessment. These investment peaks would occur at different times for BDR and the SSA and DCR:

- the BDR peak would relate primarily to peak field development and occur around 2025
- SSA and DCR peak would relate more to pipeline facility construction (compression and laterals) and occur in 2009

In the SEIA (EIS Volume 6), labour demand was predicted to exceed labour supply during the forecast peak years of project construction between 2007 and 2009. In the hypothetical scenario, labour demand is also expected to exceed supply in the BDR and the SSA during several years. However, the incremental labour demand should be within the overall labour capacity of the Northwest Territories between 2011 and 2045.

It is expected that the labour force would expand and relevant education, skills and experience would increase over this time. As a result, the shortfalls in labour supply in the BDR and the SSA could be met by labour from other regions within the Northwest Territories on a rotational or permanent basis, or the shortfall could be addressed by labour from the south on a rotational or permanent basis.

Each of these labour demand and supply scenarios generates different implications for community and regional infrastructure, and community wellness. Although it is not possible to predict precisely how the Northwest Territories labour market would respond, conservative assumptions were made that would result in some level of in-migration during these years of peak demand.

In the SSA, the peak could occur immediately following the project peak. Because a regional shortfall in supply is possible, it is expected that about the same number of in-migrants could move to Norman Wells in 2009 as the number expected for the project in 2007. This would mean the expected post-project reduction in population likely would be delayed for one or two years. However, the supply imbalance should be reduced to low levels by 2011.

In the BDR, the peak labour shortfall is projected to occur much later for the hypothetical scenario than for the project. However, it could result in an in-migration to Inuvik of about the same size as that for the project peak. The scenario peak would not occur until 2021, which would provide an adjustment period.

Activity in the DCR is not expected to generate labour force demands that would exceed regional supply at any time in the scenario. As a result, no additional in-migration would be expected. The same is true for the industrial and commercial centres of Hay River, Yellowknife and Enterprise.

For the project, most in-migration effects were expected in the regional centres. This would also be the case for the hypothetical scenario. Speculative job-seekers would not need to migrate to smaller communities because:

- direct employment could be obtained in their home communities
- indirect and induced opportunities would be concentrated in the regional centres

As described previously, there are several possible management alternatives and related outcomes. The mitigation measures proposed for the project could be extended or strengthened for the hypothetical scenario. Industry, regulators and governments could manage employment and hiring policies through the planning and approvals process and various agreements, in a way to limit in-migration.

11.2.4.4 Infrastructure and Community Services

Assuming that the mitigation and management controls proposed for the project would be similar to those implemented for the hypothetical scenario, the incremental construction and operations labour force and population would not adversely affect community and regional infrastructure.

For mitigation and management measures relevant to limiting potential incremental population and related housing effects, see EIS Volume 6, Part A, Sections 3.3.4 and 4.3.4. These measures focus on:

- recruiting and hiring processes designed to discourage speculative in-migrants
- providing self-contained camps for most project personnel

Cooperative action by government employment agencies would be warranted to address migrants seeking indirect and induced employment opportunities. Government management measures specific to the housing sector could include:

- repairs to existing substandard housing
- incentives to the private sector to construct additional accommodation

The only issue of management concern would be housing requirements in Norman Wells and, to a lesser extent, in Inuvik. In both these centres, some housing shortages would be expected, and the associated increases in rental prices. Government management action would be required, related primarily to low-cost housing for the vulnerable components of the Inuvik and Norman Wells populations affected by price increases.

Although the projected population growth in the hypothetical scenario represents a doubling of the predicted project effects, it is expected to build to this level over an extended period in Inuvik. This should provide time for market adjustment, and for cooperation between industry and government on other management actions that ongoing monitoring might suggest.

The doubling of demands and the extension of the peak for one or two years could pose a more serious management challenge in Norman Wells. Mitigation suggested for the project would be extended and strengthened for the scenario, with the housing sector operators, the industry and government cooperating in shared management initiatives. However, this adverse effect would be expected to decline rapidly.

11.2.4.5 Individual, Family and Community Wellness

Health and Wellness Conditions

The cumulative employment opportunities from the scenario would provide Aboriginal and other northern residents with additional income. This would likely have effects on individual, family and community wellness in the regional centres of Inuvik and Norman Wells, and in the many Aboriginal communities that would supply rotational workers. Well-being would be affected in all of these communities.

There would be significant material benefits. Most workers from these communities would spend some of their earnings on:

- equipment that would increase traditional harvesting efficiency
- home improvements, appliances, better clothing and nutrition, which would improve their quality of life

However, there would also be adverse effects on health and well-being. Health might be affected by:

- increased exposure to contagious diseases among the workers
- increased spending on substance abuse

The consequence of increased substance abuse would be increases in accidents and violent offences. Families and community relations would be affected.

For the scenario, the additional health and social problem conditions commonly associated with an increase in disposable income would be expected to increase beyond the project-specific effect levels. However, in the past, people have adjusted over time to the continuing availability of employment and enhanced income. Many would learn to make increasingly better lifestyle choices. Socio-economic conditions would stabilize and the problem conditions associated with initial large influxes of income would gradually decline in most communities.

Because of the sustained level of economic activity and related attraction of migrants to Inuvik, many health and social problem conditions would persist there for the longer term. Managing these effects would be challenging. The effects in the other communities would be at a lower level and for a shorter period.

Health and Wellness Services

Cumulative economic benefits, and the associated health and wellness problem conditions would induce cumulative effects on health, social and protective services. These would be experienced in communities with workers involved in scenario employment, and also in the regional centres of Inuvik and Norman Wells.

The mitigation measures suggested in EIS Volume 6, Part B, Section 5.2.4, would contribute to limiting and controlling potential cumulative effects in the scenario. Of particular relevance would be the actions identified as community or government responsibility. They focus on enhanced social service delivery, and on-the-job and community-based support for workers and their families. They address such issues as alcohol abuse control and treatment, and personal financial management.

The cumulative effects would be:

- substantial and of longer duration in Inuvik, because of the scale of the cumulative activity
- less pronounced and for a shorter period in Norman Wells

Appropriate monitoring, as described in EIS Volume 6, Part B, Section 10, would help communities, the GNWT, contractors and service providers to:

- cooperatively monitor and measure cumulative socio-economic indicators
- adjust service needs if necessary

Importantly, as revenue from the Mackenzie Gas Project and other projects began to flow, governments would have greatly increased financial capacity to address service issues.

Implementing the recommended measures for social services would increase the effectiveness of wellness centres in dealing with cumulative effects on community wellness. However, an increase in service demands would be likely in Inuvik and, to a lesser extent, in Norman Wells, and also in many outlying communities supported by these centres. Accordingly, cumulative project effects on wellness services would be adverse and occur at a high to moderate level. The effects in Inuvik might be long–lasting, but in the other communities would be a short-term concern.

Public Safety and Protection Services

The cumulative demographic effects could affect public safety conditions and demands on protection services. Appropriate mitigation would limit or control these effects. The industry operators would be responsible for:

- maintaining security at camps
- setting policies regarding behaviour in camps

- coordinating with the RCMP regarding activities and plans that could influence RCMP workloads

Shared responsibility for effects management by communities and governments would also be required.

Appropriate monitoring, as described in EIS Volume 6, Part B, Section 10, would help communities, the GNWT, contractors and protective services to:

- cooperatively monitor and measure cumulative socio-economic indicators
- make any necessary service adjustments

As mentioned previously, governments would have increased fiscal capacity to meet these needs. The mitigation and management measures described in EIS Volume 6, Part B, Section 5.5.4, and those referred to previously, which are related to community health and well-being, are also relevant.

Inuvik and Norman Wells, and some outlying communities, could experience some cumulative effects to protection services. In Inuvik, these would pose a serious management challenge over the long term because of likely increases in population and income levels. High-level but temporary effects would occur in Norman Wells, and more moderate effects would occur in outlying communities that participate in substantial hydrocarbon employment.

Educational Attainment and Services

The hypothetical scenario would provide the prospect, for study area students and educational authorities, of a sustained level of demand for a trained labour force. This would be an incentive for:

- young people to stay in school and seek advanced training and education

- governments and industry to provide the educational resources and training necessary to increase the skills and capacities of the labour force

The additional incentive provided under the scenario assumptions would result in a moderate positive effect in the regions and NWT as a whole.

11.2.4.6 Traditional Harvesting and Culture

Survival by harvesting country food is central to Aboriginal culture. This is sustained today by community influences that communicate preferences for, and encourage harvesting of, traditional foods. Sustaining the knowledge, lore and skills necessary for harvesting these foods depends on motivation.

Harvesting and seasonal wage employment are symbiotic, because wage employment is necessary to pay for the expensive equipment and supplies needed for efficient harvesting. The hypothetical scenario would provide cumulative wage employment opportunities that would support harvesting expenses.

Employment could also affect harvester lore and disciplines by:

- bringing Aboriginal and non-Aboriginal workers together on the job
- pre-empting harvesting traditions because of time needed for employment

Some Aboriginal workers might experience the paid work as more comfortable and more rewarding than harvesting, promoting interest in a non-traditional lifestyle.

Elders are powerful influences for sustaining tradition and continue to play a large motivational role for harvesters. Mackenzie Gas Project proponents will support Elders' efforts to meet traditional requirements by providing flexible work schedules to accommodate traditional harvesting and other Aboriginal cultural, family and community needs, where possible, recognizing that work flexibility will be limited in the peak winter construction seasons.

Cumulative influences might either strengthen or weaken language and culture, as in the case of resource harvesting. The effect on cross-generational transference of traditional language facility, and knowledge of, and identification with, traditional culture, are central to questions about language and cultural retention.

Recent surveys have shown a decline in the use of Aboriginal languages in all regions. Fluency declined by 11% between 1989 and 1999 in the Northwest Territories as a whole. This erosion of fluency in Aboriginal language is already strongly influenced by the use of English in the media, schooling and most work situations. As a result, cumulative employment opportunities would have little additional effect on language and cultural retention.

As predicted for the project, traditional harvesting is so important to study area Aboriginal residents that they would continue their current vigorous efforts to sustain this activity. This would also apply to the hypothetical scenario. The additional employment and income opportunities from the scenario would have both positive and adverse effects, but on balance would be slightly adverse in the BDR and SSA.

11.3.1 SOURCES OF ADDITIONAL DATA

As the project proponents receive additional information, the assessment team will integrate that information with the information in the EIS. The data could come from:

- community-based traditional knowledge studies
- additional information from other sources
- community-based impact assessments

As the data is received, it will be used to:

- verify and provide additional details about baseline conditions for VCs
- refine site-specific surveys, monitoring studies and mitigation measures

If the project proponents receive information that changes the EIS, they will provide information to the Joint Review Panel about any revisions to that assessment.

11.3.2 NORTHWESTERN ALBERTA CUMULATIVE EFFECTS

A report entitled *Mackenzie Gas Project Environmental Impact Statement Supplemental Information – Northwestern Alberta,* was filed with the National Energy Board and the Joint Review Panel on December 31, 2004. The report contains a biophysical and socio-economic cumulative effects assessment of the Mackenzie Gas Project in northwestern Alberta. The report is available on the Mackenzie Gas Project Web site, www.mackenziegasproject.com.